HATCHERY AND GENETIC MANAGEMENT PLAN
(HGMP)

Hatchery Program:	McKenzie River Spring Chinook Salmon
Species or Hatchery Stock:	Spring Chinook Salmon (stock 23)
Agency/Operator:	US Army Corps of Engineers / Oregon Department of Fish and Wildlife
Watershed and Region:	McKenzie River, Willamette River, Columbia River
Date Submitted:	February 2016
Date Last Updated:	February 2016

EXECUTIVE SUMMARY

The Hatchery and Genetic Management Plan (HGMP) describes the current management of the McKenzie Hatchery Spring Chinook Program. This HGMP is required to initiate formal Endangered Species Act (ESA) Section 7 consultation with the National Marine Fisheries Service (NMFS) to allow for artificial propagation of threatened natural-origin fish from the Upper Willamette River (UWR) Spring Chinook Salmon Evolutionarily Significant Unit (ESU). There is a two-part purpose of the McKenzie Hatchery spring Chinook program: to provide ESA conservation benefits, consistent with survival and recovery of the ESU, and, to mitigate for habitat lost or made inaccessible by the construction and operation of Blue River and Cougar Dams, which will provide adult returns to help meet harvest objectives for the McKenzie River, lower basin, and ocean fisheries. Because the McKenzie Hatchery Spring Chinook Program provides important conservation and reintroduction benefits to the natural population, the broodstock will be managed as an integrated stock with the natural population in the McKenzie River. Natural-origin spring Chinook salmon will be regularly incorporated into the hatchery broodstock when conditions permit. Natural-origin spring Chinook integration will be performed at levels that minimize the impact to the natural population.

Hatchery spring Chinook spawning naturally in the McKenzie River Basin will be managed at less than 10% proportion of hatchery origin spawners (pHOS) in the entire McKenzie subbasin excluding the intentional reintroduction area upstream Cougar Dam. Increases in the production of natural-origin spring Chinook by additional actions that address other key limiting factors for McKenzie River spring Chinook salmon will also help reduce pHOS over time because pHOS is dependent upon the abundance of natural-origin fish.

This HGMP describes several new management actions that are expected to reduce the proportion of hatchery-origin spawners (pHOS) in the McKenzie subbasin (excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam) to less than 10% in the long-term: 1) reductions in hatchery releases, 2) improvements in attraction of hatchery salmon back to the McKenzie hatchery, 3) removal of hatchery Chinook at Leaburg Dam, and 4) improvements in natural-origin returns to Cougar Dam. The hatchery smolt release in the McKenzie River has decreased from 1.2 million to 604,750 fish annually. Modifications to the hatchery ladder entrance went into effect in 2014 and provided immediate improvements to hatchery salmon attraction back to the hatchery in 2015. Additional improvements to the hatchery water supply will provide benefits for better attracting returning adults back to the McKenzie hatchery beginning in 2020. In 2015 and beyond, hatchery Chinook salmon may be removed at Leaburg Dam fish ladder in order to further reduce pHOS in the McKenzie River. Lastly, recent improvement at Cougar Dam (completion of the Water Temperature Control Tower and adult collection facility in 2007) may increase natural-origin Chinook salmon production and reduce pHOS. The HGMP includes the assessment of how these actions will likely reduce pHOS to less than 10% in in the entire McKenzie subbasin with the exception of the intentional reintroduction area above Cougar Dam

In 2018 the first full cohort of hatchery fish that have been released under the 604,750 smolt

production regime will return as adults; therefore, 2018 will be the first time that the efficacy of the change to the productions level can be evaluated. It is not anticipated that changes to the 604,750 release level will occur until more empirical data is available to demonstrate the results of all of the management changes described above. In the future, the hatchery release level can be adjusted upwards or downwards to better meet conservation (broodstock and outplanting) and fishery goals while meeting pHOS targets. The maximum number of spring Chinook smolts that will be released into the McKenzie Basin is 787,000 at approximately 10 fish per pound (subject to the terms and conditions of any NMFS approval that results from the submission of this HGMP).

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SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

McKenzie River Spring Chinook Salmon Program

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

The Spring Chinook Salmon (CHS) (*Oncorhynchus tshawytscha*) stock reared at McKenzie Hatchery (stock 23) originated from the wild stock of CHS in the McKenzie River. The natural origin spawning population and the McKenzie Hatchery population of CHS in the McKenzie River are part of the Upper Willamette River (UWR) Evolutionarily Significant Unit (ESU) for CHS and are listed as threatened under the ESA.

1.3) Responsible organization and individuals.

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Hatchery Manager:	Kurt Kremers, McKenzie Hatchery Manager
Agency or Tribe:	Oregon Department of Fish and Wildlife
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1.4) Funding source, staffing level, and annual hatchery program operational costs.

Funding: Ongoing funding for hatcheries in the McKenzie River Spring Chinook Salmon Program is provided by:

Cost responsibilities for McKenzie Hatchery production are split between the US Army Corps of Engineers (USACE) (with partial reimbursement by Bonneville Power Administration (BPA) according to its operation and maintenance power share percentage at Cougar Dam) and Oregon Department of Fish and Wildlife (ODFW) based on each party's production level. Per the 2012 Cooperative Agreement between the USACE and ODFW (Section 2.1.2.5), the USACE funds the annual production and release of up to a maximum of 80,800 pounds of smolts that could be used to mitigate for habitat lost from the construction of Cougar and Blue River dams. Beginning in 2015 the USACE intends to fund the production and release of 604,750 juvenile spring Chinook into the McKenzie Basin. Future releases of spring Chinook salmon smolts into the McKenzie Basin will not exceed 787,000 at approximately 10 fish per pound (subject to the terms and conditions of any NMFS approval that results from the submission of this HGMP).

Staffing Level: This facility currently has five permanent positions and one seasonal (ten-month) position, but staffing may be re-evaluated in the future.

Budget: The annual operation and maintenance budget, including both USACE and ODFW programs, for the spring Chinook at McKenzie Hatchery for budget year 2013-14 was $897,000 (including indirect costs). Funding for fish pathology, fish identification (marking), and Research, Monitoring, and Evaluation (RM&E) is separate from the operation and maintenance budget.

1.5) Location of hatchery and associated facilities.

The McKenzie Hatchery is located on the McKenzie River near river mile 37, which is about 17 miles east of Springfield, Oregon. The facility is located at an elevation of 700 feet (ft.) above sea level, at latitude 44º 07' 00" N and longitude 122º 38' 10" W. The regional mark processing center code is 5F33317 H17 21.

Leaburg Dam, which is privately-owned by the Eugene Water and Electric Board, is located on the McKenzie River near river mile 38.9.

Adult collection occurs at the McKenzie Hatchery. However, hatchery-produced broods are also collected at Leaburg Dam during the late run time, while the number of wild fish is very low at Leaburg Dam. In the past (1996-1997 and 2006-2008), some wild adults were also collected for broodstock from the left bank fish ladder at Leaburg Dam. All spawning and rearing activities occur at the McKenzie Hatchery.

1.6) Type of program.

The McKenzie CHS hatchery program is managed as an integrated program meant to provide ESA conservation benefits, consistent with survival and recovery of the ESU[1], and, to mitigate for habitat lost or made inaccessible by the construction and operation of

[1] *See* 65 Fed. Reg. 42477 (Jul. 10, 2000), codified at 50 C.F.R. § 223.203(b)(5)(i)(C).

Blue River and Cougar Dams, which will provide adult returns to help meet harvest objectives for the McKenzie River, lower basin and ocean fisheries.

The hatchery program was founded on McKenzie River stock salmon and uses integration to avoid genetic drift, reduce domestication risks, and maintain stock suitability for outplanting to assist with conservation, recovery, and reintroduction efforts while minimizing impacts to the donor population.

1.7) Purpose (goal) of Program. The purpose of the program is to provide ESA conservation benefits, consistent with survival and recovery of the ESU, and, to mitigate for habitat lost or made inaccessible by the construction and operation of Blue River and Cougar Dams, which will provide adult returns to help meet harvest objectives for the McKenzie River, lower basin, and ocean fisheries.

1.8) Justification for the program.

The authorities for the Willamette River hatcheries derive principally from the 1938 "An Act Authorizing the Construction of Certain Public Works on Rivers and Harbors for Flood Control, and for Other Purposes," (52 Stat. 1215) and the Flood Control Act of 1950, "An Act Authorizing the Construction, Repair, and Preservation of Certain Public Works on Rivers and Harbors for Navigation, Flood Control, and for Other Purposes" (Pub. L. No. 516-81) and the house documents referred to therein. The Flood Control Act of 1950 appropriated funds and reauthorized the Corps' activities in the Willamette Basin "substantially in accordance with the plans recommended in the report of the Chief of Engineers, both contained in House Document 531."

USACE mitigation was developed prior to the ESA listing of Upper Willamette River (UWR) spring Chinook. Since the ESA listing, it also became important to manage the McKenzie hatchery program consistent with the ESA. As a result, the program is adaptively managed to address ESA conservation needs and harvest, consistent with survival and recovery of the ESU. NMFS, ODFW, USACE (with support from BPA) conducted extensive analyses throughout 2014 and 2015 to determine an appropriate smolt release level to meet broodstock and outplanting needs while reducing pHOS. This level was determined to be 604,750 smolts. In 2018, the first full cohort of hatchery spring Chinook resulting from the 604,750 production regime will return as adults. This will provide the first data point to empirically gauge the efficacy of the 604,750 production level. It is not anticipated that the production level will be altered from 604,750 until additional years of data are available to ascertain the efficacy of all of the hatchery management changes. The year 2021 will mark the first full cohort of returning adults salmon that have undergone all of the hatchery management changes meant to lower pHOS. The hatchery release level can be adjusted upwards or downwards to better meet conservation (broodstock and outplanting) and fishery goals while meeting pHOS targets. The maximum number of spring Chinook smolts that will be released into the McKenzie Basin is 787,000 at approximately 10 fish per pound (subject to the terms and conditions of any approval that results from the submission of this HGMP).

The McKenzie River hatchery spring Chinook program provides harvest opportunities in the McKenzie River and contributes, along with other upper Willamette hatchery programs, to sport and commercial fisheries in the mainstem Willamette River, lower Columbia River, and Pacific Ocean. The harvest goal for the McKenzie River sport fishery is 1,000 CHS (OAR 635-500-0271). The combined upper basin hatchery production supported harvest of over 27,000 adults in sport and commercial fisheries in the lower Willamette and Columbia Rivers and 123,000 angler days in the lower Willamette River in 2011 (Fish Management Evaluation Plan [FMEP] 2012).

Outplanted CHS serve conservation and RM&E purposes by reintroducing salmon into historic habitats to reduce extinction risk of the McKenzie natural population and inform managers about the feasibility and details of reintroduction efforts. Reintroduction efforts also benefit conservation of ESA-listed bull trout and nutrient enrichment. A draft Reintroduction Plan that uses hatchery fish being discussed and formalized by the NMFS, USFWS, ODFW, USACE and BPA in consideration of recommendations from the Hatchery Management and Fish Passage Technical Teams within the Willamette BiOp Willamette Action Team for Ecosystem Restoration (WATER) forum (See the Draft Reintroduction Plan in Appendix C).

1.9) List of program "Performance Standards".

See Section 1.10

1.10) List of program "Performance Indicators" designated by "Benefits" and "Risks".

Category 1: Legal Mandates

Standard 1.1: Meet production levels for mitigation consistent with the USACE's authorities and the Cooperative Agreement (2012), fisheries goals, and ESA conservation objectives consistent with survival and recovery of the ESU, including producing fish for reintroduction purposes.

Indicator 1.1.1: Produce and release up to 787,000 spring Chinook salmon smolts annually for release into the McKenzie River. The proposed production level for brood years 2013-2017 is 604,750 smolts annually. ***Benefit***

Standard 1.2: Program goals are aligned with authorized federal, state, regional, and local fisheries conservation and restoration initiatives.

Indicator 1.2.1: Program is aligned with the Oregon Native Fish Conservation Policy (NFCP), the McKenzie River Sub-Basin Plan, the Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NMFS 2011) (The Recovery Plan) where appropriate, and complies with the Willamette Biological Opinion (NMFS 2008). The Hatchery and Genetic Management Plan (HGMP) will be reviewed and submitted to NMFS for approval. ***Benefit***

Category 2: Harvest

Standard 2.1: Maintain sufficient hatchery broodstock to mitigate for habitat lost or made inaccessible by the construction and operation of Blue River and Cougar Dams while minimizing impacts to natural-origin Chinook salmon. The program provides adult returns to help meet harvest objectives for the McKenzie River, lower basin, and ocean fisheries. Take of listed fish associated with harvest is covered through the FMEP for upper Willamette spring Chinook (ODFW 2001a).

Indicator 2.1.1: Number of hatchery CHS available for harvest in ocean, Columbia River, Willamette River, and McKenzie River sport and commercial fisheries. ***Benefit***

Category 3: Conservation

Standard 3.1: Maintain heterozygosity, reduce domestication risk, and avoid genetic drift by integrating natural-origin broodstock (pNOB) at a target rate (pNOB; averaging 5-10% annually) using unmarked adults volunteering to the hatchery facility. Additional integration may be necessary if the loss of heterozygosity or genetic drift is detected but pNOB will not exceed 2% of the natural-origin return annually, when returns are expected to exceed 650 fish.

Indicator 3.1.1: Maintain characteristics similar to natural-origin fish with respect to age at maturity, run timing, sex ratio, size, fecundity, etc. ***Benefit***

Standard 3.2: Produce and release sufficient numbers of hatchery Chinook salmon to support successful outplanting of Chinook upstream of Cougar Dam. The total outplanting goal for above Cougar Dam is 400 females and 200 males (this includes natural-origin and hatchery-origin) fish, See Section 10 and Section 15 for further details. Adult hatchery fish outplanted into the Mohawk River and above Trail Bridge Dam are from surplus adult returns, as they are available.

Indicator 3.2.1: Abundance and productivity of hatchery returns available for outplanting are adequate to support research to determine: spawning success (including PSM), Smolt-to-Adult Return Ratio (SAR), recruits per spawner (productivity), adult migration and spawn timing, number of juveniles emigrating from spawning areas, genetic diversity, and support reintroduction efforts. ***Benefit***

Standard 3.3: Reduce potential for negative ecological interactions between hatchery and naturally-produced juvenile Chinook salmon.

Indicator 3.3.1: Specific interactions to look for are: residualism or delayed migration that could result in competition for food and space, disease prevalence in hatchery fish that could be transferred to naturally-produced fish, and risk of hatchery smolt predation on natural-origin fry. ***Risk***

Standard 3.4: Meet or exceed benchmarks for rearing and releasing high quality fish to minimize impacts on naturally-produced fish.

Indicator 3.4.1: Performance targets for benchmarks for rearing and release as indicated in Table 1.9-1. ***Benefit***

Standard 3.5: Monitor benchmarks to help minimize impacts of adult returns on naturally-produced populations to meet ESA conservation needs, consistent with survival and recovery of the ESU and, where appropriate, to aid in recovery goals.

Indicator 3.5.1: Performance targets for benchmarks for returning hatchery fish as indicated in Table 1.9-2. ***Benefit***

Standard 3.6: Monitor benchmarks and protocols for broodstock.

Indicator 3.6.1: Performance targets for benchmarks for hatchery broodstock as indicated in Table 1.9-3. ***Benefit***

Standard 3.7: The target rate for pHOS in the natural-origin spawning population in the McKenzie subbasin excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam, as explained in further detail in the below indicators, is < 10%.

Indicator 3.7.1: As directed by NMFS, the performance target is pHOS < 10% in the McKenzie subbasin, excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam. Provisions are made for the intentional supplementation using hatchery Chinook salmon for reintroduction purposes above Cougar and outplanting of any surplus returning adults above Trail Bridge Dam.

Indicator 3.7.2: pHOS will be evaluated based on a three-year rolling average beginning in 2018. The first evaluation will analyze returns through and including the 2018 return year because in 2018 all adult hatchery Chinook returns to the McKenzie River will have had the benefit of the following management changes: 1) reductions in hatchery releases, 2) modification of the hatchery ladder, and 3) removal of hatchery Chinook at Leaburg Dam beginning each year in July (this action began in 2015). In 2021 all adult hatchery returns will have also benefitted from improved homing due to imprinting from Cogswell Creek. The hatchery release level can be adjusted upwards or downwards to better meet conservation ***Risk***

(broodstock and outplanting) and fishery goals while meeting pHOS targets. The maximum number of spring Chinook smolts that will be released into the McKenzie Basin is 787,000 at approximately 10 fish per pound (subject to the terms and conditions of any NMFS approval resulting from the submission of this HGMP).

Indicator 3.7.3: Trap and remove hatchery-origin salmon and from the left bank ladder trap on Leaburg Dam during July through September, after the bulk of the natural-origin salmon run has passed as indicated by hatchery origin returns being greater than hatchery origin returns for a few days, to reduce pHOS.

Standard 3.8: The target rate for pHOS in the natural-origin spawning population in the McKenzie subbasin upstream of Cougar Dam is <5% once passage provisions have been completed and outplanting of hatchery fish is no longer necessary except in extreme circumstances. It is not anticipated that fish will be outplanted above Blue River Dam at this time.

Indicator 3.8.1: The performance target is pHOS < 5% for natural-spawning Chinook salmon upstream of Cougar Dam, once outplanting of hatchery fish is no longer necessary except in extreme circumstances.

Indicator 3.8.2: Percentage of hatchery fish spawning naturally above Cougar Dam. Annual monitoring via spawning surveys provides the data for this indicator. An annual report will be provided to NMFS by ODFW and reviewed and funded by the USACE.

Standard 3.9: Supplement the spawning population above Cougar Dam with hatchery spring Chinook salmon for reintroduction purposes.

Indicator 3.9.1: Supplement natural-origin escapement with hatchery origin adults to meet a minimum escapement goal of 400 female and 200 male CHS on spawning grounds above Cougar Dam, and potentially, to the extent surplus returning hatchery adults are available each year, 60 female and 60 male CHS above Trail Bridge Dam for conservation and nutrient enhancement purposes. ***Benefit***

..

Category 4: Life History Characteristics

Standard 4.1: Maintain life history characteristics of broodstock that are similar to natural-origin CHS.

Indicator 4.1.1: Life history characteristics of the broodstock including: morphometric (length and weight), sex ratio, average number of eggs per ***Benefit***

female by age class, age structure, adult migration timing, and spawn timing (Table 1.9-3).

Standard 4.2: Rear and release hatchery CHS to minimize impacts to naturally-produced juvenile CHS.

Indicator 4.2.1: Hatchery fish will be released as smolts from McKenzie Hatchery in the lower McKenzie River and in time and space, and in a condition that minimizes the interaction with listed fish. ***Risk***

Standard 4.3: Release hatchery fish that are ready to migrate.

Indicator 4.3.1: Timely migration of all hatchery fish released as indicated by: residualism rates, rates of outmigration, precocial rates, and proportion of fish that migrate per day. ***Risk***

Category 5: Genetics

Standard 5.1: Minimize genetic effects of hatchery fish spawning with naturally-produced fish (also see Standard 3.7).

Indicator 5.1.1: Monitor and evaluate pHOS; natural-origin CHS abundance; productivity; genetic diversity; and spatial structure; relative reproductive success; effective population size; adult migration and spawn timing; sex ratio; spatial distribution of redds; number of juveniles emigrating from spawning areas; and emigrants per redd. Monitoring these parameters is both consistent with the concepts of "viable" and "critical" salmonid population thresholds identified by NMFS, and helpful in assessing the effects of management and conservation actions to ensure that actions provide for ESA conservation, consistent with survival and recovery of the listed species, as consistent with NMFS' regulations at 50 C.F.R § 223.203(b). ***Risk***

Standard 5.2: Broodstock collection does not adversely impact the genetic diversity of the natural population.

Indicator 5.2.1: Genetic composition of natural and hatchery CHS; pHOS; and, Proportion of Natural-origin Brood (pNOB). Estimates of pNOB will not exceed 2% of the natural-origin return annually, when returns are expected to exceed 650 fish. ***Risk***

Standard 5.3: Integrate natural-origin broodstock at a target rate averaging 5-10% annually to avoid genetic drift and reduce domestication risks of the hatchery stock.

Indicator 5.3.1: Maintain genetic diversity of broodstock similar to natural- ***Benefit***

origin fish. Integration levels and genetics will be assessed periodically to ensure hatchery broodstock is maintained as similarly as possible to the natural-origin population.

Category 6: Operation of Artificial Production Facilities

Standard 6.1: McKenzie Hatchery facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols such as those described by Integrated Hatchery Operations Team (IHOT), Pacific Northwest Fish Health Protection Committee (PHFHPC), and Investigational New Animal Drug Permit (INAD).

Indicator 6.1.1: Annual reports indicating compliance. ***Benefit***

Standard 6.2: McKenzie Hatchery effluent will not negatively impact natural populations.

Indicator 6.2.1: McKenzie Hatchery is operated under an individual (National Pollutant Discharge Elimination System) NPDES permit and water quality of hatchery effluents is monitored to comply with the permit, to maintain Oregon water quality standards for protection of aquatic life. ***Risk***

Standard 6.3: Water withdrawals and in-stream water diversions will not impact natural, ESA-listed fish populations.

Indicator 6.3.1: Water withdrawals and in-stream diversions in relation to existing permits.

Standard 6.4: Release only fish that are pathogen free or have been certified by a state pathologist, and that will not increase levels of existing pathogens in natural populations.

Indicator 6.4.1: Certification of juvenile fish health immediately prior to release, including pathogens present and their virulence. ***Risk***

Indicator 6.4.2: An evaluation of pathogen levels in natural populations before and after artificial production releases. ***Risk***

Standard 6.5: Broodstock collection at the McKenzie Hatchery does not result in significant stress, injury, mortality or altered distribution (spatial and temporal) of the naturally-produced population.

Indicator 6.5.1: Mortality rates in natural-origin fish captured, handled, and released. ***Risk***

Indicator 6.5.2: Prespawn mortality rates of trapped fish in the hatchery or ***Risk***

after release.

Indicator 6.5.3: The number and percent of CHS captured at McKenzie Hatchery that are natural-origin CHS (after otolith analyses of all unmarked CHS).

Category 7: Socio-Economic Effectiveness

Standard 7.1: Estimated harvest and ESA conservation benefits, consistent with survival and recovery of the McKenzie River Spring Chinook Salmon UWR ESU and, where appropriate, to assist in recovery, will equal or exceed hatchery production costs based on a benefit-cost model (ODFW 1999).

Indicator 7.1.1: Annual budget expenditures. ***Neutral***

Indicator 7.1.2: Provide adequate CHS to support sport, tribal, and commercial fisheries in the Pacific Ocean, Lower Columbia and Willamette rivers, and McKenzie River while complying with the ESA. ***Benefit***

Category 8: Ecosystem Function

Standard 8.1: Provide nutrient enrichment and food web benefits in natural spawning streams in the McKenzie River Basin.

Indicator 8.1.1: Pathogen-free hatchery fish may be placed in streams for nutrient enrichment. ***Benefit***

Indicator 8.1.2: Hatchery carcasses placed for nutrient enrichment will comply with ODFW and Oregon Department of Environmental Quality (ODEQ) guidelines for disease control and water quality. ***Benefit***

Table 1.9-1. Recommended performance targets for rearing and release of hatchery fish.

Variables	Performance Target (benchmark)
Size at release	Target size at release is 10-11 fish per pound (fpp)
Release timing	See Table 1.11.2-1
Acclimation time	N/A (fish over-winter on site)
Migration timing	Similar to naturally-produced fish
Level of disease/pathogen occurrence in hatchery smolt for release	Below ODFW Fish Health Management Policy and IHOT standards
Number of fish released	Up to approximately 787,000 smolts for all hatchery purposes (see Section 1.11.2 below). The proposed release is up to 604,750 smolts annually for at least brood years 2013 through 2017.
Number of hatchery produced fish required for broodstock and conservation needs	To satisfy this variable up to 604,750 smolts are released in the McKenzie River to meet broodstock and other conservation (outplanting above Cougar Dam) needs. The goal for returns back to the hatchery to meet all adult

	needs is 1,416.
In-hatchery life stage survival	Maximum and unbiased survival
Rearing density	Implement best management practices
Growth rate	Achieve target size at release
Residualism rates	< 10%
Precocial rates	< 10%

Table 1.9-2. Recommended performance targets for returning adult hatchery fish.

Variables	Performance Target (benchmark)
Number of hatchery produced fish removed for broodstock	The broodstock size for the production goal of 604,750 smolts is up to 523, this number is necessary to account for PSM in the hatchery and the greater proportion of male adult Chinook that return to the hatchery. The broodstock size for a 787,000 smolt production program is approximately 520 fish..
Number of hatchery fish harvested	State of Oregon goal of 1,000 minimum within McKenzie basin, plus ocean/Columbia River/Lower Willamette fisheries, consistent with the authorized Fisheries Management and Evaluation Plan (FMEP, ODFW 2001)
Number of fish passed upstream into target areas above Cougar Dam. Surplus adults may be outplanted above Trail Bridge Dam and in the Mohawk River as available.	Supplement natural-origin escapement with hatchery origin adults to meet a minimum escapement goal of 400 female and 200 male CHS above Cougar Dam. If surplus hatchery fish are available, supplement 60 female and 60 male ChS above Trail Bridge Dam and 50 male and 50 female ChS into the Mohawk River.
Age structure	Similar to naturally-produced fish
Sex ratio	Similar to naturally-produced fish
Fecundity	Similar to naturally-produced fish
pHOS	Projected level to achieve desired viability over long-term is < 10% for total natural spawning population in the McKenzie River subbasin, excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam. See Section 3.7.2.
Abundance	Sufficient returns to McKenzie Hatchery to maintain hatchery program broodstock provide hatchery fish for reintroduction needs above Cougar Dam.
Genetic diversity	Maintain genetic diversity and avoid genetic drift
Adult migration and spawn timing	Similar to naturally-produced fish
SAR	.40%

Table 1.9-3. Recommended performance targets for hatchery broodstock.

Variables	Performance Target (benchmark)
Number of naturally-produced fish spawned	Annually; depends in part on natural escapement levels and a determined need to meet HMP fishery objectives (see Section 6.2.3)
Number of hatchery fish spawned	The broodstock size for the production goal of 604,750 smolts is up to 450 adult fish spawned. The broodstock size for a smolt production program of up to 787,000 is up approximately 520 fish spawned.
Morphometrics	Sample 100% of broodstock
Run timing	Similar to naturally-produced fish
Spawn timing	Similar to naturally-produced fish
Age	Similar to naturally-produced fish
Fecundity	Similar to naturally-produced fish
pNOB	5-10% target
Genetic diversity	Maintain heterozygosity and avoid genetic drift
Sex ratio	Similar to naturally-produced fish
Age structure	Similar to naturally-produced fish
Average number of eggs per female by age class	Similar to naturally-produced fish
Adult migration and spawn timing	Similar to naturally-produced fish
Average size (fork length) per age class	Similar to naturally-produced fish

1.11) Expected size of program.

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

The McKenzie spring Chinook hatchery salmon program proposes to collect and spawn up to 523 (225 females) to meet production goals including Bacterial Kidney Disease (BKD) culling and anticipated mortality during rearing.

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

The current release of hatchery spring Chinook in the McKenzie River is up to 604,750 smolts annually.

The release of 604,750 spring Chinook smolts annually provides hatchery adults for broodstock and outplanting above Cougar Dam approximately 50% of the time and reduces stray rate risk. pHOS rates are further reduced by implementing hatchery improvements (ladder, imprinting, and

acclimation) and removing hatchery adults from the Leaburg Dam ladder.

pHOS will be evaluated based on a three-year rolling average beginning in 2018. The first evaluation will analyze returns through and including the 2018 return year because in 2018 all adult hatchery Chinook returns to the McKenzie River will have had the benefit of the following management changes: 1) reductions in hatchery releases, 2) modification of the hatchery ladder, and 3) removal of hatchery Chinook at Leaburg Dam beginning each year in July (this action began in 2015). In 2021 all adult hatchery returns will have also benefitted from improved homing due to imprinting from Cogswell Creek. The hatchery release level can be adjusted upwards or downwards to better meet conservation (broodstock and outplanting) and fishery goals while meeting pHOS targets. The maximum number of spring Chinook smolts that will be released into the McKenzie Basin is 787,000 at approximately 10 fish per pound (subject to the terms and conditions of any NMFS approval resulting from the submission of this HGMP).

Table 1.11.2-1. Proposed maximum annual releases of both USACE and ODFW McKenzie Spring Chinook Salmon in brood years 2013-2017.

Life stage	Release location	Release period	Mean size at release (fish per lb.)	Number of fish released	Total lbs. released
1+ Yearling	McKenzie Hatchery	February	10	201,583	20,158
1+ Yearling	McKenzie Hatchery	March	10	201,583	20,158
1+ Yearling	McKenzie Hatchery	April	10	201,583	20,158
Total				604,750	60,475

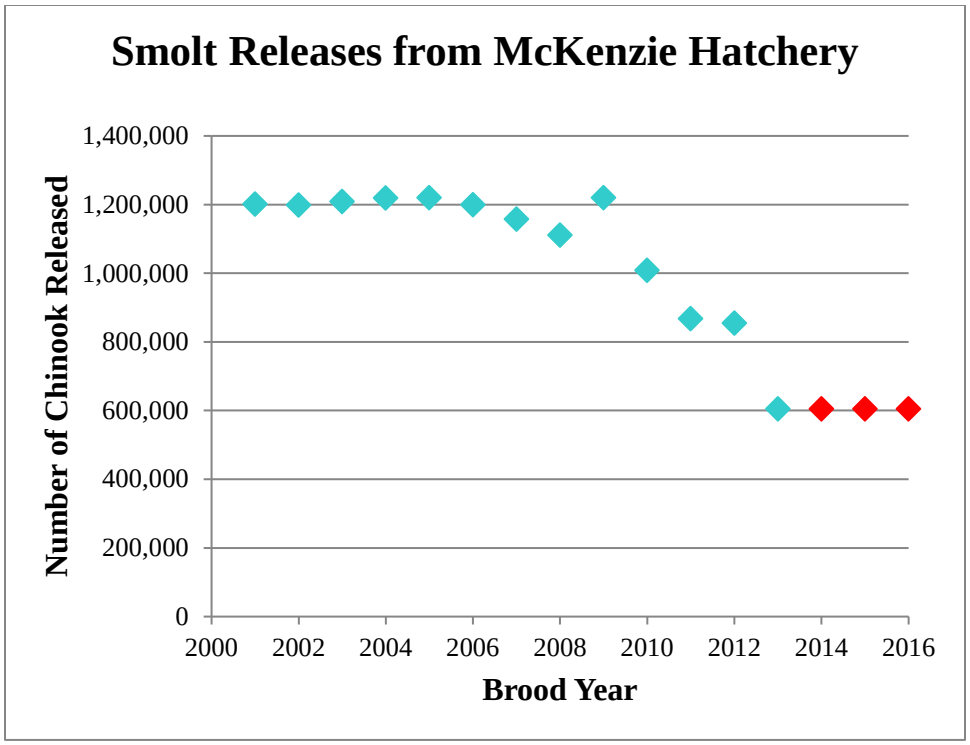


Figure 1. Proposed releases of hatchery spring Chinook salmon in the McKenzie River. Future releases are highlighted in red color.

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

Performance of the McKenzie Spring Chinook Salmon hatchery program is assessed by evaluating smolt-to-adult survival rates, contributions to the fisheries, impacts to wild salmonids, and hatchery returns. Expanded Coded Wire Tag (CWT) recovery data has been used to estimate simple smolt-to-adult return rates by dividing the total number of estimated wire recoveries by the total number of fish released with tags. Because of the small number of actual (observed) CWT's recovered, the calculated estimates of survival are subject to variability due to a lack of standardization in fishery, hatchery and spawning ground sampling and recovery programs, modifications to fishery regulations, and inconsistent tagging rates of smolts.

Coded-wire tag release and recovery data was used to calculate SAR for the 1996-2006 brood years released into the McKenzie River (Table 1.12-1). For the 1996-2006 brood years, the average smolt-to-adult survival rate ranged from 0.21-1.46%. The average across these brood years was estimated at 0.59%, which corresponds to an average return of 6,093 fish per brood year for the corresponding smolt releases. The smolt-to-adult return rates for 1986-1995 were estimated to be 0.63% with an average return of 5,657 fish per brood year (Lewis et al. 2003). However, these numbers did not include CWT recoveries from the fishery above Willamette Falls, as there was limited creel sampling done above the Falls before 1996.

McKenzie Hatchery spring Chinook smolts have been CWT-tagged and released into the McKenzie in November and March since 1979. Beginning in the early 1990s and continuing through 2011, a February release group was added. Expanded CWT recovery data was used to calculate SARs for the various groups by month of release for brood years 1990-2007. Overall, the average survival for releases occurring in February and March (0.49% and 0.57%, respectively) were greater than the 0.39% for the November releases (Table 1.12-2).

Table 1.12-1. Smolt-to-adult survival for McKenzie Hatchery Spring Chinook Salmon released into the McKenzie River for two time periods, 1986-1995 (Lewis et al. 2002), and 1996-2006 based on estimated CWT recoveries.

Brood Year	Smolt Release	Total Returns [a]	Smolt-to-Adult Survival
1986	934,637	21,536	2.30%
1987	946,162	11,871	1.25%
1988	873,463	10,278	1.18%
1989	865,119	2,878	0.33%
1990	1,022,561	1,086	0.11%
1991	805,342	1,738	0.22%
1992	732,635	1,280	0.17%
1993	1,001,235	1,875	0.19%
1994	592,237	1,279	0.22%
1995	953,885	2,745	0.29%
1996	888,128	5,293	0.60%
1997	925,781	5,336	0.58%
1998	948,120	13,880	1.46%
1999	949,696	6,381	0.67%
2000	1,138,319	10,183	0.89%
2001	1,153,730	3,242	0.28%
2002	1,145,600	5,149	0.45%
2003	1,160,288	2,444	0.21%
2004	1,164,449	5,034	0.43%
2005	1,181,073	4,525	0.38%
2006	1,122,328	5,558	0.50%
2007	1,157,020	TBD	TBD
2008	1,180,480	TBD	TBD
2009	1,223,302	TBD	TBD
2010	1,007,800	TBD	TBD
2011	867,457	TBD	TBD
2012	853,979	TBD	TBD
2013	604,750	TBD	TBD
Ave.	**987,267**	**5,885**	**0.61%**

a. Does not include catch above Willamette Falls.

The Oregon harvest goal for the McKenzie River sport fishery is 1,000 CHS. However this does not include harvest associated with ocean, lower Columbia River, and lower Willamette River fisheries. According to the FMEP for 2011 (ODFW 2012), harvest objectives were achieved in 5 of 10 years between 2001 and 2010 during run years where returns to the McKenzie River typically exceeded 5,000 adults.

Expanded CWT recovery data, based on release groups containing adipose fin-clipped and coded-wire tagged fish (AD+CWT), have also been used to estimate adult contribution to fisheries by harvest categories (Table 1.12-3). For brood years 1998-2006, a portion of the release groups were coded-wire tagged but not adipose fin clipped. The intent of the double index-tagged (DIT) groups was to develop a means of assessing the effect of mark-selective fisheries on released non-clipped fish. However, not all tag recovery sampling programs were scanning every fish for the presence of wire--electronic tag detection rather that visual—making an analysis of the impact to non-clipped "wild" fish impossible. Survival based on CWT recoveries for release groups with both traditional and DIT marking strategies can only be calculated for the adipose fin-clipped CWT tagged release groups, effectively reducing the number of tag recoveries (sample size) that can be used for calculations. For the 1990-2006 brood years, the McKenzie Hatchery CHS program contributed an average of approximately 1,914 adults per brood year to commercial, sport, and tribal fisheries combined. For the past 10 brood years (1997-2006), the combined fishery contribution has averaged 2,701.

Table 1.12-2. Percentages of CWT's recovered for McKenzie Spring Chinook Salmon released into the McKenzie River by brood year and release month based on estimated CWT recoveries of AD+CWT marked fish.

	Release Month					Total %
Brood Year	October	November	January	February	March	Recovered
1990		0.34%			0.06%	0.15%
1991		0.14%			0.23%	0.21%
1992				0.14%	0.23%	0.20%
1993					0.19%	0.19%
1994				0.24%	0.18%	0.21%
1995				0.24%	0.38%	0.33%
1996		0.23%		0.72%	0.81%	0.60%
1997		0.19%		0.41%	1.08%	0.58%
1998		0.92%		1.14%	2.07%	1.46%
1999		1.05%		0.58%	0.59%	0.67%
2000		0.85%		0.67%	1.30%	0.89%
2001		0.30%	0.27%		0.29%	0.28%
2002	0.32%			0.60%	0.33%	0.45%
2003		0.17%		0.22%		0.21%
2004		0.05%		0.76%	0.30%	0.43%
2005		0.37%		0.39%		0.38%
2006		0.13%		0.51%	0.87%	0.50%

2007[a]		0.30%		0.17%	0.22%	0.23%
Average % Recovered	0.32%	0.39%	0.27%	0.49%	0.57%	0.48%

[a] Data includes recoveries through November 2011 and is therefore incomplete for brood year 2007.

In addition, actual returns to the McKenzie Hatchery and Leaburg Dam by run year are provided in Tables 1.12-4 and 2.2.2-2, respectively. Returns to McKenzie Hatchery ranged from 702 in 1994 to over 6,000 in 2002-2004 (Table 1.12-4), and in the majority of years, the number of returns has been in excess of the number of adults needed for broodstock collection (see Section 7). Counts of hatchery-origin CHS adults at Leaburg Dam ranged from 185 in 1997 to approximately 3,000 in 2003 and 2004.

Table 1.12-3. Estimated fishery contribution of McKenzie River spring Chinook stock released into the McKenzie River, based on AD+CWT recoveries for 1990-2006 brood years.1

			HARVEST				ESCAPEMENT		
Brood Year	# Smolts Released	%AD +CWT	Ocean Commercial	Ocean Sport	Freshwater Commercial	Freshwater Sport	Hatchery	Spawning Survey	Total Returns
1990	1,022,561	14.0	79	0	44	677	764	7	1,571
1991	805,342	15.4	129	284	7	389	834	13	1,656
1992	732,635	92.6	53	0	12	287	1,077	19	1,449
1993	480,183	17.2	56	15	6	74	757	17	925
1994	600,181	15.5	113	0	0	79	1,012	39	1,243
1995	953,885	16.9	73	60	67	936	1,835	130	3,102
1996	888,128	93.2	361	21	396	1,300	3,147	68	5,293
1997	925,781	93.8	217	24	456	858	3,737	44	5,336
1998	948,120	15.7	1,648	79	381	2,656	8,983	134	13,880
1999	949,696	16.4	840	22	685	1,259	3,526	49	6,381
2000	1,138,319	8.8	1,173	27	560	2,477	5,924	23	10,183
2001	1,153,730	8.9	404	0	274	780	1,752	34	3,242
2002	1,145,600	9.3	648	0	334	1,185	2,940	43	5,149
2003	1,160,288	9.3	104	0	18	573	1,707	43	2,444
2004	1,164,449	9.2	130	0	12	1,809	3,018	65	5,034
2005	1,181,073	9.2	258	27	135	1,750	2,313	44	4,525
2006	1,122,328	9.6	574	258	694	3,689	197	135	5,548
10-year Average	**1,088,938**	**19.0**	**599**	**44**	**355**	**1,704**	**3,410**	**61**	**6,172**

[1/] Excludes data for smolt release groups lacking CWT fish.

Table 1.12-4. The number of adult Spring Chinook Salmon returning to McKenzie Hatchery, 1990-2013.

Calendar Year	Adults to McKenzie Hatchery
1990	3,216
1991	4,497
1992	3,374
1993	2,051
1994	702
1995	1,135
1996	1,573 [1/]
1997	1,546 [2/]
1998	1,690
1999	2,279
2000	3,553
2001	3,920
2002	6,832
2003	6,260
2004	6,647
2005	3,256
2006	3,118 [3/]
2007	2,530 [4/]
2008	3,036 [5/]
2009	3,735[6/]
2010	6,974[7/]
2011	5,998
2012	3,951 (includes 65 fish from Leaburg Dam and 13 fish from Leaburg Hatchery)
2013	2,560 (includes 34 fish from Leaburg Dam and 17 fish from Leaburg Hatchery)

[1/] Includes 50 adults transferred from Leaburg Dam to McKenzie Hatchery.
[2/] Includes 26 adults transferred from Leaburg Dam to McKenzie Hatchery.
[3/] Includes 92 adults transferred from Leaburg Dam to McKenzie Hatchery.
[4/] Includes 139 adults transferred from Leaburg Dam to McKenzie Hatchery.
[5/] Includes 229 adults transferred from Leaburg Dam to McKenzie Hatchery.
[6/] Includes 150 adults transferred from Leaburg Hatchery
[7/] Includes 127 adults transferred from Leaburg Hatchery
2011 includes 60 fish from Leaburg Dam and 5 fish from Leaburg Hatchery, all hatchery origin

Source: ODFW HMIS database; Firman et al. (2002); K. Kremers, personal communication, 2012.

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

The McKenzie River Hatchery was constructed in 1938 to rear CHS. This hatchery replaced the old McKenzie Hatchery that raised salmon and trout from 1907 to 1938. The hatchery facilities in their current configuration were completed in 1975.

1.14) Expected duration of program.

The program will continue for an undefined period into the future.

1.15) Watershed targeted by program.

Spring Chinook Salmon smolts are released into the mainstem McKenzie River.

1.16) Indicate alternative actions considered for attaining program goals.

1.16.1) Key issues and alternatives.

To meet the stated goals of the McKenzie River Hatchery program, the facility will release up to 787,000 (currently 604,750) CHS smolts annually to, in part, mitigate impacts from construction and operation of Cougar and Blue River dams, provide returns for commercial and sport fisheries, assist with passage studies, meet tribal obligations for subsistence and ceremonial purposes, support conservation with an adequate potential for recovery. Production associated with the federal mitigation responsibility provides for the release of an adequate number of juveniles (a maximum of 80,800 pounds of smolts) to mitigate for habitat lost or made inaccessible by Cougar and Blue River dams.

The existing hatchery program supports ESA conservation goals and harvest, consistent with survival and recovery of the ESU, as associated with the McKenzie River. However, it is anticipated that hatchery production associated with USACE mitigation will be reduced in the future as natural production above Cougar Dam is restored. Natural production increases are expected as a result of implementation of the 2008 Biological Opinion, which is informed by the recommendations in the 2011 Recovery Plan. This HGMP allows for a maximum of 787,000 smolts to be released annually. The current estimate is that a program of up to 400 adult females may be needed to support spring Chinook reintroduction above Cougar Dam. The hatchery program also supports bull trout conservation, RM&E, and research into the development of passage solutions at Cougar Dam. Expanding hatchery production is not an alternative considered at this time due to the need to reduce hatchery CHS spawning in the McKenzie subbasin excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam to less than 10%. To the extent there are available surplus hatchery Chinook adults beyond the needs for hatchery broodstock and Cougar outplanting, an additional 120 (60 female and 60 male), and 100 adults (50 female and 50 male), will be provided to support outplanting above Trail Bridge Dam, and to the Mohawk River, respectively.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS

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

The Willamette BiOp (2008) incidental take statement and its subsequent February 13, 2013 clarification letter provides Section 7 ESA incidental take authorization for the Willamette Project (which encompasses all of the federal hatchery programs including the McKenzie spring Chinook hatchery program) funded by the Corps in the Upper Willamette River (with partial reimbursement from BPA according to its operation and maintenance power share percentage at the Willamette dams that produce hydropower). Additional coverage is needed through this HGMP to allow direct take of natural-origin adults into the broodstock. The freshwater fisheries that affect natural-origin Chinook salmon and harvest hatchery Chinook salmon returning to the Willamette River (including McKenzie hatchery Chinook salmon) are authorized under the ESA by a FMEP approved by NMFS (ODFW 2001a).

Several other ESA documents provide additional analysis relating to the CHS resources in the McKenzie River. They include:

FERC. (Federal Energy Regulatory Commission). 2001. Biological Assessment for the Eugene Water and Electric Board's McKenzie River Hydroelectric Projects. Federal Energy Regulatory Commission, Washington, DC.

FERC. (Federal Energy Regulatory Commission). 2003. Biological Assessment for Eugene Water and Electric Board's Carmen Smith Hydroelectric Project. Federal Energy Regulatory Commission, Washington, DC.

NMFS (National Marine Fisheries Service). 2000a. Biological Opinion on the impacts from the collection, rearing, and release of listed and non-listed salmonids associated with artificial propagation programs in the Upper Willamette CHS and winter steelhead evolutionarily significant units. Portland, OR.

NMFS and US Fish and Wildlife Service (USFWS). 2001. Biological Opinion on the effects of the relicensing of Eugene Water and Electric Board's (EWEB) Leaburg-Walterville hydroelectric project in the McKenzie subbasin, Oregon, on Upper Willamette River Chinook Salmon, Columbia River bull trout, Canada Lynx, Bald Eagle, Northern Spotted Owl, Bradshaw's Lomation, Kincaids's Lupine, NMFS, and USFWS, Oregon State Office, Portland, Oregon.

NMFS. 2003. Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Consultation on the effects of EWEB's Carmen-Smith Part 12 Submittal to FERC for Trail Bridge Dam Emergency Spillway Expansion, and Continued Operation of the Carmen-Smith Hydroelectric Project in the McKenzie Subbasin, Oregon on: Upper Willamette River Chinook salmon. NMFS, Oregon State Office, Portland, Oregon.

NMFS. 2007. Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Consultation Construction and Operation of the Army Corps of Engineers Fish Trap at Cougar Dam South Fork McKenzie River, HUC 1709000403; Lane County, Oregon.

ODFW and NMFS (Oregon Department of Fish and Wildlife and National Marine Fisheries Service). 2011. Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead. Oregon Department of Fish and Wildlife. Salem, Oregon. National Marine Fisheries Service, Portland, Oregon.

USACE (U. S. Army Corps of Engineers). 2000. Biological Assessment of the effects of the Willamette River Basin flood control projects on species listed under the Endangered Species Act. Final; April 2000. USACE, Portland District.

USACE (U.S. Army Corps of Engineers), BPA, BOR. 2007. Supplemental Biological Assessment of the Effects of the Willamette River Basin Flood Control Project on Species Listed Under the Endangered Species Act. Final, May 2007. USACE, Portland District.

ODFW also has a Section 6 Cooperative Agreement with the USFWS for listed species under USFWS jurisdiction.

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

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

(a) Identify the NMFS ESA-listed population(s) that will be <u>directly</u> affected by the program.

<u>Upper Willamette Chinook Salmon</u>

The Upper Willamette River (UWR) Chinook salmon, which includes the McKenzie River CHS population, was listed as threatened under the ESA on March 24, 1999 (64 FR 14308) and reaffirmed June 28, 2005 (70 FR 37160), and also by NMFS in 2011 (Ford, 2011). Critical habitat was designated Feb. 16, 2000 (65 FR 7764). The following provides life history information for the population.

Adult Run Timing and Spawning Distribution. The largest remaining wild population of UWR CHS in the Willamette Basin is in the McKenzie subbasin. UWR CHS typically enter the Columbia River in February and March. Adults typically enter the McKenzie subbasin in mid-May, with the peak of the run passing Leaburg Dam in June. Adult migration tapers off in July, associated with rising water temperatures. Movement past Leaburg Dam resumes in August and September as spawning season approaches (Tim Downey, EWEB biologist, personal communication). Spawning occurs from August through October, with peak spawning in late September (Mattson 1962). Most of the spawning by natural-origin fish (94%) occurs upstream of Leaburg Dam. The current timing and distribution of spawning fish appears to be similar to what it was historically, with spawning throughout the river but "principally from Leaburg Post Office up to its source" (ODF 1903).

Age Structure. Willamette and McKenzie River CHS return from the ocean as 3-6-year-old fish. Rich and Holmes (1928), reporting on marking studies done on Willamette basin CHS runs between 1916 and 1927, reported that the most abundant age class was age-5 fish, and age-6 fish were more abundant than age-4 fish. Mattson (1963) analyzed scales from CHS caught in the sport fisheries in the Willamette River from 1946-1948 and 1951. He reported that 4.6% were age 3 (jacks); 24.2% were age 4; 61.1 % were age 5, and 10.5% were age 6. The samples analyzed by these investigators were presumably a mixture of hatchery and wild Chinook salmon from throughout the Willamette basin. Age analysis of fish from spawning surveys suggest that natural-origin fish more closely resemble the age structure observed by Mattson (1963) than hatchery-origin fish, with a majority of age-5 fish, but with fewer age-6 fish than what was observed historically (Table 2.2.1-1 and Table 2.2.1-2).

Table 2.2.1-1. Age composition of Upper Willamette River wild Chinook salmon sampled at hatcheries and on spawning ground surveys. Natural origin of fish verified based on otolith analyses. Data from unpublished ODFW records provided by the ODFW Fish Life History Analysis Project.

		Total Age			
Year	N	3	4	5	6
2002	345	0.3%	44.6%	54.5%	0.6%
2003	246	0.4%	19.9%	77.2%	2.4%
2004	183	0.0%	23.0%	76.0%	1.1%
2005	173	1.2%	15.0%	80.3%	3.5%
2006	194	1.0%	42.8%	54.6%	1.5%
2007	386	0.0%	17.4%	78.8%	3.9%
2008	220	4.1%	29.1%	62.7%	4.1%
2009	241	0.8%	59.3%	35.3%	4.6%
2010	129	3.1%	38.8%	57.4%	0.8%
2011	370	0.5%	55.4%	43.8%	0.3%
2012	198	0.0%	15.2%	79.3%	5.6%

Source: Schroeder et al. 2007; K. Schroeder, unpublished data; ODFW Fish Life History Analysis Project, unpublished data.

Table 2.2.1-2. Age composition (percent of sample) by return year of hatchery origin Spring Chinook Salmon in the McKenzie River basin, 1995-2001 and 2007-2008. (Data are based on analysis of scales from randomly selected adults at the time of spawning and from mortalities prior to spawning.)

Return Year	Percent of Sample				Sample size
	Age 3	Age 4	Age 5	Age 6	
1995	1.9	46.8	49.6	1.8	1128
1996	1.1	42.5	56.5	0.0	1573
1997	0.7	26.5	72.5	0.3	1596
1998	1.8	41.3	53.9	3.0	1716
1999	2.1	75.0	22.9	0.0	2279
2000	1.4	76.8	21.8	0.0	3553
2001	1.0	59.8	39.2	0.0	3920
2007	0.0	32.9	65.8	1.3	76
2008	0.0	86.6	13.4	0.0	67
2012	0.0	35.5	58.1	6.5	31

Source: K. Schroeder, personal communication (November 2009); ODFW Fish Life History Analysis Project, unpublished data; and Boatner and Foster 2001.

Spawning and Incubation. Spring Chinook Salmon spawning in the Willamette basin usually occurs from August 25 through October 15, with peak spawning activity in late September. Mattson (1962) noted the latest natural spawning observed in the McKenzie under natural conditions was October 22. However abnormal conditions associated with dam constructions pushed spawning activity into November in some instances. Water temperature is the main factor influencing the incubation period, which can range from 58 to 105 days. Spawning has occurred throughout the basin historically, including most major tributaries (NMFS and USFWS 2001).

Rearing. Willamette CHS exhibit complex, variable rearing and migration patterns. Juvenile Chinook salmon may spend up to 1½ years in their natal stream. In the McKenzie River, Chinook salmon have been observed moving downstream past Leaburg Dam as fry shortly after emergence, as juveniles throughout their first year, and as smolts in the spring of their second year. This may be a dispersal movement rather than a true migration. Mattson (1962) identified three general migration patterns in seaward migration of Willamette CHS observed in the lower Willamette River at Lake Oswego; the first is a spring-summer migration of 0-age juveniles that usually peaks from April through June. However, Chinook salmon juveniles were observed as early as January, and peak counts were made as late as August. These first-spring migrants range in size from 40-90 mm. The second migration period occurs in the fall and winter when the fish are about one year old. This migration generally peaks in October and is associated with the onset of heavy fall rains. Fall migrants are usually between 100-130 mm in length. The third migration occurs in the second spring when the fish are about 1½ years old. This migration peaks between March and May, and the fish 100-140 mm in length.

Ocean Distribution. Based on CWT returns, McKenzie Chinook salmon spend most of their ocean life in Alaskan and British Columbia waters (NMFS 2000a).

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

Columbia River Bull Trout

Columbia River bull trout were listed as "threatened" under the federal ESA in June 1998. Bull trout are native to the McKenzie River basin are regularly observed in the river immediately upstream from the hatchery outfall. Bull trout are also known to use the river to its confluence with the Willamette. Annual counts of bull trout at Leaburg Dam have ranged from one to 40 fish (USFWS 2002, M. Hogansen, ODFW, personal communication).

Historically, the basin likely had one or two fluvial populations distributed from the mouth upstream to Tamolitch Falls. The Bull Trout Draft Recovery Plan (USFWS 2002) lists three populations of bull trout in the McKenzie Basin: 1) the mainstem McKenzie River and tributaries up to Trail Bridge Dam, 2) the McKenzie River and tributaries from Trail Bridge Dam up to Tamolitch Falls, and 3) the South Fork McKenzie River above Cougar Dam. These populations were artificially formed when dam construction fragmented the original McKenzie population. The largest concentrations of bull trout in the McKenzie currently are in the South Fork above Cougar Dam and in the mainstem McKenzie above river mile 39 (at Leaburg Dam).

Bull trout may benefit from the McKenzie CHS hatchery program due to increased food supply in the form of naturally-produced juvenile Chinook salmon in the South Fork McKenzie above Cougar Dam and in the mainstem above Trail Bridge Dam resulting from releases of surplus adult hatchery CHS. Bull trout fry, however, may be affected by spring Chinook smolts through competitive interactions for food and space.

Lower Columbia River Steelhead

The Lower Columbia River steelhead ESU was listed as threatened under the ESA on March 19, 1998 and reaffirmed January 05, 2006 (71 FR 834). This ESU occupies tributaries to the Columbia River between the Cowlitz and Wind Rivers Washington, inclusive, and the Willamette and Hood rivers in Oregon, inclusive. Excluded are steelhead in the upper Willamette River Basin above Willamette Falls, and steelhead from the Little and Big White Salmon rivers in Washington. Many populations in the Lower Columbia River steelhead ESU are small and have long and short-term trends in abundance.

Upper Willamette River Steelhead

The Upper Willamette River steelhead ESU (listed as threatened under the ESA on March 24, 1999 and reaffirmed January 05, 2006 (71 FR 834)), includes native winter-run populations from Willamette Falls upstream to and including the Calapooia River. Significant natural populations of steelhead occur in the North Santiam, the South Santiam, the Molalla, and the Calapooia rivers. Additionally, smaller, but still significant

natural populations occur in several West Valley tributaries (Tualatin, Yamhill, Luckiamute, and Rickreall). There are no hatchery programs included in this ESU (NMFS 2006). Steelhead numbers in this ESU are depressed from historical levels but to a much lesser extent than CHS in the Willamette Basin (McElhany et al. 2007). Steelhead generally meet VSP targets for abundance but are limited by diversity and spatial structure. Restoration of access to historic spawning and rearing areas is essential to achieving population viability. The upper Willamette River steelhead ESU may be incidentally affected by McKenzie Hatchery spring Chinook program due to competitive interactions for food and space.

Lower Columbia River Chinook Salmon

The Lower Columbia River Chinook salmon ESU was listed as threatened under the ESA on March 24, 1999 and reaffirmed June 28, 2005 (70 FR 37160). This ESU includes all naturally spawned CHS populations residing below impassable natural barriers (e.g. long-standing, natural waterfalls) from the mouth of the Columbia River to the crest of the Cascade Range just east of the Hood River in Oregon and the White Salmon River in Washington. This ESU excludes populations above Willamette Falls. Within this ESU, there are historic runs of three different Chinook salmon populations: spring-run, fall-run (tules), and late-fall (bright) Chinook salmon. Current data for the Lower Columbia River Chinook salmon ESU indicated that populations currently have low abundance. Improved hatchery management practices have reduced the risks of diversity and productivity of natural populations in the Lower Columbia River Chinook salmon ESU.

Lower Columbia River Chum Salmon

The Lower Columbia River chum salmon (*O. keta*) ESU was listed as a threatened species on March 25, 1999 and reaffirmed on June 28, 2005. The ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon.

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

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

The most recent status review of Upper Willamette spring Chinook salmon was completed in 2011 (NMFS 2011; Ford 2010). The McKenzie population is one of only two populations within the ESU to be considered at a low risk of extinction for the four VSP parameters and the only population classified as a "genetic legacy" (NMFS 2011). The best indicator of population status is from the counts of natural-origin Chinook salmon migrating past Leaburg Dam. The area upstream of Leaburg Dam is the primary production area for natural-origin spring Chinook salmon. From 2002 through 2013, on average 94% of natural-origin fish spawning occurred upstream of Leaburg Dam in the McKenzie Basin (the remaining 6% of natural-origin fish observed spawning were below Leaburg Dam; Table 2.2.2-3; Sharpe 2014).

Over the last decade, the counts of natural-origin Chinook at Leaburg Dam have exhibited a downward trend (Table 2.2.2-1). The return of natural-origin salmon in 2013 was the fifth lowest count observed at Leaburg Dam since 1994. However, when taking into account fishery harvest below Leaburg Dam in the lower Columbia and Willamette Rivers, the overall return of McKenzie River natural-origin salmon in 2013 may have been the second lowest return ever recorded. This is because in years 1994, 1995, and 1997, lower river fisheries harvested between 11% to 39% of the McKenzie return in those years before the fish reached Leaburg Dam (Figure 2.2.2-1; ODFW 2001). The lowest return of McKenzie spring Chinook salmon ever recorded occurred in 1997.

Table 2.2.2-1. Spring Chinook Salmon counts at Leaburg Dam on the McKenzie River, 1994-2011 (ODFW 2012).

	Natural-Origin[1/]		Hatchery[1/]		
Run Year	Number	Percent	Number	Percent	Total
1994	825	54	701	46	1,526
1995	933	58	689	42	1,622
1996	1,105	76	340	24	1,445
1997	991	84	185	16	1,176
1998	1,415	76	459	24	1,874
1999	1,383	72	526	28	1,909
2000	1,985	75	672	25	2,657
2001	3,433	80	869	20	4,297
2002	4,223[2/]	69	1,864	31	6,087[3/]
2003	5,784[2/]	62	3,543	38	9,413[4/]
2004	4,788	53	4,246	47	9,052
2005	2,579	83	515	17	3,148
2006	2,225	70	945	30	3,170
2007	2,757	83	558	17	3,315
2008	1,365	83	290	17	1,655
2009	1,185	72	460	28	1,645
2010	1,357	51	1,298	49	2,655
2011	2,288	81	548	19	2,836
2012	1,654	84	323	16	1,977
2013	1,156	79	307	21	1,497

1/ Starting in 2001, the presence of thermal marks in otoliths of unclipped carcasses on spawning grounds was used to estimate numbers of unclipped hatchery fish in the Leaburg Dam counts. The number of clipped fish in the Leaburg Dam count was adjusted by the clipped to unclipped ratio in carcasses recovered upstream of the dam to account for fall back and recounting of clipped fish at Leaburg Dam.
2/ Includes a preliminary estimate of 18% non-adipose-fin-clipped fish that were found to have otolith marks indicating they were reared in a hatchery.
3/ An additional 690 adipose fin-clipped hatchery fish were removed from Leaburg Dam ladder.
4/ An additional 1,197 adipose fin-clipped hatchery fish were removed from Leaburg Dam ladder.

Table 2.2.2-2. Spawning distribution of natural-origin spring Chinook above and below Leaburg Dam, 2002-2013.

	Below Leaburg Dam		Above Leaburg Dam	
Year	Natural-origin spawners	Proportion	Natural-origin spawners	Proportion
2002	139	0.10	1307	0.90
2003	70	0.04	1540	0.96
2004	32	0.02	1599	0.98
2005	84	0.04	2208	0.96
2006	102	0.06	1473	0.94
2007	66	0.02	2818	0.98
2008	99	0.07	1325	0.93
2009	123	0.11	988	0.89
2010	51	0.04	1388	0.96
2011	223	0.09	2190	0.91
2012	115	0.08	1399	0.92
2013	30	0.03	1053	0.97
average		0.06		0.94

Outplanting of spring Chinook above Cougar Dam began in 1993. The construction of an adult trap at the base of Cougar Dam was completed in 2010. Prior to having an adult trap at Cougar Dam returning adult Chinook could not be collected and enumerated, so it was not known which returning adults were derived from the progeny of Chinook that had previously been outplanted above Cougar Dam.

From 2010 through 2013, the number of natural-origin CHS collected at the Cougar Dam trap ranged from 217 to 496 (See Draft Reintroduction Plan in Appendix C).

The Recovery Plan (ODFW and NMFS 2011) considers the McKenzie CHS population to currently be at low risk of extinction over the next 100 years for all four attributes of a VSP. The status of the McKenzie River population of UWR CHS with respect to each VSP parameter is described in detail in Ford et al. (2010). Despite being at low risk of extinction, the desired status of the McKenzie River population of UWR CHS is to attain at status of very low extinction risk to achieve the delisting scenario for the ESU. This very low extinction risk equates to an abundance level for the McKenzie River population of approximately 9,000 natural-origin salmon. The current abundance of adult CHS returning to the McKenzie River (as measured at Leaburg Dam) is presented in Table 2.2.2-2.

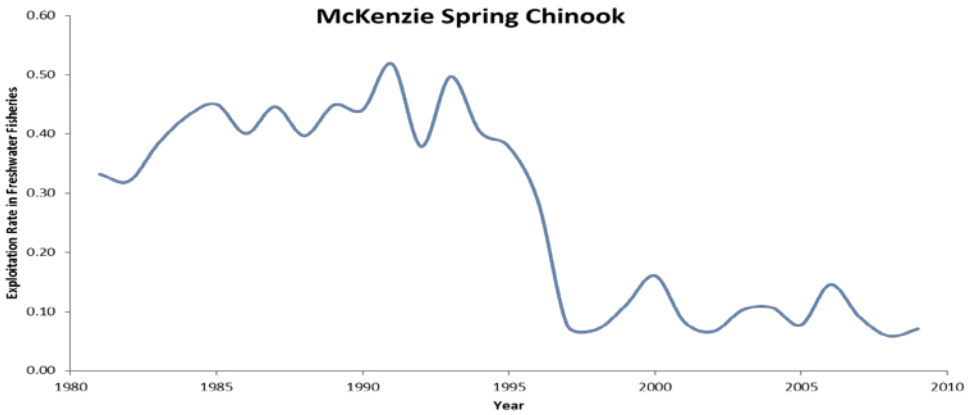
Recent natural-origin spawning escapements in the McKenzie River exceed critical and interim viable thresholds for abundance and productivity (see ODFW 2013 for these

thresholds). The McKenzie River historically produced 40% of the CHS above Willamette Falls, and it may now account for 25% of the production potential in the basin. Dams on the mainstem McKenzie River (Trail Bridge) and on tributaries to the McKenzie (Blue River and South Fork McKenzie) have eliminated some historic spawning areas in order to generate hydroelectric power or help provide crucial flood damage reduction for the Willamette Valley. Inaccessible habitat upstream from Cougar Dam represents 25% of the historic spawning area in the McKenzie River and is, disproportionately, the best habitat in the McKenzie basin. The Carmen Smith Settlement Agreement includes upstream and downstream passage facilities at Trail Bridge Dam.

Leaburg Dam fish counts before 1994 were directly affected by releases of hatchery CHS upstream from the dam. Since 1994, counts have ranged from 1,176 in 1997 to over 9,000 in 2003 and 2004 (ODFW 2013). Leaburg counts of natural-origin fish have increased from 825 in 1994 to over 5,000 in 2003 (Table 2.2.2-2). These numbers do not account for the natural-origin CHS that spawned below Leaburg (approximately 6% of total; Sharpe 2014), thus the number of natural-origin CHS that escaped into the McKenzie Basin is somewhat higher than Leaburg Dam counts.

Figure 2.2.2-1 Exploitation rate of McKenzie spring Chinook in freshwater fisheries.

Figure 2.2.2-1. Reduced harvest of natural-origin spring Chinook salmon due to harvest management change.



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

Specific productivity cohort analyses are not available for the most recent returns to the McKenzie River. However, over the last two generations (2002-2013) returns of natural-origin spring Chinook salmon to Leaburg Dam counting station have been declining. This indicates the productivity rate of spring Chinook salmon is less than one (i.e. in a state of population decline). Total recruitment to freshwater of McKenzie natural-origin Chinook in 2013 was the fifth lowest on record. This return was produced prominently by the low returns observed in 2008 and 2009, and also indicates the return was below replacement.

(c) Provide the most recent 12-year annual spawning abundance estimates or other abundance information. Indicate source of data.

Table 2.2.2-3. Summary of Chinook salmon spawning surveys in the McKenzie River and comparison to redd densities 2005 - 2012 (Schroeder 2012).

McKenzie River Survey Section	Redds/km										
	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002
Below Leaburg Dam	25.7	22.9	27.4	17.4	24.5	14.7	7.5	7.8	10.3	17.8	12.0
Leaburg - SF McKenzie	5.8	10.0	11.5	4.6	5.2	14.8	5.2	4.1	12.9	9.7	7.5
South Fork below Cougar Dam	9.5	13.6	7.4	9.7	11.9	16.6	12.2	12.2	20.2	12.1	15.3
Above South Fork McKenzie	4.5	11.1	8.6	4.8	5.7	13.2	6.9	12.6	7.9	9.2	7.4
S. Fork McKenzie Above Cougar	7.0	8.9	7.1	11.0	6.3	5.7	6.5	4.4	--	--	--

[a] Does not include 15 redds and 20 carcasses collected below Dearhorn

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

The proportion of hatchery-origin spring Chinook salmon spawning in the McKenzie Basin is shown in Table 2.2.2-4. The highest pHOS has been observed below Leaburg Dam; where McKenzie and Leaburg hatchery facilities are located and where there is few natural-origin Chinook spawning (Table 2.2.2-5). In the primary Chinook production area above Leaburg Dam, pHOS has ranged from 15% to 45%, with an average of 26% from 2002-2013. The highest concentrations of hatchery-origin spawners occur near Leaburg Dam, with fewer hatchery fish spawning in the headwaters of the McKenzie River where most of the natural-origin Chinook spawn (Figure 2.2.2-1).

Table 2.2.2-4. Estimated proportion of hatchery-origin (pHOS) Chinook spawning below and above Leaburg Dam, 2002-2013 (Sharpe 2014), and the whole basin (Peven 2015).

	pHOS		
Year	Below Leaburg Dam	Above Leaburg Dam	Total Basin pHOS
2002	0.80	0.35	0.47
2003	0.93	0.39	0.54
2004	0.94	0.38	0.48
2005	0.50	0.18	0.20
2006	0.58	0.17	0.22
2007	0.78	0.16	0.21
2008	0.83	0.16	0.34
2009	0.72	0.26	0.37
2010	0.91	0.45	0.53
2011	0.59	0.25	0.30
2012	0.83	0.16	0.35
2013	0.84	0.15	0.28
Average	0.77	0.26	0.36

Table 2.2.2-5. Estimated Proportion of Hatchery Adults in the McKenzie Based on Carcass Recoveries 2002-2013 (ODFW) compared to pHOS estimates from spawner abundance estimates (Table 2.2.2-2).Carcass data were adjusted using otolith scores. The weighted pHOS estimate using carcass data accounts for differences in carcass recovery rates and spawner distributions. An alternate estimate for pHOS using spawner abundance estimates is also presented.

Year	Below Leaburg redds	Abv Leaburg redds	pHOS Below Leaburg	pHOS Above Leaburg	Weighted pHOS from carcass data (Weighting Factor is Redd Count)	Basin-wide pHOS from spawner abundance estimates
2002	226	807	80%	35%	45%	47%
2003	379	1016	93%	39%	54%	54%
2004	202	1038	94%	38%	47%	48%
2005	34	1072	50%	18%	19%	20%
2006	56	709	58%	17%	20%	22%
2007	95	1346	78%	16%	20%	21%
2008	191	629	83%	16%	31%	34%
2009	129	531	72%	26%	35%	37%
2010	209	1013	91%	45%	53%	53%
2011	131	1168	59%	25%	28%	30%
2012	268	666	83%	16%	35%	35%
2013	63	495	84%	15%	23%	28%

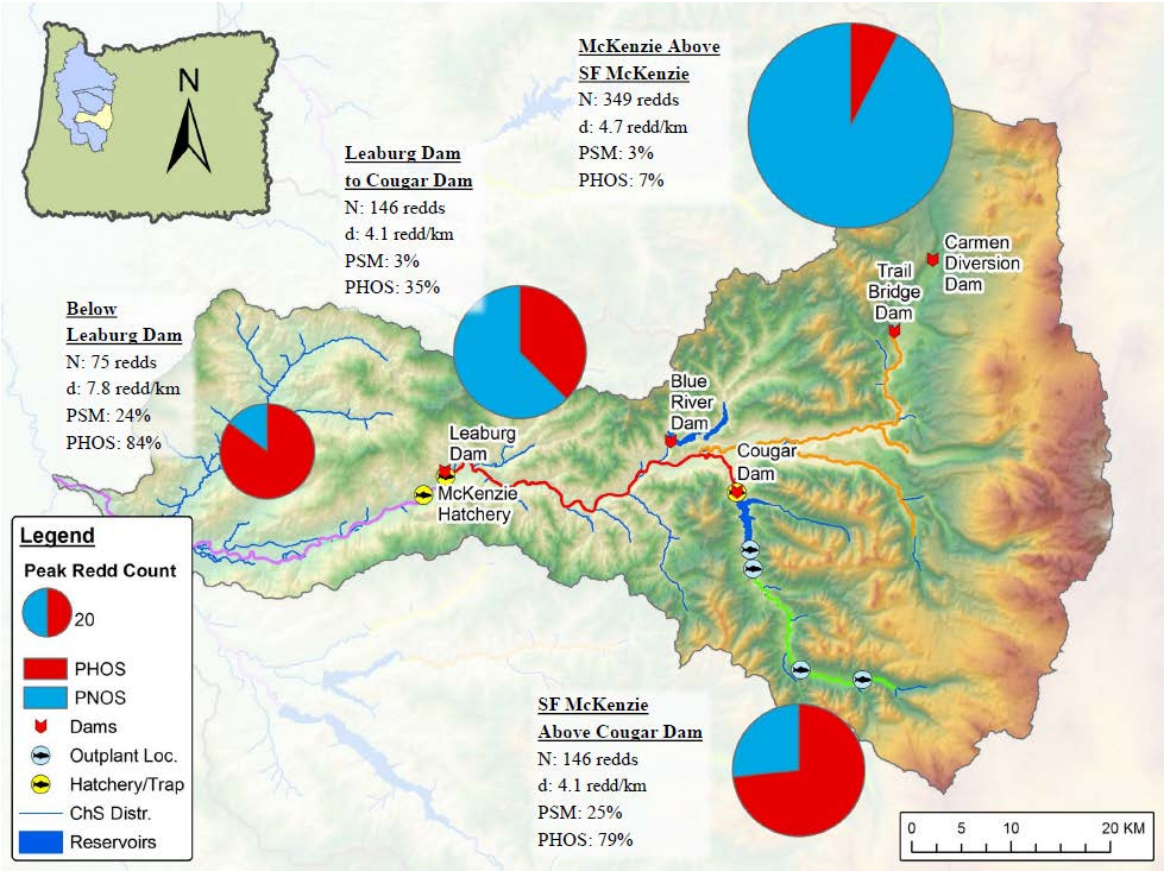


Figure 2.2.2-1 Summary of spring Chinook spawning surveys for 2013. The size of the pie charts reflect the relative number of redds (N). PSM is prespawning mortality rate. PHOS is proportion of hatchery-origin Chinook compared to natural-origin Chinook. Hatchery Chinook are purposefully outplanted in the SF McKenzie River above Cougar Dam for reintroduction purposes in historic habitat. Figure taken from Sharpe (2014). Note: the unweighted pHOS for the entire basin (excluding the reintroduction areas above Cougar Dam and Trail Bridge Dam) in 2013 was 28%.

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

(a) 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.

Broodstock collection at McKenzie Hatchery occurs from mid-May through mid-October. All CHS captured at the McKenzie Hatchery are ESA-listed as part of the Upper Willamette ESU. Thus, direct or indirect take of listed CHS is part of normal trap operation through migration delay, capture, handling, and upstream release. Trapping and handling devices may further lead to injury to listed fish through confinement, delayed migration and spawning, or delayed mortality as a result of injury. In addition,

direct take is needed for up to 600 adults for broodstock needs including incorporation of natural-origin adults into the broodstock at a rate averaging 5-10% annually. The number of natural-origin fish incorporated into the broodstock would range from 30 to 60 fish at a broodstock size of 600. The total natural-origin run would not be impacted by more than 2% from broodstock collection. Natural-origin adults incorporated into the broodstock are typically those that stray into the hatchery, however, additional adults could be needed to supplement integration on a case by case basis; most likely the natural-origin CHS that could be collected from the Leaburg Dam trap. Competition, disease, predation, and genetic interactions between hatchery and natural- origin fish in the McKenzie River may result in additional indirect take; however, these effects have not been quantified. The McKenzie Hatchery utilizes release strategies that promote rapid emigration to minimize interactions between hatchery-origin CHS smolts and natural-origin juveniles.

Baseline monitoring research is included as part of the Cooperative Agreement for hatchery funding through the USACE. Uncertainty research is funded separately. In addition, the USACE has developed an RM&E plan that includes a framework for future RM&E activities related to the Willamette Hatchery Program in general and the McKenzie River CHS Hatchery Program specifically. The hatchery RM&E plan identified recommendations as well as variables important for evaluating hatchery performance. A more focused Three-Year Monitoring and Evaluation Plan was developed in 2011 to help inform hatchery monitoring and evaluation. Various RM&E studies may be considered through the structure of WATER. Individual RM&E actions will be associated with various levels of take. These actions and potential take associated with uncertainty research will be addressed on an annual basis.

(b) Past takes associated with the hatchery program, including numbers taken and observed injury or mortality levels for listed fish (if known)

Prior to 2001 (i.e. before all of the returning hatchery fish were marked), wild CHS were not readily distinguishable from hatchery fish. Consequently, there is little specific information on the level of take associated with the adult trapping and holding before that time. However, since hatchery fish returns have been externally marked (2001 and beyond), the observed number of natural-origin CHS entering the McKenzie Hatchery is very low (less than 1% of CHS collected at hatchery). Table 2.2.3-1 reports the mortality of adult CHS at McKenzie Hatchery from 1990 to 2011, that includes adults taken for broodstock and holding mortality.

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

Projected incidental take levels for CHS at McKenzie Hatchery is presented in Tables 2.2.3-2. Take levels were estimated independently for the hatchery and wild components of the ESU. Incidental take attributable to some hatchery operations (e.g., juvenile releases) and related RM&E programs are not quantifiable at this time. As part of the

RM&E program, monitoring and evaluation activities will be conducted to provide information on incidental take levels associated with hatchery operations, and will result in task-specific take estimates. Generated take estimates should be reviewed annually as part of baseline and uncertainty monitoring as identified in the hatchery mitigation agreement.

Table 2.2.3-1. Numbers of Spring Chinook Salmon taken for broodstock and holding mortality at McKenzie Hatchery, 1990-2013.

	Fish Held (No.)			Males		Females		Total	
Brood Year	Males	Females	Total	No.	%	No.	%	No.	%
1990	861	398	1,259	139	16.1	95	23.9	234	18.2
1991	1,641	1,309	2,950	81	4.9	135	10.3	216	7.3
1992	1,019	680	1,699	163	16.0	126	18.5	289	16.8
1993	950	965	1,915	62	6.5	82	8.5	144	7.5
1994	385	310	695	103	26.8	118	38.1	221	31.5
1995	600	507	1,107	53	8.8	24	4.7	77	6.8
1996	584	608	1,776	46	7.9	66	10.9	112	9.3
1997	628	644	1,272	38	6.1	26	4.0	64	5.0
1998	578	558	1,136	31	5.4	36	6.5	67	5.8
1999	719	691	1,410	20	2.8	24	3.5	44	3.0
2000	482	468	950	27	5.6	19	4.1	46	4.7
2001	489	560	1,049	60	12.3	59	10.5	119	11.2
2002	638	597	1,235	50	7.8	56	9.4	106	8.6
2003	734	751	1,485	291	39.7	297	39.6	588	39.6
2004	702	543	1,245	34	4.8	41	7.6	75	6.0
2005	663	621	1,284	122	18.4	80	12.9	202	15.7
2006	581	570	1,151	41	7.1	30	5.3	71	6.1
2007	589	609	1,198	19	3.2	39	6.4	58	4.8
2008	714	724	1,438	43	6.0	52	7.2	95	6.6
2009	592	614	1,206	43	7.2	58	9.4	101	8.3
2010	929	1,032	1,961	71	7.6	69	6.7	140	7.1
2011	887	892	1,779	59	6.5	68	7.6	127	7.1
2012	657	664	1,321	8	1.2	16	2.4	24	1.8
2013	521	538	1,059	28	5.4	21	3.9	49	4.6
Average					9.75		10.91		10.14

Table 2.2.3-2 - Estimated listed salmonid take levels by hatchery activity.

Listed species affected: Spring Chinook Salmon ESU/Population: Willamette Activity: Brood Collection/Trapping					
Location of hatchery activity: McKenzie Hatchery Dates of activity: May - October Hatchery program operator: ODFW					
	Annual Take of Listed Fish By Life Stage (Number of Fish)				
Type of Take	Egg/Fry	Juvenile/Smolt	Adult		Carcass
			Hatchery	Wild	
Observe or harass a)					
Collect for transport b)			1,416	0	
Capture, handle, and release c)			0	120	
Capture, handle, tag/mark/tissue sample, and release d)			1,416		
Removal (e.g., broodstock) e)			Up to 600	30-60	
Intentional lethal take f)			100		
Unintentional lethal take g)			<10%	<5%	
Other Take (specify) h)					

a) Contact with listed fish through hatchery program-related stream surveys, carcass and mark recovery projects, or migration delay at weirs.
b) Take associated with weir or trapping operations where listed fish are captured and transported for release (above dams for reintroduction-conservation purposes).
c) Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream (ex. 2013 when no natural-origin adults collected for brood).
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 (assumes 5-10% integration).
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.

(d) 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.

Currently, all natural-origin fish returning to the hatchery are potentially used in the broodstock. Approximately 100 unmarked adults return to the hatchery on an annual basis; 20% of these unmarked returns are actually of natural-origin, based on otolith analysis. There is higher risk of increasing pHOS by outplanting unmarked adults due to the inability to distinguish unmarked (unclipped) hatchery from natural-origin adults. A

contingency plan for disposition of excess take of natural-origin CHS will follow development of identification methods that can be applied in real time.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any Evolutionary Significant Unit (ESU)-wide hatchery plan or other regionally accepted policies. Explain any proposed deviations from the plan or policies.

Upper Willamette River Conservation and Recovery Plan for Chinook salmon and steelhead (OAR 635-500-6600)

In August 2011, the Recovery Plan for the Upper Willamette River Chinook ESU and steelhead Distinct Population Segment (DPS) was adopted (ODFW and NMFS 2011). The Upper Willamette River Chinook ESU includes the McKenzie spring Chinook population. The Recovery Plan provides the primary guidance for addressing limiting factors and threats for ESA Section 4 recovery of Willamette River CHS and establishes delisting criteria. Chapters 4 and 6 of the plan documented the current status of the population across the ESU and report desired status goal for the population based on interrelations of the populations, limiting factors and threats (LFT), and recovery potential by subbasin. The plan also contains standards for a "viable salmonid population" (VSP) of McKenzie River spring Chinook salmon in terms of abundance, productivity, distribution and diversity. The plan also establishes measurable criteria for delisting spring Chinook salmon, with a focus on reducing threats that contribute to the species decline. General limiting factor threats in the McKenzie River subbasin and their relative mortality impacts on spring Chinook salmon include freshwater habitat loss and degradation (26%), flood control/hydropower dams (49%), other species (5%), harvest (5%), and hatchery (13%).

The McKenzie CHS population is currently at low risk of extinction, but not recovered. The desired status is to increase the abundance of spring Chinook to approximately 9,000 fish and the population at a very low risk of extinction (1%). Chapter 7 of the Recovery Plan identified several management actions to achieve desired status. For details see: http://www.dfw.state.or.us/fish/CRP/upper_willamette_river_plan.asp

Recovery Plan recommendations related to the hatchery program are cross-referenced in Table 3.1-1 of this HGMP.

Willamette Hatchery River Basin Flood Control Project Biological Opinion (NMFS 2008)

In July 2008, the NMFS released their BiOp regarding impacts to ESA-listed species that are related to the Willamette Project, including operation of USACE's 13 Willamette Project dams and funding of the Hatchery Mitigation Program (NMFS 2008). In this

opinion, NMFS concluded that the proposed action (PA) was likely to jeopardize the continued existence of the listed UWR spring Chinook salmon ESU and winter steelhead DPS, and to adversely modify or destroy designated critical habitat for those species. NMFS provided Reasonable and Prudent Alternatives (RPA), a package of measures designed to ensure survival with an adequate potential for recovery of the CHS ESU and steelhead DPS.

Section 5 describes the effects of the PA on ESA-listed fish, with the effects of hatchery programs specifically presented in Section 5.1.5. Chapter 9 describes RPAs; those specific to fish hatchery programs and facilities are discussed in Sections 9.4.6, 9.4.7, and 9.6. RPAs related to the hatchery program are summarized in Table 3.1-1 of this HGMP. RPA 1.1-1.4 of the BiOp describes WATER, the interagency coordination and adaptive management forum that will be used to implement actions delineated in the BiOp. RPA 6.2.3 of the BiOp describes the current hatchery program and the related CHS reintroduction/outplant program.

Fishery Management and Evaluation Plan-Upper Willamette River Spring Chinook Salmon in Freshwater Fisheries of the Willamette Basin and Lower Columbia River Mainstem (ODFW 2001a).

This document outlines the plans for selective fisheries for hatchery Chinook salmon in the Willamette and lower Columbia rivers, and plans for evaluation of the effectiveness of the fishery regulations in protecting natural spawning populations. The McKenzie hatchery program is part of this comprehensive plan. The selective fishery was implemented in 2001 and limits cumulative impacts from freshwater fisheries (recreational and commercial) to <15% annually. Over the last decade, actual impacts have typically ranged from 8 to 10%. The FMEP (FMEP 2001a and annual updates) calls for a comprehensive monitoring and evaluation program assessing the catch of natural-origin fish, the abundance of wild and hatchery fish, and angler compliance throughout the basin. The results of the monitoring program are assessed and presented in annual reports.

Willamette Basin Fish Management Plan- Spring Chinook Salmon Chapters (ODFW 1998)

This document predates listing but still provides direction for the management of Willamette River Basin CHS populations by identifying and addressing factors that impact each subbasin population. The plan also restricts and manages fisheries on CHS adults in ways consistent with rebuilding wild populations. The measures outlined in the plan are designed to maintain viable populations of CHS in the Willamette Basin.

ODFW Policies

Native Fish Conservation Policy (OAR 635-007-0502 through -0506): The Oregon Fish and Wildlife Commission have approved the NFCP. This document provides interim direction until a species conservation plan is completed. The NFCP defines ODFW's

principal obligation for fish management as the conservation of naturally-produced native fish in the geographic areas to which they are indigenous. The policy is based on the concept that locally adapted populations provide the best foundation for maintaining and restoring sustainable naturally-produced fish. The NFCP requires a conservation plan for each native stock within each Species Management Unit (SMU). The ODFW completed an Oregon Native Fish Stock Status Report in 2005. Information in the document will be used for the development of conservation plan as part of the NFCP. The conservation plan shall illustrate the responsible use of hatchery-produced fish within the SMU.

Hatchery Management Policy (OAR 635-007-0543 though -0548): This policy provides guidance for the responsible use of hatchery-produced fish. The policy outlines the best management practices for hatchery programs to ensure conservation and management of both naturally-produced native fish and hatchery produced fish in Oregon.

Table 3.1-1. BiOp and Recovery Plan Actions (Note: This table is for informational purposes only. The actual documents should be consulted for the full context and meaning of the RPA, Recovery Plan, and Proposed Action.).

Proposed Action (PA)	Recovery Plan Goals and/or Reasonable and Prudent Alternatives (RPA)	Timeframe
Continue use of McKenzie (stock 023), CHS.	Recovery Plan (229-SUB-MK); BiOp (RPA measure 4.1, 6.1.5, and 6.2.3 adult Chinook outplanting; 6.2.2 genetically integrated management; and 9.5.1 RM&E): use McKenzie stock to help re-establish production above Cougar Dam.	Immediate/ongoing
Continue collecting McKenzie CHS broodstock at McKenzie Hatchery; supplement the unclipped portion at McKenzie Hatchery with fish from Leaburg Dam, if necessary.	Recovery Plan (229-SUB-MK); BiOp (RPA measures 4.1, 6.1.5, and 6.2.3): use McKenzie stock to help re-establish production above Cougar Dam.	
Continue to collect McKenzie broodstock throughout the run to ensure the hatchery population is similar to the naturally-spawning population.	Recovery Plan; BiOp (RPA measures 4.1, 6.1.5, 6.2.3, 6.2.2, and 9.1.5): It will be important to maintain similarities between the hatchery and wild population in the near term.	Immediate/ongoing

Proposed Action (PA)	Recovery Plan Goals and/or Reasonable and Prudent Alternatives (RPA)	Timeframe
Integration levels averaging a minimum of 5-10% will be used to maintain heterozygosity of the hatchery stock, avoid genetic drift, and meet mitigation and conservation supplementation goals when the minimum natural-origin run size exceeds 650 CHS annually.	Recovery Plan (RP Action ID - 230-SUB-MK; 10-ESU-ADM; 22-ESU-ADM): 1) Integration is needed to help increase PNOB and PNI in the population. 2) HMP integration goals: Maintain production goals and run characteristics through integration of natural-origin broodstock of between 5 and 10%. If it is determined that run characteristics cannot be maintained, collect additional natural-origin adults from the Leaburg Fish Ladder for incorporation into the broodstock. Specifics of collection and integration rate will be determined on a case-by-case basis.	Immediate/ongoing
	3) Conduct scientific review of current UWR hatchery programs and develop recommendations for achieving a conservation (reintroduction) hatchery program or suite of strategies that promotes and maintains a locally adapted population in the short term (until other LFT conditions are improved), and how to maintain VSP attributes and recovery goals. Fund and implement conservation and outplanting programs that maintain genetic diversity of local broodstock and manage the composition of natural spawners to meet conservation and recovery goals; monitor and evaluate implementation of actions through the end of the ESA take coverage period.	
Continue to use random spawning protocol with a 1:1 male-to-female ratio for McKenzie CHS.	Protocol as noted. ODFW will work with NMFS if spawning protocols are changed to reflect emerging science on pairing consistent with programmatic goals outlined in this HGMP.	Immediate/ongoing
Continue to adipose fin-clip and otolith mark (as needed) all CHS produced by McKenzie Hatchery.	Recovery Plan: (RP Action ID - 29-ESU-ADM; 30-ESU-ADM) BiOp (RPA 6.1.3) needed to implement harvest management program, and assess pHOS trends, and for eventual reintroduction of natural-origin only fish.	Immediate/ongoing
Insert CWTs or other tagging as needed into juvenile hatchery fish from McKenzie Hatchery in addition to current practice of adipose fin-clipping and otolith marking.	Recovery Plan (30-ESU-ADM, 29-ESU-ADM) and BiOp (RPA 6.1.3): Continue to mark all hatchery fish releases in the Willamette Basin with an adipose fin-clip and otolith mark; CWTs (or blank tags if appropriate) or Passive Integrated Transponder (PIT) tags are inserted into a proportion of all hatchery CHS released into the McKenzie Basin to confirm origin and support RM&E needs.	Immediate/ongoing

Proposed Action (PA)	Recovery Plan Goals and/or Reasonable and Prudent Alternatives (RPA)	Timeframe
Reduce the pHOS level in the McKenzie River spring Chinook population to less than 10% in the entire McKenzie subbasin, excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam.	BiOp (RPA 6.1.4) actions and recovery plan recommendations to reduce pHOS: USACE and BPA will fund (subject to available funding) the design and construction of hatchery improvements. Reduce hatchery production to 604,750 to decrease the number of hatchery-origin fish spawning in the wild. Reduce total hatchery production when productivity of the natural-originpopulation improves. Implement technologically feasible, biologically, and cost-effective passage actions at Cougar Dam to restore productivity in blocked habitats above the project. ODFW will attempt to remove at least 100 hatchery adults from the Leaburg Dam ladder trap. This operation will be conducted only when counts at Leaburg Dam show that hatchery fish make up more than 50% of the daily count of spring Chinook, to limit handling effects on natural origin fish. Enhance habitat productivity in other areas of the McKenzie River to improve spawning and rearing areas. The intended effect of these efforts is to reduce the overall pHOS level of the spring Chinook population to less than 10%. Status will be reviewed and any subsequent actions determined, if needed, once the above actions have been completed.	
Continue the CHS Reintroduction/Outplant Program and evaluate long-term feasibility of establishing viable populations in historic habitats in the South Fork McKenzie above Cougar Dam.	Recovery Plan: (RP Action ID - 212-SUB-MK; 215-SUB-MK; 229-SUB-MK) adapted from Appendix E of Plan BiOp: (RPA 4.1, 6.1.5, 6.2.3, 4.10, 4.11, 4.12, 4.12.1, 9.3, and 9.5.1).	Immediate/ongoing Immediate/ongoing
Collect, hold, transport, and release outplanted fish in a manner that increases the likelihood for spawning success.	Recovery Plan: (RP Action ID 229-SUB-MK) BiOp: (RPA 4.3) Implement best management practices for optimal handling, sorting, and release to support successful research, monitoring, evaluation, and reintroduction. Protocols will be documented in the annual Willamette Fish Operations Plan (WFOP).	Immediate/ongoing

Proposed Action (PA)	Recovery Plan Goals and/or Reasonable and Prudent Alternatives (RPA)	Timeframe
	Work with USFS, Services (NMFS and USFWS), ODFW, and WATER to prioritize, design and construct each release site, which may include infrastructure to minimize stress and injury of adults.	Construction completion June 2013
Ensure that outplanted fish represent the life history characteristics of the natural population and promote successful production.	Meet integration goals to maintain population run timing, and size and age at maturity.	Immediate/ongoing

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

Cooperative Agreement between the USACE and the State of Oregon (ODFW) for the Operation and Maintenance of Willamette Valley, Cole Rivers, and Bonneville Hatcheries within the USACE, Portland District Hatchery Mitigation Program (Cooperative Agreement; USACE and ODFW 2012).

McKenzie Hatchery is one of several hatcheries funded by the USACE to mitigate for the loss of natural spawning, feeding, and rearing grounds for fish caused by construction of multi-purpose dams and reservoirs in the Willamette Valley. The Cooperative Agreement identifies maximum production levels. The Cooperative Agreement between ODFW and USACE outlines the process and considerations for reviewing and adjusting (as appropriate) mitigation production levels. Adjustments will be considered to: reduce and minimize effects on ESA-listed fish; meet mitigation program goals, adjusted to account for fish passage improvements, and comply with ESA, and support ESA-listed fish re-introduction efforts above WVP dams. The Cooperative Agreement also provides for evaluation of the hatchery program through Corps-funded RM&E.

Eugene Water and Electric Board FERC License # 2496.

This license mandated improvements to the fish ladders at Leaburg Dam, but did not require construction of fish trapping facilities at these two fish ladders. The license also mandated the screening of Walterville Canal to increase the survival rate of natural-origin CHS juveniles.

The Individual NPDES Permit for McKenzie Hatchery issued by the ODEQ, to comply with the federal Clean Water Act.

3.3) Relationship to harvest objectives.

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

Spring Chinook salmon fisheries occur during the spring and summer in the lower mainstem Columbia River including select-area fisheries, mainstem Willamette River, and the McKenzie River. Oregon Department of Fish and Wildlife implemented selected fisheries on marked hatchery CHS beginning in 2001. The fisheries target fin-marked hatchery fish only. The fishery management strategy is discussed in detail in the Fisheries Management and Evaluation Plan (ODFW 2001a). In 2012, the McKenzie Hatchery program along with other Willamette Basin hatcheries contributed to a total commercial and sport harvest of over 21,000 CHS below Willamette Falls including over 17,000 in the lower Willamette River. Approximately 7,500 adults were harvested in upper Willamette River sport fisheries, including an estimated 1,358 adult CHS were harvested in the McKenzie River recreational fishery in 2012 (FMEP 2013).

3.4) Relationship to habitat protection and recovery strategies

General Habitat Restoration Strategies. ODFW works with land and resource management agencies, landowners, and other environmental interest groups (such as watershed councils) with a goal to ensure the maximum available protection to fish habitat is applied. Habitat protection and improvement supports management strategies, resulting in benefits to both hatchery and wild CHS populations. Hatchery fish have an important role in ongoing ESA conservation and recovery planning efforts in the basin (e.g., adult outplanting/reintroduction, juvenile releases above Cougar Dam and, when surplus hatchery fish are available, above Trail Bridge Dam).

Eugene Water and Electric Board (EWEB) recently built or rebuilt several fish passage or fish protection structures at their hydroelectric facilities on the McKenzie River. The improvements include a new fish screen for the Walterville hydroelectric diversion canal; rebuilding the tailrace barrier at the Walterville Canal; building a new tailrace barrier at the Leaburg Powerhouse; and repairing both fish ladders at the Leaburg Dam. These improvements are anticipated to benefit both hatchery and natural-origin CHS populations. A fish ladder will be constructed at Trail Bridge Dam as part of the FERC Carmen-Smith relicensing process. The license settlement identifies 100% screening of the turbine flows to NMFS criteria along with other prescriptive passage and protection measures.

3.5) Ecological interactions.

Releases of hatchery CHS could potentially increase negative ecological interactions with naturally rearing salmonids from McKenzie Hatchery downstream, including natural-origin CHS and winter steelhead. These potential interactions, discussed previously in Section 1.10, are recommended to be considered as minimal threats when compared with other limiting factor threats in the McKenzie River Subbasin and mainstem Willamette in the Recovery Plan and do not rank as either primary or secondary threats; however,

information available to quantify hatchery fish/wild fish interactions is lacking.

SECTION 4. WATER SOURCE

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

Water rights for McKenzie Hatchery total 31,500 gallons per minute (gpm) from two sources: 1) the McKenzie River, and 2) Cogswell Creek. The McKenzie River right is for 50 cubic feet per second (cfs) and delivered through the Leaburg Canal. There are two water rights for Cogswell Creek, a 5 cfs water right with 1936 priority date and a 15 cfs water right with a 1972 priority. All raceways are supplied with single-pass water. Cogswell Creek use normally does not surpass 5% of total use throughout the year, including during adult collection. Water temperature (Table 4.1-1) can be slightly altered with chilled water during egg incubation while otolith marking is being conducted. Water quality remains high throughout the year with problems only during flood events.

Table 4.1-1. Monthly Average (°F) Water Temperature at McKenzie Hatchery 2001-2011.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp	41.4	41.6	43.0	45.9	49.4	53.3	58.1	57.3	53.9	49.9	44.5	41.5

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.

McKenzie Hatchery's main intake is on the Leaburg power canal and operated by EWEB. This water source is screened two miles upstream at Leaburg Dam on the McKenzie River before reaching the hatchery intake. Risk to listed fish is low because the screens comply with NFMS fish screening criteria (NMFS 2011). In addition, ESA-listed fish are not present in Cogswell Creek. While no ESA-listed fish are present in Cogswell Creek, there are native migratory fish present in Cogswell Creek that may be entrained into the water diversion.

The water supply is occasionally at risk of dewatering due to maintenance operations needed by EWEB. The risk to hatchery fish and natural-origin broodstock would be reduced if a backup water supply was available to the hatchery during the summer. During the winter, water supplies can be supplemented from Cogswell Creek. During replacement of Leaburg screening facilities in 2003, flows in Leaburg Canal were substantially reduced. During this period hatchery needs, primarily to attract and hold adults, were met by temporarily pumping 30-50 cfs from the drawn-down canal. While temporary pumping can generally supply the quantity of water needed, water temperatures in the drawn-down power canal may be suboptimal, especially during warm

summer periods. In 2003, prespawning mortality was 39% versus a norm of 9% because of the warmer water temperature. To minimize loss of broodstock, most production was transferred to other facilities. When EWEB shuts off the canal in high water events, local inflow is adequate to replace the quantity needed for hatchery operations.

Hatchery effluent at the McKenzie Hatchery is mitigated by a pollution abatement pond. The pond is cleaned periodically when capacity is about 25% full (once every 2-3 years). McKenzie Hatchery is currently under the Three Basin NPDES permit with no effluent violations. A new NPDES permit was implemented in July 2007. As a result of the abatement pond and requirements under the NPDES permit, the risk of hatchery effluent resulting in take of listed species is considered to be low.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Brood Collection at McKenzie Hatchery: Broodstock enter the McKenzie Hatchery fish ladder from the river and navigate 12 jump steps where they then advance 100 ft. to the next 5 jumps, allowing passage under Greenwood Drive. From this point they move upstream 50 yards and make a final jump over a finger weir into the collection channel. The collection channel is located at the downstream end of the holding ponds. From here the fish are crowded into the spawning building using a power crowder. A lift brings the fish up to two holding tanks where they can be anesthetized. The fish then can be handled for sorting, inoculation, transport, or placement into the holding ponds for broodstock.

The USACE and BPA, in coordination with ODFW, propose to improve homing and attraction at McKenzie Hatchery by increasing the use of local Cogswell Creek water in incubating, rearing and adult collection facilities. The water supply improvement project was funded in FY 15 and scheduled to begin construction in FY16.

Brood Collection at Leaburg Dam Ladder: ODFW will consider collection of natural-origin adult Chinook salmon from the left bank fish ladder at Leaburg Dam if monitoring results demonstrate need for higher integration levels of the natural-origin component of the broodstock. Collection from the ladder has proven to be effective in the past for supplementing the natural-origin component of the broodstock, but is labor intensive and has associated risks. These risks include handling stress from trapping too many fish in the ladder section. In addition, this technique temporarily disrupts the upstream migration of fish using the ladder and results in some fish backing out of the ladder as the water is drained. Natural-origin adults that volunteer to the hatchery will be used for brood. However, if monitoring results detect measurable reductions in heterozygosity or increased genetic drift, than broodstock may be collected from the Leaburg Ladder for incorporation into the broodstock. Specific needs will be determined on a case-by-case basis and coordinated and concurred by NMFS' Propagation and Inland Fisheries Branch staff prior to implementation.

Removal of hatchery-origin fish at Leaburg Dam Ladder: Hatchery salmon and steelhead may be trapped and removed from left bank fish ladder at Leaburg Dam to reduce hatchery fish straying upstream of Leaburg Dam. Trapping may occur only after the peak of the natural-origin CHS migration in May through early July has passed Leaburg Dam. The intent of this effort would be to remove the later arriving hatchery CHS that have been observed migrating past Leaburg Dam in July through September to further reduce pHOS in the McKenzie Subbasin. In recent years, from zero to 100 hatchery CHS have typically been trapped and removed at Leaburg Dam. The preliminary target would be to trap and remove approximately 100 hatchery CHS at Leaburg Dam. The specific plans for operation of the trap at Leaburg Dam will be submitted by USACE, BPA, and ODFW to NMFS. Written concurrence by NMFS' Propagation and Inland Fisheries Branch staff of the specific plans is required before implementation.

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

McKenzie Hatchery has a liberation tank truck (purchased in 2005) with a 1,500-gallon capacity. While broodstock is generally collected and spawned on-site, this unit can haul up to 130 adult CHS. For outplanting, approximately 75 fish per load are hauled following the outplanting protocol described in Section 15. Fish are anesthetized with Tricaine Methanesulphonate (MS-222), and manually loaded into a polyvinylchloride (PVC) pipe attached to the transport truck.

5.3) Broodstock holding and spawning facilities.

The adult holding ponds at McKenzie Hatchery consist of two concrete ponds, each of which is 30 ft. by 135 ft. Each pond is divided into two separate holding areas with aluminum fencing. The aluminum fencing is also used to keep the fish away from the area of incoming water, which minimizes injuries from attempts to jump into the incoming water stream. The holding ponds have a spray system that is used for treatment of the water for fungus control.

Adults held for broodstock are selected for mating by removing fish from anesthetic tanks to a stainless steel table. Spawning ripeness is determined, and the fish is either humanely killed or placed into a tube where it slides back to the holding pond. Fish killed for spawning are bled, rinsed off with water and then placed on stainless steel racks prior to egg taking and fertilization.

5.4) Incubation facilities.

Incubation facilities consist of 38 full stacks of vertical tray incubators (640 trays). Dual water supplies are available from either the McKenzie River or Cogswell Creek, and can be isolated from each other. The two water supplies are used independently for incubation. A water chiller cools a limited amount of water for otolith marking.

5.5) Rearing facilities.

Rearing facilities at McKenzie Hatchery include eight Canadian troughs of 89 cubic ft. each, and 30 concrete raceways with a volume of 3,338 cubic ft. each.

5.6) Acclimation/release facilities.

All fish produced for release in the McKenzie River are currently reared, acclimated, and released at McKenzie Hatchery. Fish are reared within hatchery raceways that drain into the fingerling release pipeline. This pipeline then flows directly into the McKenzie River via the fish ladder.

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

Flood events can cause operational difficulties due to damage to intake structures by heavy debris and by causing heavy silt loads in the water supply. Flood events necessitate increased monitoring (i.e. manual operation) of the water supply intakes or strainers in the incubation building. Normally flood events do not result in significant fish mortality. As described previously, maintenance or emergency operations that reduce flows in the Leaburg Power Canal can adversely affect the hatchery water supply. In 2003, this resulted in higher than usual adult holding mortality during the summer and the need to transfer some production temporarily to other facilities.

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

The hatchery is staffed full-time. The water system is equipped with a low-water alarm system to help prevent catastrophic fish loss resulting from water system failure. A backup generator is in place. Equipment is disinfected before and after each use as a measure to prevent contamination or horizontal transmission of pathogens. Fish health is examined regularly by ODFW's fish health specialist and treated whenever necessary, to prevent transmission of diseases to the watershed.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

6.1) Source.

Broodstock for the McKenzie River CHS program is collected from adult Chinook salmon returning to McKenzie Hatchery. Hatchery fish returning to the collection

facility are mixed and randomly selected for spawning. Natural-origin fish volunteering to the hatchery are incorporated into the broodstock (see Section 6.2.3). The natural-origin component of the broodstock may be supplemented with adults captured at the Leaburg Dam left bank fish ladder if determined necessary to maintain heterozygosity, reduce domestication effects, and/or avoid genetic drift (see section 5.1 for further details). If additional natural-origin salmon are needed for broodstock, it is anticipated that only males would be collected to allow their subsequent release following spawning. However, the specific details will be developed on a case-by-case basis and based on monitoring results and integration levels.

6.2) Supporting information.

6.2.1) History.

The broodstock for the McKenzie River CHS hatchery fish originated primarily from adult returns to the McKenzie River basin. However, Middle Fork Willamette and other Willamette River stocks have been incorporated into McKenzie Hatchery broodstock over the years, and there is evidence that strays from other hatcheries were incorporated into the broodstock in the past. An ODFW document (author and date unknown) indicates the following:

"in some years from 1908-1938, the egg-take station for McKenzie Hatchery was located at or below the confluence with the McKenzie and Willamette Rivers. Willamette and McKenzie stocks were likely mixed on several occasions."
"… The 1953 brood reared and released at McKenzie Hatchery contained 30 percent Middle Fork Willamette stock."
"From 1965 to 1975, almost every brood was comprised of or supplemented by stocks transferred into McKenzie Hatchery or the McKenzie River from other Willamette stations:

1965 – No egg take at McKenzie, unknown egg source, probably Dexter.
1966 – Got eggs from Dexter.
1967 – Got adults from Cougar, eggs from Dexter.
1968 – Got fry from Oakridge.
1969 – Got adults from Dexter, about 1/3 of the juveniles released were Dexter stock.
1970 – Adults shipped in from Dexter.
1971 – Adults shipped in from Fall Creek (Willamette stock) mixed with adults from McKenzie.
1972 – Adults from McKenzie and Fall Creek (Willamette); Leaburg Hatchery reared and released mixture of McKenzie and Marion Forks stocks.
1973 – Adults from McKenzie, Dexter, and Fall Creek (Willamette).
1974 – Unknown adult source; eggs came in from Oakridge.
1975 – 1.2 million eggs came in from South Santiam.

On October 3, 1969, Dale Hagey (EWEB biologist) collected 80 vertebral cores from salmon in the reach from Leaburg Dam to Greenwood Drive. Analysis of oxytetracycline

(OTC) marks on the cores showed that 48.7% of these spawned carcasses returned from releases of Middle Fork stocks below Dexter Dam.

Adults returning to McKenzie Hatchery in 1978 bore marks which, when expanded by known ratios of marked to unmarked fish, indicated that 25% of the spawners originated at other hatcheries (this is a minimum percentage, since not all hatcheries had marked groups out).

In the past, a portion of the McKenzie production was shipped to other hatcheries for a portion of the rearing. From 1990 to 1992, a portion of eggs were transferred to and reared at Marion Forks Hatchery. In 1993, two batches of eyed eggs were transferred; one group went to Marion Forks Hatchery (320,000), and the other went to Willamette Hatchery (432,000). Those eggs transferred and reared at Marion Forks were later returned to McKenzie Hatchery as fry. From 1993 to 1999, a portion (typically about 320,000) of each annual brood has been transferred to Willamette Hatchery and reared through smolt stage. Since 1999, McKenzie Hatchery has reared and released all production on station.

Since at least 1990, broodstock for the McKenzie River CHS hatchery program has been derived entirely from CHS collected at McKenzie Hatchery and on occasion at Leaburg Dam. Refer to Table 6.2.3-1 for details regarding adults collected and spawned.

Ever since the listing of Upper Willamette spring Chinook salmon ESU in 1999, collection of broodstock for the McKenzie Hatchery required only locally returning CHS to the McKenzie River be used (NMFS 2000; NMFS 2008). Only McKenzie River CHS have been used for the hatchery program.

6.2.2) Annual size.

Adult collection goals are based upon conservation/enhancement objectives and annual production goals for the McKenzie subbasin, and anticipated mortality at the egg/juvenile stages and adult holding mortality losses. For releases from brood years 2014 through 2016, the smolt release goal is no more than 604,750 fish. This equates to an annual broodstock size of 450 fish (225 females).

To satisfy smolt production of 787,000 fish annually for the McKenzie Hatchery, the current green-egg take goal is approximately 1,260,000 eggs based on 4200 eggs per female. This equates to a broodstock collection goal of approximately 600 adult fish (300 females and 300 males).

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

Adults collected for broodstock have included both naturally-produced and hatchery-origin fish. The 1998 Willamette Basin Fish Management Plan called for incorporating 10-25% natural-origin fish into annual broodstock (ODFW 1998); however, since 2006, the minimum goal of 10% was only met in a single year (i.e., 2006; Table 6.2.3-1). In other years, the proportion of natural-origin fish incorporated in the hatchery broodstock

has ranged from 1.2 -7.9% of the broodstock (Table 6.2.3-1). In 2013-2015, no natural-origin fish were incorporated into the broodstock.

The natural-origin fish integration rate for the McKenzie Hatchery is an average rate of 5 to 10% to maintain heterozygosity of the hatchery broodstock, reduce domestication effects, minimize genetic drift, and limit the impact of take on natural-origin spring Chinook to 2% of the expected run each year. The 5-10% level of integration was determined, through genetic modeling, to adequately maintain heterozygosity and allelic richness in the wild and hatchery spring Chinook populations of the McKenzie River (Johnson and Friesen 2013). ODFW will incorporate wild McKenzie spring Chinook into the broodstock in years that the expected run of wild adult spring Chinook into the McKenzie is greater than 650 fish. An adult run size of 650 fish approximates an effective population size of 500 fish (based on Waples 1990). An effective population size of 500 can be expected to retain enough genetic variation so as to preserve long-term adaptive potential (Allendorf et al. 1997; Williams et al. 2008). Between 2006 and 2012, the integration rate was approximately 5%, using only natural-origin adults that volunteered to the hatchery (Table 6.2.3-2).

The percentage of unclipped adults in the McKenzie Hatchery trap has been estimated at below 5% and approximately 60 - 80% of these unclipped fish (based on otolith analyses) are of hatchery origin (K. Kremers, personal communication). Differentiation of natural-origin adults from unclipped hatchery adults at the hatchery is through the extraction and analysis of the otolith which precludes ODFW's ability to return to the river unclipped fish that are of natural origin and retain unclipped hatchery fish – both must either be retained or released. In those years that the expected number of unmarked natural-origin adults that volunteer to the hatchery will be greater than 2% of the expected run of natural-origin spring Chinook, and the run is expected to produce more than 650 natural-origin adults, ODFW will incorporate all unmarked fish that volunteer to the hatchery into the broodstock. Passage counts at Leaburg Dam through early July will be used to project run strength. This practice will serve to reduce potential genetic impacts from unmarked hatchery fish that would otherwise spawn in the wild. All unmarked adults that volunteer to the hatchery will be incorporated into the hatchery broodstock unless the expected natural-origin run is 650 fish or less. In years when less than 650 natural-origin Chinook are expected, all unmarked fish that enter the hatchery will be released back into the McKenzie River. During small run years (<650 natural-origin adults), demographic risks to the wild population from integration would very likely be greater than genetic risks posed by unmarked hatchery fish released to the river.

The integration goal defined above will be assessed periodically. Based on RM&E results, the integration target could be adapted to ensure that the hatchery program can meet its goals for mitigation and conservation. If higher levels of natural-origin integration are determined to be necessary, capturing natural-origin adults at Leaburg Dam may be appropriate to achieve those levels. The thresholds of a run of no less than 650 and mining of no more than 2% of the run will still apply.

Table 6.2.3-2 reports estimated proportion of natural-origin broodstock incorporated into the hatchery broodstock from 2006 to 2012 as verified by otolith analysis. No natural-

origin adults were incorporated into broodstock in 2013-2015. All unmarked adults returning to the hatchery were recycled back to the McKenzie River.

Table 6.2.3-1. Adult spring Chinook salmon returns to McKenzie Hatchery, fish used for broodstock, eggs transferred, and fry ponded (1994-2013)

Brood Year	Adults Entering McKenzie Hatchery [1/]	Adults Spawned			Egg Take (in 1,000s) [3/]	Egg Transfers (in 1,000s)	Fry Ponded	Live-Out
		Males [2/]	Females	Spawning Ratio (M:F)				
1994	702	176	186	0.95	809	0	660	0
1995	1,135	455	461	0.99	1,915	370	1,150	0
1996	1,573 [4/]	484	487	1.00	2,059	311	1,415	122
1997	1,546 [5/]	591	617	0.96	2,805	330	1,826	263
1998	1,690	493	506	0.97	2,351	312	1,625	535
1999	2,279	658	673	0.98	2,677	435	1,497	793
2000	3,553	452	450	0.99	1,851	3	1,380	1,863
2001	3,920	432	542	0.80	2,503	9	1,488	2,116
2002	6,832	500	500	1.00	2,289	1	1,388	4,611
2003	6,260	499	510	0.98	2,407	0	1,425	3,155
2004	6,647	492	497	0.99	2,111	179	1,350	3,695
2005	3,256	541	541	1.00	2,214	0	1,463	979
2006	3,118[6/]	490	490	1.00	2,138	0	1,347	1,399
2007	2,530[7/]	510	510	1.00	2,237	64	1,370	1,083
2008	3,036[8/]	651	651	1.00	3,195	1,268	1,376	1,218
2009	3,735	556	556	1.00	2,473	359	1,630	1,591
2010	6,974	798	798	1.00	3,382	744	1,622	1,597
2011	5,998	797	797	1.00	3,675	1,144	1,581	N/A
2012	3,951	802	802	1.00	3,415	1,071	1,673	1,604
2013	2,560	495	495	1.00	2,261	1,040	899	N/A

[1/].[4/] In 1996, 50 adults were transferred from Leaburg Dam to McKenzie Hatchery.
[5/] In 1997, 26 adults were transferred from Leaburg Dam to McKenzie Hatchery.
[6/] In 2006, 92 adults were transferred from Leaburg Dam to McKenzie Hatchery.
[7/] In 2007, 139 adults were transferred from Leaburg Dam to McKenzie Hatchery.
[8/] In 2008, 229 fish were transferred from Leaburg Dam and Hatchery to McKenzie Hatchery.
[9/] In 2009, 150 fish were transferred from Leaburg Hatchery
[10/] In 2010, 127 fish were transferred from Leaburg Hatchery.
[11/] In 2011, 65 fish were transferred from Leaburg Dam and Hatchery

Table 6.2.3-2 Estimates of the Proportion of Natural-origin Broodstock (pNOB) at McKenzie Hatchery, 2006 - 2012.

Year	Natural-origin CHS Broodstock	Hatchery-origin CHS Broodstock	pNOB
2006	100	891	0.101
2007	81	939	0.079
2008	90	1,176	0.071
2009	52	1,060	0.047
2010	22	1,574	0.014
2011	75	1,594	0.045
2012	49	1,560	0.030
Average			0.051

6.2.4) Genetic or ecological differences.

Using genotypic data for 13 microsatellite markers, Johnson and Friesen (2012) found no significant genetic difference between hatchery and natural-origin spring Chinook sampled in 2011 from the McKenzie River (H_0: $\theta = 0$; $p > 0.05$). Johnson and Friesen (2012) also found no evidence for positive selection on four immune-relevant loci (Tonteri et al. 2008), as allele frequencies at these markers were very similar for the McKenzie hatchery and natural-origin CHS populations.

Genetic similarity between the McKenzie hatchery and CHS populations is not surprising in view of the facts that 1) the hatchery brood stock was founded by local, spawners; 2) fish have been regularly integrated into the hatchery brood stock and; 3) a proportion of hatchery-origin fish spawn in the wild.

However, genetic similarity achieved through brood stock integration may not fully mitigate negative effects of hatchery fish on the natural population. Chilcote et al. (2011) found no difference between integrated brood stock programs and segregated brood stock programs in terms of their relative impact on population intrinsic productivity, leading the authors to conclude that integration may not be an effective means to eliminate the impact of hatchery programs on natural populations.

While ecological differences likely exist between hatchery and natural-origin McKenzie River CHS, a limited number of comparisons have been reported. Schroeder et al. (2001) found that juvenile sub-yearling Chinook salmon released in the fall from McKenzie Hatchery tended to migrate past Willamette Falls earlier than similarly aged fish that had been tagged at Leaburg Dam. Cannon et al. (2010) found that adult run timing differed slightly between adipose fin-clipped and unclipped McKenzie River Chinook salmon, as clipped fish appeared to present a stronger late (September) passage peak at Leaburg Dam than unclipped fish.

Banks et al (2013) investigated differences in recruit per spawner (RS) between hatchery and natural-origin Chinook outplanted upstream from Cougar Dam. The mean RS of

natural-origin Chinook was less than that of hatchery origin Chinook, though they also observed a significant interaction between *sex* and *origin*. An interaction plot indicated that the mean RS for natural-origin males was greater than hatchery origin males, whereas the mean RS for hatchery females was greater than natural-origin females (Figure 6.2.4-1).

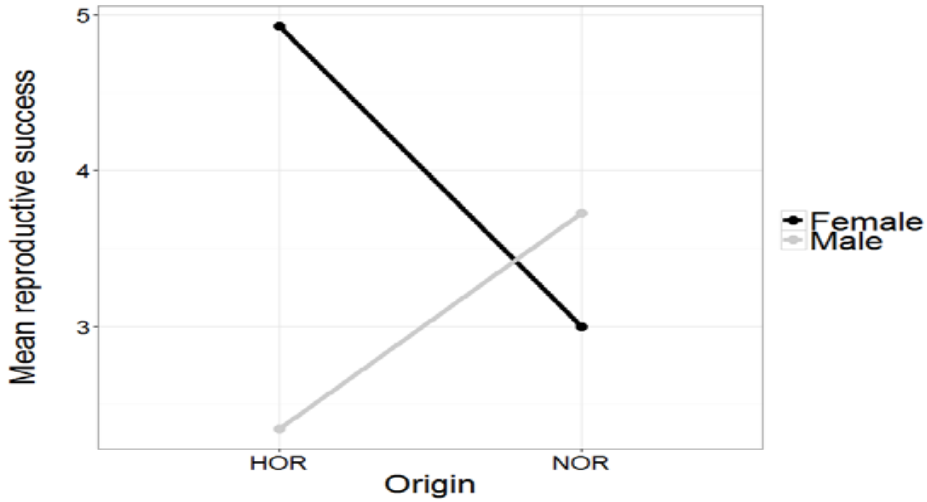


Figure 6.2.4-1. Interaction plot describing the differences in mean reproductive success between HOR and NOR for each sex. (HOR – hatchery origin; NOR – natural origin)

6.2.5) Reasons for choosing.

McKenzie River CHS were chosen as the optimal brood source for the McKenzie hatchery program because they were indigenous to the basin and therefore believed to be the best locally adapted stock available for hatchery production.

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.

The use of McKenzie River stock (random selection, brood taken throughout the run period, egg takes throughout spawning period) and integration of natural-origin adults will reduce adverse genetic or ecological effects, avoid genetic drift, and maintain genetic diversity and similarity of the hatchery stock to natural-origin CHS. All unclipped adult CHS entering the McKenzie Hatchery will be incorporated into the broodstock. These fish are often mismarked hatchery fish, as shown by otolith marks. Hatchery-origin adults in excess to broodstock needs are outplanted in efforts to evaluate the potential for restoring self-sustaining populations of naturally produced CHS upstream of Cougar Dam (see attached draft McKenzie re-introduction plan).

SECTION 7. BROODSTOCK COLLECTION

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

Returning adults (and jacks) are collected and spawned for broodstock.

7.2) Collection or sampling design.

Adults used for broodstock purposes are collected throughout the run from May to October. The hatchery trap is operated continuously; fish are incorporated into the broodstock in approximately the same distribution as they arrive at the trap, including late-arriving fish in September. Fish from all portions of the run are used in the broodstock. Fish returning to the collection facility are mixed and randomly selected for spawning when they are ripe. Adults arriving at McKenzie Hatchery in excess of broodstock needs will be outplanted in accordance with Section 15, of the CHS outplanting protocols addendum.

Currently, natural-origin fish incidentally entering the McKenzie Hatchery trap are incorporated into the broodstock. Given this protocol for broodstock incorporation, it is estimated that the actual level of natural-origin fish in the broodstock will be approximately 5% annually (see Section 6.2.3). Once escapement targets have been met (>650 natural-origin CHS returning to McKenzie River as indexed by Leaburg Dam counts), additional natural-origin fish may be incorporated into the broodstock at levels outlined in Section 6.2.3.

7.3) Identity.

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

Only one Chinook salmon population is present in the McKenzie River basin.

(b) Methods for identifying hatchery origin fish from naturally spawned fish.

All hatchery-origin CHS will be externally marked with an adipose fin clip and marked with an otolith marker. The fish at the McKenzie Hatchery are adipose fin-clipped using an automatic marking trailer, which is highly effective; nevertheless a small percentage (usually less than 5%) are mismarked or the adipose fin regenerates. In the past, a portion of each release group was wire tagged in addition to receiving the adipose and otolith marks. Beginning with the 2008 brood year, all fish were wire tagged for detection and separation of hatchery adults at the proposed Leaburg Sorting Facility; however, efforts to design and construct a sorting facility were determined to be infeasible by the Region and 100% wire tagging was discontinued for brood year 2010. Currently, a portion of each release group is wire tagged in addition to receiving the adipose and otolith marks. The internal wire tags and otolith marks allow verification of

hatchery- origin broodstock to compensate for error associated with adipose regeneration in some hatchery-origin fish (Table 6.2.3-1). Non-fin-clipped fish returning to the hatchery are checked for the presence of a wire tag. All three marks allow hatchery-origin fish to be distinguished from naturally spawned fish. If needed to assess integration levels or recycling needs, "real-time" genetic identification may be considered as a means of distinguishing unmarked hatchery adults from natural-origin adults.

7.4) Proposed number to be collected.

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

The McKenzie Hatchery goal is to have a maximum broodstock population of approximately 520 fish for spawning, including approximately 260 males and 260 females, with a 1:1 male-to-female spawning ratio depending upon the run size (IHOT 1994). For the smolt releases from brood years 2013-2017, the broodstock goal is up to 450 fish for the production of up to 604,750 fish released annually.

Table 7.4-1. Maximum Adult Requirements for Broodstock and Outplanting

Minimum Escapement to McKenzie Hatchery [1]	Males	Females	Total
McKenzie mitigation brood need	260	260	520
Outplant Upstream of Cougar Dam as necessary	200	400	600
Total	460	660	1120

[1] Does not include adult holding mortality of 10%, or the increased number of adults needed due to the disproportionately low number of female to male hatchery adult returns. As a result the minimum number of adults was increased to 1416.

7.4.2) Broodstock collection levels for the last 12 years, or for most recent years available.

The past broodstock collection levels are provided in Table 7.4.2-1. The level of natural-origin fish integrated into the hatchery broodstock was presented in Table 6.2.3-1.

Table 7.4.2-1. Broodstock collection and production data for brood years 1988-2013.

Year	Adults				
	Females	Males	Jacks	Eggs	Juveniles
1988	1,089	1,647	30	1,553,110	1,073,520
1989	1,152	1,952	50	2,208,490	1,815,200
1990	1,156	1,980	59	1,300,430	1,075,470
1991	1,840	2,610	47	2,311,450	1,112,630

Table 7.4.2-1. Broodstock collection and production data for brood years 1988-2013.

Year	Adults				
	Females	Males	Jacks	Eggs	Juveniles
1992	1,410	1,931	33	2,458,400	1,809,580
1993	1,000	1,035	16	3,513,900	2,657,440
1994	310	385	7	809,240	592,240
1995	507	600	7	1,914,590	1,234,970
1996	732	824	17	2,059,000	1,357,750
1997	759	776	11	2,804,880	1,832,450
1998	811	849	30	2,174,900	1,597,880
1999	993	1,238	48	2,677,000	1,488,340
2000	1,584	1,921	48	1,850,880	1,329,330
2001	1,681	2,171	68	2,503,000	1,219,000
2002	3,000	3,768	64	2,289,000	1,263,900
2003	2,899	3,272	89	2,407,000	1,282,880
2004	2,718	3,885	44	2,111,000	1,237,150
2005	1,444	1,769	43	2,214,000	1,348,380
2006	1,076	1,924	26	2,138,000	1,302,300
2007	1,053	1,295	43	2,237,150	1,357,290
2008	1,171	1,591	45	3,194,940	1,359,800
2009	1,240	2,094	251	2,472,980	1,591,000
2010	2,790	3,864	193	3,381,820	1,597,300
2011	2,594	3,192	147	3,675,000	1,561,530
2012	2,038	1,735	100	3,415,000	1,604,000
2013	1,376	974	159	2,261,000	N/A

7.5) Disposition of hatchery-origin fish collected at the hatchery

Hatchery origin adults returning to the hatchery are allocated in accordance with ODFW's FHMP (OAR 635-007-0542 through 0548) as modified to in consideration of specific recovery plan recommendations and actions identified in the Willamette BiOp according to the following priorities:

1. Broodstock
2. Outplanting above Cougar Dam.
3. Outplanting above Trail Bridge Dam.

4. Provide fish for tribal ceremonial and subsistence use (specifics of the tribal allocations were provided in Section 7.4.1);
5. Outplanting into the Mohawk River;
6. Provide for experimental, scientific or educational uses identified in conservation plans, management plans or other Department agreements;
7. Provide for carcass sales to buyers to generate revenue for hatchery operations, as authorized in Fish Hatchery Management Policy (FHMP);
8. Place carcasses in natural spawning and rearing areas to enhance nutrient recycling, consistent with ODEQ requirements, management plans and pathology constraints identified in OAR 635-007-0549;
9. Provide fish to charitable food share programs benefiting needy Oregonians;
10. Provide fish for animal feed to animal rehabilitation shelters, zoos, or other such operations; and
11. Dispose of fish in a landfill or at a rendering plant.

The ODFW Fish Division may approve additional uses or deviations from the stated order of preference to satisfy agreements with management partners, respond to unique situations or respond to unforeseen circumstances. Outplanting needs to support passage studies and research are coordinated annually by Corps, BPA, USFWS, ODFW, and NMFS with recommendations from WATER's RM&E Oversight Team annual planning process to support ongoing mitigation and meet ESA conservation goals, consistent with survival and recovery of the ESU. Specific goals are identified in Table 7.4-1. The action agencies will document outplanting and broodstock numbers in the annual Willamette Fish Operations Plan (see Willamette BiOp 2008).

7.6) Fish transportation and holding methods.

Refer to sections 5.1, 5.2, and 5.3 for descriptions of handling, holding and transportation of broodstock.

Fish transport and holding methods will be documented in the annual Willamette Fish Operations Plan (see 2008 BiOp).

7.7) Describe fish health maintenance and sanitation procedures applied.

Upon collection, broodstock are anesthetized with MS-222 and injected with antibiotics (OTC and erythromycin) prior to placement in the holding pond. Broodstock are treated with hydrogen peroxide three days per week for fungus control. Ponds are inspected daily for mortality; dead fish are removed daily. Pathology checks health status monthly, and high water quality is maintained. If open wounds are present, iodophor is used as salve. If fish are being processed for transport to food share, then adults are handled with carbon dioxide.

7.8) Disposition of carcasses.

Spawned out carcasses are used for stream enrichment consistent with ODEQ requirements, management plans and pathology constraints identified in OAR 635-007-0549. Starting in 2009, all spawned out carcasses were used for stream enrichment in the upper McKenzie watershed. Spawned out carcasses may also be buried to a local landfill, if not suitable for stream enrichment due to concerns of pathogens.

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

CHS broodstock collection at McKenzie Hatchery occurs throughout the entire run, from May through October. Collection of brood fish is random, with sex ratio and timing representative of the run during trap operation.

Currently, most natural-origin fish incidentally entering the McKenzie Hatchery trap are incorporated into the broodstock, and some natural-origin fish arriving at the Leaburg Dam during the peak of the wild run in June may be used to increase the natural-origin broodstock component per guidelines outlined in Section 6.2.3.

The risk of adverse ecological or genetic effects to listed fish will be minimized by hatchery management practices described in this document and the FHMP (see Section 3.2). In addition, hatchery reform measures identified in Section 9 will be followed.

SECTION 8. MATING

8.1) Selection method.

Fish are selected and paired at random to minimize selective pressures from hatchery practices. Once collected for brood, unmarked and marked fish are spawned randomly, without respect to origin. Broodstock collection endeavors to represent the genetic variability of the stock by taking an unbiased, representative sample with respect to run timing, size, sex, age, and other phenotypic traits identified as important for long-term fitness (IHOT 1994). Recent science suggests that non-random mating may be preferable in some instances to mimic mate selection in natural-origin fish. Alternative mating strategies will be reviewed and implemented based on best available science to achieve program objectives. Only McKenzie CHS stock 023 are used for broodstock.

8.2) Males.

Males and females are randomly selected from the available broodstock. The typical sex ratio for this program is a 1:1 male-to-female spawning ratio. No backup males are used. Jacks are generally not used for spawning, because they tend to slip through the crowder bars and avoid capture during spawning activities.

8.3) Fertilization.

Broodstock are humanely killed and bled prior to spawning. Eggs from one female are fertilized with sperm from one male. Males are not re-used. Eggs from two females are placed in each Heath tray separated by a divider. Fertilized eggs are subjected to a 10-minute iodophore bath for disinfection in the Heath trays. Trays and egg batches are individually marked so eggs can be discarded if BKD tests are positive.

If the hatchery reduces the number of eggs retained below the amount of green eggs taken, a proportional amount of each male/female cross is culled so that the gene pool of the brood is representative of the parental stock. Exceptions may occur if there is a high degree of disease or epidemics associated with certain parents. If this occurs, offspring of diseased parents may be culled to maximize long-term survival of hatchery population without inherited diseases.

In addition to the Department-wide fish disease control and disease prevention programs, McKenzie Hatchery monitors fish health; apply therapeutic and prophylactic treatments, and sanitation activities (IHOT 1994).

8.4) Cryopreserved gametes.

No cryopreserved gametes are used for the McKenzie CHS (stock 023) program.

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.

The McKenzie Hatchery uses a random spawning selection and a 1:1 male-to-female spawning ratio to avoid intentional selection of physical characteristics such as run timing, age or size etc., to maintain genetic diversity in hatchery population. Sanitation and other preventive measures are taken to maintain fish health and prevent transmission of diseases during mating.

SECTION 9. INCUBATION AND REARING

9.1) Incubation.

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

See Table 6.2.1-1 for the number of eggs taken during 1990- 2011. Table 9.1.1-1 reports egg and fry mortality rates from 1988 through 2011.

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

This program takes additional eggs to ensure enough BKD negative eggs for production is achieved. Any excess eggs or BKD-culled eggs are disinfected and buried. Higher mortalities during egg shock starting in 2001 and continuing periodically has also accounted for additional eggs to be taken.

9.1.3) Loading densities applied during incubation.

The standard loading density per tray used during early incubation is all the eggs taken from 1-2 females of average fecundity, until the eyed stage. After the eyed stage, a loading density of 8,000 eggs per tray is used. Incubator flow is 4.5 gpm. Egg size is 84 eggs per ounce.

Table 9.1.1-1. Survival rates of spring Chinook from green egg to eye-up and ponding at McKenzie River Hatchery, 1988-2013.

Year	%Egg Loss	%Fry Loss
1988	10.7	1.0
1989	5.7	0.6
1990	6.7	1.1
1991	5.5	1.2
1992	10.6	1.4
1993	8.6	1.3
1994	16.1	2.8
1995	11.1	1.2
1996	5.1	1.0
1997	13.5	1.1
1998	10.4	1.8
1999	7.3	0.6
2000	10.5	0.9
2001	35.1	1.0
2002	11.9	1.1
2003	23.2	4.8
2004	9.6	2.9
2005	7.9	1.5
2006	28.9	3.3
2007	9.2	2.4
2008	8.6	1.1
2009	7.6	1.8
2010	27.1	1.4
2011	9.15	N/A
2012	23.3	1.4
2013	2.8	1.6

9.1.4) Incubation conditions.

Water temperatures are monitored with thermographs. Chilled water is used to otolith mark all fry. Silt management is accomplished by visual inspection and rodding of trays when needed. Cumulative temperatures are recorded daily.

Incubation trays consist of a slotted tray supported within a tray. Silt collects beneath the slotted trays holding the eggs. Metal rods located under these trays are used to manually agitate the silt and force it to drain out a stopper hole in the larger tray.

9.1.5) Ponding.

Button-up occurs from approximately 1,550 to 1,625 temperature units (TUs). A visual check is performed to determine degree of button-up (i.e. absorption of egg yolk sac following hatch). Ponding normally occurs from mid-December through January and is a forced ponding. Once ponded into Canadian troughs or directly into outdoor raceways, feeding is held off for 7 to 10 days for maximum absorption of yolk sac. Fish size at ponding is 1,250-1,325 fish/lb. Lengths are not measured at ponding.

9.1.6) Fish health maintenance and monitoring.

The McKenzie Hatchery is operated in compliance with ODFW's Fish Health Management Policy and the IHOT fish health guidelines.

Eggs are treated with formalin drip three times a week (1:600 for 15 minutes) for fungus control. Visual monitoring is conducted daily to detect disease or other problems. Eggs are shocked at approximately 550 TUs by pouring eggs from trays into baskets. Eggs are counted and picked by machine with some hand picking by the hatchery crew. Yolk sac malformation has not been a problem at McKenzie Hatchery.

All family egg groups are numbered and tracked throughout the incubation process. Risks are minimized through the use of water supply alarms and daily monitoring of eggs. Silt is removed by rodding of the trays.

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.

The protocols listed above to maintain survival across all stages of incubation are followed for eggs of hatchery and natural-origin fish. Maximum and unbiased survival is the goal for both hatchery and natural-origin stock. Consequently, all eggs are handled in a manner to reduce any adverse effects, including differential survival (as it pertains to selecting for traits), altered water quality etc. The hatchery is staffed at all hours and alarms systems are in place to reduce the risk to both listed and non-listed fish due to water system failure.

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 twelve years, or for years dependable data are available.

Table 9.2.1-1 below reports survival rates of CHS at McKenzie Hatchery from fry to fingerling and fingerling to smolt for 1989-2010 brood years.

Table 9.2.1-1. Survival rates for CHS reared at McKenzie Hatchery, 1989-2013.

Year	Fry to Fingerling	Fingerling to Smolt
1989	99.4%	96.3%
1990	98.9%	94.7%
1991	98.8%	94.6%
1992	98.6%	93.8%
1993	98.7%	95.6%
1994	97.2%	92.9%
1995	98.8%	95 0%
1996	99.0%	96.3%
1997	98.9%	96.7%
1998	94.7%	97.0%
1999	99.4%	96.6%
2000	98.8%	96.1%
2001	96.6%	98.7%
2002	95.2%	98.4%
2003	95.2%	98.3%
2004	93.9%	98.7%
2005	94.2%	98.8%
2006	99.8%	95.8%
2007	98.9%	99.7%
2008	99.4%	99.3%
2009	98.3%	99.3%
2010	99.2%	99.1%
2011	98.5%	99.4%
2012	96.7%	98.9%
2013	98.3%	N/A

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

Rearing standard limits for Chinook salmon are 8 lbs./gpm and 1.23 lb./cu. ft. (IHOT 1993). Rearing density in 2001 ranged from 0.80 lb./cu. ft. to 1.11 lb./cu. ft. at release. Pounds per gallon per minute ranged from 5.75 to 7.45 at release.

9.2.3) Fish rearing conditions.

Water temperatures are recorded daily by thermograph, loading densities monitored with monthly sampling, ponds cleaned weekly, and mortality removed daily. Pond flow is approximately 700 gpm. Monthly average temperatures of the water supply are provided in Table 4.1-1.

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.

Growth rates are programmed for a specific target weight at release. Table 9.2.4-1 reports target growth rates (fish/lb.) for CHS at the McKenzie Hatchery. Interim growth rate data are not available.

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

See Table 9.2.4-1 for fish growth (fish/lb.). Energy reserve data is not collected.

Table 9.2.4-1. Targeted size (fish per pound at the end of the month) for the three release groups of McKenzie CHS.

Month	Jan. Release (fish/lb.)	Feb. Release (fish/lb.)	Mar. Release (fish/lb.)
January	950	1,080	1,022
February	655	580	570
March	363	350	330
April	205	222	210
May	115	136.5	124
June	69	82.5	76
July	41	50	46
August	25	33.5	31
September	20	25.8	23.9
October	11	20.5	19.3
November	11	17.2	15.7
December	10	14.4	12.9
January	Released	12.0	10.8
February		Released	9.5
March			Released

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W. /day and lbs./gpm flow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Fish are hand fed Bio-Oregon Skretting dry feed in the morning or throughout the day as needed. Food consumed as a percent of body weight/day ranges from 1.0-3.6%. Average yearly food conversion for spring Chinook is 1.1.

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

Fish health is inspected/monitored regularly by ODFW fish health specialist once in a month or more frequently, if necessary. Treatments for pathogens at McKenzie Hatchery vary depending on the life stage of the fish and the disease agent being treated. Green eggs are routinely water hardened in diluted buffered iodophor. Later, flush treatments of formalin (1:600) for 15 minutes are given three to five times per week for fungus

prevention. Static bath treatment of juvenile fish with formalin is applied to control external parasites and/or fungal infections. Treatment of CHS adults for fungus control is done with drip treatments of hydrogen peroxide at 100 parts per million (ppm) active ingredient. CHS adults are given antibiotic injections of erythromycin and OTC, under a veterinary prescription, to prevent bacterial infections such as furunculosis and BKD. Juvenile fish are treated for bacterial infections with OTC, florfenicol or Romet medicated feed according to label, under a veterinary prescription or under an INAD. Equipment is disinfected before use.

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

Physical observation of fish size, coloration, and behavior are the indices used for smoltification, and no ATPase enzyme activities are measured.

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

Fish are reared under natural water temperatures. New headers have been installed in all rearing ponds to distribute flow more evenly and provide higher velocities that may improve rearing conditions. At this time, no other “natural” rearing methods have been implemented at McKenzie Hatchery.

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.

McKenzie River CHS of both wild and hatchery origin are ESA-listed. Staff reduces potential for domesticating fish by following established hatchery protocols. Fish are released at a size and during a high flow event whenever possible to encourage rapid downstream migration and thereby minimize interactions with natural-origin fish. Egg trays that include progeny from natural-origin broodstock are marked appropriately to ensure the eggs are reared on-site, not culled for excess, or transferred to other programs.

SECTION 10. RELEASE

10.1) Proposed fish release levels.

The maximum proposed McKenzie River juvenile CHS releases for brood years 2013 through 2017 are described in Table 1.11.2-1. Releases are up to 604,750 fish (up to 201,583 fish at10 fish/lb. for each release in February, and March) through 2019 (See Section 3.7.2). Specific release dates may be adjusted between or within years in response to growth rates, smoltification, environmental conditions, and other factors to optimize outmigration. Specific locations of proposed releases.

Stream, river, or watercourse:	McKenzie River 0201500000
Release points:	River Mile 37, Lat. N44 degrees 7.11’, Long. W122 degrees 38.27’

Major watershed: McKenzie River
Basin or Region: Willamette Basin

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

See table 1.11.2-1. The size and times of the hatchery releases into the McKenzie River are given in Table 9.2.4-1.

Unfed fry releases ranging from 40,000 to 100,000 fry will be used in lieu of adults when adult returns are inadequate to support ODFW's reintroduction goals and bull trout conservation goals upstream from Trail Bridge Dam. Outplanting of surplus adults and fry releases will be discontinued once runs have been re-established above the project.

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

Under the current program, smolt releases from McKenzie Hatchery are completed around the first week of February, and March. Actual release dates are variable to take advantage of freshets as well as considerations of fish size and pathology recommendations. Smolts will continue to be released into the McKenzie River via the adult collection ladder that runs from the hatchery to the mainstem McKenzie River.

10.4) Fish transportation procedures, if applicable.

All smolts are now released directly from the hatchery into the McKenzie River. See Section 5.2 for description of liberation transport unit for hauling adults.

10.5) Acclimation procedures.

All fish are reared throughout their life cycle at McKenzie Hatchery and released directly from the hatchery into the McKenzie River. To release fish from the McKenzie Hatchery, screens are pulled to initially allow fish to leave the ponds volitionally prior to being forced from the ponds into the fingerling release pipe traveling underground to the fish ladder emptying into the McKenzie River.

10.6) Marking applied, and proportions of the total hatchery population marked, to identify hatchery adults.

All juvenile CHS released for this program are externally marked with an adipose fin clip to identify hatchery fish among all returning adults. In addition, all hatchery-reared smolts are marked with an otolith mark, which distinguishes them from naturally-produced CHS, as a check against poor or missed marks and to allow identification of strays of program fish.

In the future, all Chinook salmon smolt production will continue to be adipose fin-clipped and otolith-marked. In addition, 100,000 smolts from each of the McKenzie River release groups will be coded wire-tagged (USACE 2007, NMFS 2008).

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

Surpluses are generally reduced to production levels well before time of release (usually before egg hatching occurs), and unfed fry are transferred to the STEP.

Best management practices may dictate that, based on known and anticipated disease or predation losses, fish in excess of planned production goals may be reared well past the initial ponding date. Hatchery managers, in coordination with hatchery coordinators and Fish Division staff, will establish these numbers for each facility based on survival estimates compiled by ODFW Fish Health section. Surpluses held to meet production goals should be disposed of at the earliest point in the rearing cycle. At the point in rearing cycle that the risk of these known hazards is past, these surpluses should be removed from the production cycle. Consistent with subsection (7), disposition of surplus fish from harvest hatchery programs shall be determined by Regional and Fish Division staff on an individual basis, with emphasis on minimizing conservation risks while providing angling opportunities where possible (e.g., stocked in closed water bodies). For conservation hatchery programs, disposition of surplus fish shall be determined through the department's annual production planning process, consistent with direction in the NFCP and the Hatchery Management Policy regarding the use of conservation hatcheries. Disposition of resident fish shall be determined based on statewide fish management needs. The final disposition of all surplus fish will be reported on in the Fish Propagation Annual Report.

10.8) Fish health certification procedures applied pre-release.

As per requirement of ODFW Fish Health Management Policy, fish health is inspected prior to release and only certified fish are released into the river. The fish health monitoring plan is identical to that developed for the Columbia Basin anadromous salmonid hatcheries (IHOT 1994):

All fish health monitoring will be conducted by a qualified fish health specialist. Annually examine broodstock for the presence of viral reportable pathogens. Number of individuals examined, usually 60 fish, will be great enough to assure a 95% chance of detection of a pathogen present in the population at the 5% level. American Fisheries Society "Fish Health Blue Book" procedures will be followed. Annually screen each salmon broodstock for the presence of *R. salmoninarum* (R.s). All Chinook salmon will be sampled for R.s. as part of the positive egg culling program.

Conduct examinations of juvenile fish at least monthly and more often as necessary. A representative sample of healthy and moribund fish from each lot of fish will be examined. The number of fish examined will be at the discretion of the fish health specialist.

Investigate abnormal levels of fish loss when they occur.

Determine fish health status prior to release or transfer to another facility. The exam may occur during the regular monthly monitoring visit, i.e. within 1 month of release.

Appropriate actions including drug or chemical treatments will be recommended as necessary. If a bacterial pathogen requires treatment with antibiotics a drug sensitivity profile will be generated when possible.

Findings and results of fish health monitoring will be recorded on a standard fish health reporting form and maintained in a fish health database.

Fish culture practices will be reviewed as necessary with facility personnel. Where and when pertinent, nutrition, water flow and chemistry, loading and density indices, handling, disinfecting procedures, and treatments will be discussed.

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

Contingency plans are in place to deal with chemical spills or water system failures. In the event of a complete water system failure, fish programmed for release into the McKenzie River would be released into the river after Regional or Manager approval. In the event of a partial water system failure or a chemical spill upstream, fish would be saved according to the following priorities:

a) Chinook salmon broodstock
b) Eggs and fry
c) Fingerlings
d) Smolts

10.10) 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.

The McKenzie CHS program releases are scheduled for February through March as smolts that are ready to emigrate to the ocean. Recent data on Chinook smolt emigration rates and tracking at Willamette Falls suggest the vast majority of the hatchery Chinook releases migrate downstream quickly. McKenzie hatchery spring Chinook salmon are late-winter released and have a median travel time to Willamette Falls of 27 to 53 days, which is longer than natural-origin fish with a median travel time of 6 to 34 days. Because the hatchery fish releases occur before the peak of the natural-origin smolt emigration in April-May, interactions are reduced. Some hatchery Chinook do not emigrate downstream quickly and residualize in the lower McKenzie River and Willamette River, but this occurrence is minor. By releasing the fish at optimal migration times, inter-specific competition with natural-origin fish should be minimized.

In addition, fish are released during high flow events to increase the likelihood of rapid downstream migrations and to decrease the likelihood of interactions with natural-origin fish.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Describe plans and methods proposed for monitoring and evaluation of "Performance Indicator" identified for the program, and indicate whether funding and support logistics are available.

Monitoring and evaluation activities listed for McKenzie Hatchery are developed, reviewed, and funded through the Cooperative Agreement between the Corps and ODFW for the hatchery mitigation program. The agreement addressed both baseline and uncertainty monitoring. Appendix A contains the 2014 draft Monitoring and Evaluation Plan for the Hatchery Program. The percentage of hatchery spring Chinook spawning in the wild (pHOS) is an important performance standard and indicator to be monitored and evaluated. Results of the annual evaluation will be provided to NMFS. The following pHOS draft monitoring plan is proposed to be implemented beginning in calendar year 2015:

Draft Monitoring Plan for Estimating pHOS in the McKenzie River

Introduction: The BiOp is the regulatory compliance document and the Recovery Plan is the guidance document that together shape management of ESA-listed salmonids in the upper Willamette River. The BiOp requires that pHOS be monitored and managed with the ultimate goal of attaining very low abundance of hatchery spawners in each sub-basin. The Recovery Plan provides long-term goals and recommendations for pHOS. The Hatchery Research, Monitoring and Evaluation Project is responsible for monitoring and reporting upon the distribution and abundance of natural- and hatchery-origin spawners as part of the adaptive management process intended to achieve the long-term pHOS goals.

Methods: Estimates for pHOS are derived from data obtained during annual spawning ground surveys in which the reach-specific distribution of redds and reach-specific distribution of carcasses are used in combination to calculate pHOS at the different spatial scales, including pHOS for the totality of the subbasin excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam. During spawning ground surveys surveyors, covering essentially all of the spawning habit used by spring Chinook salmon, count and record the location of individual redds. The redd counts are an index of the abundance of all spawners, both natural- and hatchery-origin. At the same time, all carcasses encountered by the surveyors are sampled to establish natural- or hatchery-origin of the fish. If a carcass is missing its adipose fin or has a coded wire tag (CWT), it is assumed to be of hatchery-origin. If a carcass has an intact adipose fin and no CWT it is counted, initially, as a natural-origin fish. Because all hatchery-origin fish receive a secondary mark during incubation, a thermal otolith mark, the otoliths are extracted, polished, and examined. Carcasses with a thermally marked otolith are tallied with the hatchery fish.

pHOS will be evaluated based on a three-year rolling average beginning in 2018. The first evaluation will analyze returns through and including the 2018 return year because in 2018 all adult hatchery Chinook returns to the McKenzie River will have had the benefit of the following management changes: 1) reductions in hatchery releases, 2) modification of the hatchery ladder, and 3) removal of hatchery Chinook at Leaburg Dam beginning each year in July (this action began in 2015). In 2021 all adult hatchery returns will have also benefitted from improved homing due to imprinting from Cogswell Creek. The hatchery release level can be adjusted upwards or downwards to better meet conservation (broodstock and outplanting) and fishery goals while meeting pHOS targets. The maximum number of spring Chinook smolts that will be released into the McKenzie Basin is 787,000 at approximately 10 fish per pound (subject to the terms and conditions of any NMFS approval resulting from the submission of this HGMP). Background information on alignment of McKenzie River ESA management objectives and hatchery program alternative actions is provided in Appendix E.

Table 11.1-2. Schedule of past and future hatchery production changes and corresponding returns of salmon by age class.

	Smolt Release by Brood Year								
	2008	2009	2010	2011	2012	2013	2014	2015	2016
	Number of Smolts Released								
	1,110,559	1,220,135	1,007,800	867,467	853,979	604,970	604,750	604,750	604,750
Age at Return, by Run Year									
2011	Jack								
2012	Age 4	Jack							
2013	Age 5	Age 4	Jack						
2014		Age 5	Age 4	Jack					
2015			Age 5	Age 4	Jack				
2016				Age 5	Age 4	Jack			
2017					Age 5	Age 4	Jack		
2018	First 604,750 release data point					Age 5	Age 4	Jack	
2019							Age 5	Age 4	Jack
2020	First data point encompassing all hatchery management changes							Age 5	Age 4

*Note: Data Points reference the 2018 and 2020 run years.

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.

The program does anticipate that additional incidental take will result from monitoring and evaluation activities, but the type and level of take is to be determined on a case by case basis for uncertainty monitoring. It is recommended that annual take statements are developed and approved/denied along with the annual review of RM&E proposals by WATER. Sections 7-10 of this HGMP describe risk aversion measures in place within the hatchery program for minimizing impacts to the wild CHS population. Take of listed species by the hatchery program is discussed in section 2.2.3.

SECTION 12. RESEARCH

Uncertainty research is focused on gaining an understanding of aspects of hatchery fish biology and behavior that have not been well studied. A discussion of potential uncertainty research is presented in the WHMP RM&E Plan (Peven and Keefe 2011). Specific RM&E projects will be defined and prioritized by USACE, USFWS, ODFW, and NMFS with recommendations from the WATER's RM&E Oversight Team annual planning process. At this time, no uncertainty research has been identified for implementation, but this decision is discussed and reviewed annually.

Cooperating and funding agencies will include: USFWS (through Sport Fish and Wildlife Restoration Program funding); USACE (with partial reimbursement by BPA according to its operation and maintenance power share percentage at Cougar Dam) (Hatchery funding); Portland General Electric, and ODFW.

Monitoring and evaluation of outplanting and reintroduction efforts in the McKenzie is outlined in section 15 of this HGMP and will be included in the final reintroduction plan (draft at Appendix C). In 2011 a Three-Year Monitoring and Evaluation Plan was developed to help inform hatchery monitoring and evaluation.

The strategic questions and RM&E objectives are based on the following hatchery management goals:

Develop and maintain a broodstock for the McKenzie CHS HMP to aid conservation supplementation goals, and assist harvest goals.

- For fishery purposes, maintain an appropriate level of genetic integration from naturally-produced fish into the HMP with approved mating protocols.
- For conservation purposes, manage HMP fish spawning in the McKenzie River to meet the specific pHOS standard specified in table 1.9.2.
- For conservation purposes, use surplus CHS from the HMP to supplement natural spawning above Cougar Dam as part of the CHS reintroduction program, in addition, surplus adults may be outplanted above Trail Bridge Dam or into the Mohawk River
- Operate McKenzie CHS hatchery in accordance with applicable federal and state laws, and cooperative agreements governing safe operation of hatchery facilities

The hatchery RM&E program will closely follow the Three-Year Monitoring and Evaluation Plan; studies identified by USACE, BPA, NMFS, ODFW, and USFWS and consider recommendations by the WATER Hatchery Management Team.

Many of the hatchery reform actions are based upon an adaptive management strategy and are dependent on several factors: (1) availability of program funds appropriated by Congress or provided by others; (2) continued RM&E to inform decisions on the appropriate improvements to downstream passage survival of juvenile spring Chinook salmon through Cougar Dam and reservoir, and (3) funding and implementation of the preferred downstream fish passage alternative for Cougar Dam and reservoir.

Consequently, actions to address ESA requirements in the McKenzie subbasin and the Willamette Basin, as a whole, will evolve and be refined over time. Hatchery reform, management, and operations are only one part of an integrated strategy under development for the survival and recovery of listed species in the basin. The potential for changes in infrastructure and operations of the dam and reservoir system plus habitat restoration needs in the basin are anticipated to be extensive, but the total funding available to the USACE, ODFW, and others for implementing changes is limited. Thus, an adequate RM&E program coupled with adaptive management is necessary to establish and maintain clear priorities for use of the available funds. Once any improvements to downstream fish passage are implemented at Cougar Dam and natural-origin returns increase back to Cougar Dam trap, the hatchery mitigation program will be reduced. This will be re-assessed on a regular basis (e.g., every five years) to evaluate adult returns to Cougar Dam trap and the appropriate adjustments to further reduce hatchery mitigation for upstream losses of wild CHS from the original construction and continued operation of Cougar Dam.

Current monitoring of hatchery fish indicates that changes from wild-type phenotypes are moderate. A research program is currently in place to evaluate the effects of hatchery programs on wild Chinook salmon populations in the Willamette system (Schroeder et al. 2005). One objective of that research is directed at defining the temporal and spatial distribution of juvenile Chinook salmon rearing so that the HMP can minimize impacts to the listed naturally-produced portion of the ESU in the McKenzie subbasin and Willamette River mainstem.

Future monitoring of natural and hatchery-origin stocks for phenotypic traits such as migration timing, size of juveniles at migration, age at maturity, etc. are proposed in the Hatchery Research, Monitoring, and Evaluation (RM&E) Plan developed under the guidance of the WATER FPHM Team (see Peven and Keefe 2011). In addition, a research program to evaluate the genetic effects of the Willamette HMP's has been completed by ODFW (Johnson and Friesen 2012). The goal of the project was to provide estimates of population genetic diversity within and among natural-origin and hatchery populations of CHS from multiple subbasins of the Willamette River. Results obtained from this project serve to inform potential management actions that could include, but may not be limited to, adult outplanting, natural-origin broodstock integration, and hatchery stock transfers. Additionally, genotypic data generated through this project will be used to evaluate the feasibility and resolution of genetic stock identification (GSI) methods for Willamette River CHS. The objectives of the work were to:

1. Collect tissue samples from natural and hatchery-origin adult CHS from major eastern subbasins of the Willamette River above Willamette Falls.

2. Genotype a representative sample of each hatchery and wild population using a suite of ten polymorphic microsatellite loci.

3. Estimate genetic diversity within and among sampled populations, using conventional population genetics measures, including heterozygosity, F_{ST} and allelic richness.

4. Evaluate potential genetic effects of management actions, including integration of natural-origin broodstock.

The report (Johnson and Friesen 2013) was recently finalized and many of the conclusions and recommendations have been incorporated into this document.

SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the information provided 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 and Title of Applicant:

Signature: _____ Date: _____

SECTION 15. OUTPLANTING PROTOCOLS

Upstream of Cougar Dam and Reservoir

Past Releases. Both hatchery and naturally produced fish have been released upstream of Cougar Dam in years when requirements for the natural-origin component of the hatchery broodstock have been met. The majority of these fish have been collected at McKenzie Hatchery.

Proposed Releases. Continue to release hatchery-origin adult Chinook salmon in the areas above Cougar Dam in combination with returns of natural-origin CHS to Cougar Dam trap (See Appendix F).

Long-term Strategy. The long-term intent of the program is to release only natural-origin fish when production and survival through Cougar Dam and reservoir are high enough to support a self-sustaining run. Information on the survival of outplanted adults and juvenile passage through the reservoir and dam is necessary to evaluate the outplant program, to determine the net benefit to releasing natural-origin adults upstream of Cougar Dam, and to determine if long-term reintroduction is feasible.

Protocols for Outplanting Adults

Priorities for the disposition of hatchery adults in excess of broodstock needs are contained in section 7.4.1 and 7.5 of this document. These goals will be reviewed annually by Corps, BPA, NMFS, USFWS, and ODFW with recommendations from the Fish Passage and Hatchery Management (FPHM) Team, based on predicted run size, results of RM&E, and the construction of new infrastructure affecting the ability to collect or release fish in the McKenzie Basin.

Long-term Strategy

Maximize adult survival to spawning and adjust target releases accordingly, based on reductions in PSM and improvements in survival at other life stages. With increased survival, the reintroduction program may reach viability goals by releasing fewer hatchery fish. Reduce the ratio of hatchery-origin fish released above Cougar Dam according to the Reintroduction Plan when it is finalized. A draft copy of the Reintroduction Plan is in Appendix C of this HGMP. Eventually, release only natural-origin fish once 400 females and 200 males return to the trap at Cougar Dam.

Eliminate the need to outplant hatchery-origin adults in areas upstream of Cougar Dam once a self-sustaining population is restored. Currently, production is well below replacement (< 0.4 recruits/spawner). In the long term, collect and release only natural-origin adults above Cougar Dam.

Sex and Age Composition of Outplanted Fish

Proposed Operation. Investigate adjustments to the sex ratio of releases based on known

differences in PSM between males and females to maximize reproductive success to ensure an adequate number of females are outplanted to seed available habitat. It is anticipated that the proposed operation will result in artificially higher productivity than will be observed under an outplanting strategy that mimics normal run timing and distribution.

Long-term Strategy. Explore the potential benefits of releasing adults according to the age and sex distribution that occurs in natural-origin fish within the McKenzie subbasin. Ensure that the minimum number of females (400) are transported to achieve the desired target number of redds.

Run Representation of Outplanted Fish (seeding rate by run size by month)

Proposed Operation. Continue to outplant hatchery fish from McKenzie Hatchery as needed to supplement outplanting of unclipped spring Chinook from the Cougar Adult Fish Collection Facility and seek to pass only adults that assign to production upstream from Cougar Dam.

Long-term Strategy. The long-term goal is to outplant only natural-origin fish from Cougar Adult Fish Trap, once at least 400 females and 200 males return to the trap.

Handling Protocols for Outplanted Fish

Proposed Operation. Continue to use of both the Cougar Adult Fish Collection Facility and McKenzie Hatchery trap to collect fish for release upstream of Cougar Dam. All transport tanks will be treated with Nov-Aqua, per manufacturer's instructions, to reduce stress during transport.

Loading Density. Transport adult spring Chinook at density ≤ 25 gallons of water per fish (60 fish/1,500 gallon tank).

Oxygen

Oxygen levels in the transport truck water should remain between 7-12 ppm (7-12 mg/L).

Temperature

Fish will not be released into receiving waters with a seven day average maximum temperature > 65°F or weekly mean temperature > 60°F. Drivers will measure the temperature of the water in the transport tank and the receiving water prior to releasing the fish. If the temperature difference between the receiving water and tank water is > 7°F, the water will be tempered to a difference of< 5°F at a rate of 1F°/6 minutes.

Hauling Frequency

Transport Period	**Hauling Frequency**
March 15 - October 15	Cougar Trap Operations: at least 2 times per week (more frequent if needed based on returns to facility. Hatchery Outplants: typically delayed until biologists have a reasonable prediction of run numbers to the Cougar Trap and anticipated supplementation needs from the hatchery.

Long-term Strategy. The Cougar adult fish facility will continue to be used for collection and passage above Cougar Dam for reintroduction efforts. Natural-origin CHS assigning to areas upstream from the project will be outplanted upstream. Most outplanted fish should be in good physical conditions (i.e., no lesions, fungus, etc.) to increase the likelihood of surviving to spawn. If a hatchery-origin CHS is collected at the trap, the fish will also be outplanted upstream if the minimum escapement of natural-origin fish is not going to be attained. Otherwise hatchery fish will not be outplanted. The facility was designed to minimize stress to fish. The operation of the trap should complement the goal of limiting stress by minimizing any fish handling that may need to occur (e.g., multiple crowds).

In addition, the following guidelines will be followed at the Cougar Trap and McKenzie Hatchery:

- Sorting of adult CHS for outplanting shall be completed in manner that minimizes stress and injury. All efforts should be made to sort adult fish a single time.
- Sorting shall be completed to ensure an adequate sex ratio for outplanting.
- The fish disposition table will be used to guide the management of anadromous and resident fish as they are encountered in the adult fish traps.

Transport Protocols for Outplanted Fish

Proposed Operation. Elevated stress caused by high transport density may have contributed to the higher incidence of PSM observed in fish outplanted above Cougar Dam, and amongst surplus adults that have been outplanted into the Trail Bridge reservoir in the past. Beginning in 2006, fish were loaded according to NMFS recommended loading density of approximately 25 gallons per fish (e.g., 40 fish/1000 gal; 50 fish/1200 gal). Densities will be reduced if water temperatures are high. All transport tanks will be treated with Nov-Aqua to reduce stress during transport. Tanks will be aerated during transport. Trucks equipped with chillers will operate them to prevent or reduce warming during transport and minimize temperature differential between the transport tank and the release stream, to the extent possible. If the receiving water is warmer, then operators may attempt temperature acclimation prior to fish release.

All truck drivers will complete the adult Chinook salmon outplant form to document oxygen levels, temperatures in the tank and release stream, immediate mortalities, loading densities, and release method. These data will be used to enable better monitoring of outplanted fish.

Table 15-1. Approximate Hauling Times and Distances from McKenzie Hatchery to Release Sites

Release Site	Distance (miles)	Transport time (minutes)
South Fork McKenzie Upstream of Cougar Dam	35	120
McKenzie River Upstream of Trail Bridge Dam	45	120

[a] Transport time does not include loading time. Source: Modified from Beidler and Knapp 2005.

Long-term Strategy. Fish will be loaded according to the NMFS recommended loading density of approximately 25 gallons per fish (40 fish/1000 gal; 50 fish/1200 gal), although densities will be reduced if water temperatures are high. All transport tanks will be treated with Nov-Aqua to reduce stress during transport. Tanks will be aerated during transport. Trucks equipped with chillers will operate to prevent or reduce warming during transport and minimize change in temperature between the tank and in the release stream, to the extent possible. If the receiving water is warmer, fish are acclimated prior to release as specified in Section 2.3.1 of the main report. In addition, fish handling will cease once temperatures reach 70°F. The primary concern for water temperature is for fish taken from McKenzie Hatchery, where water temperatures are much higher than the release location upstream of Cougar Dam in the SF McKenzie River (which is spring-fed and remains relatively cold during the summer).

Release Protocols for Outplanted Fish

Proposed Operations

Release sites. Continue to use the existing and newly constructed release locations.

Release methods. Have a minimum of a 12-inch opening on all release trucks. Set pipes at proper discharge angle and use discharge chutes. Use a water spout to flush fish from the truck. Avoid abrupt changes in temperature. Release fish early in the day whenever possible. If receiving waters are known to be too warm at certain times of year, release fish when or where waters are cooler. See Section 2.3.1 in the main report for more specific protocols. Investigate the options to improve survival such as holding fish in a hatchery pond and treating with antibiotics until they are ready to spawn, at which time they would be released. Releasing ripe fish may limit numbers outplanted and potentially reduce PSM.

Monitoring. Fish liberation truck driver and/or trained volunteer will observe released fish and document any mortality and unusual behavior for 30 minutes after release

Long-term Strategy

Release sites. All fish would be released at sites that were selected based on suitable habitat and temperature. Preference would be given to release fish at the lowermost release location upstream of Cougar Dam so that fish can migrate into preferred habitats.

Release methods. All fish would be released using smooth-walled pipe as described above.

Appendix A. Acronyms

°C	Degrees Celsius
°F	Degrees Fahrenheit
BiOp	Biological Opinion
BKD	Bacterial Kidney Disease
BO	Biological Opinion
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
cfs	Cubic Feet per Second
CHS	Spring Chinook Salmon
COP	Configuration Operation Plan
CWT	Coded Wire Tag
ODEQ	Oregon Department of Environmental Quality
DPS	Distinct Population Segment
DIT	Double Index-Tagged
ELISA	Enzyme-linked Immunosorbent Assay
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
EWEB	Eugene Water and Electric Board
FERC	Federal Energy Regulatory Commission
FHMP	Fish Hatchery Management Policy
FMEP	Fish Management Evaluation Plan
FPHM	Fish Passage and Hatchery Management Team
fpp	Fish Per Pound
FR	Federal Register
ft.	Feet
gpm	Gallons per minute
HGMP	Hatchery and Genetic Management Plan
HMIS	Hatchery Management Information System
HMP	Harvest Mitigation Program
HSRG	Hatchery Scientific Reform Group
HUC	Hydrologic Unit Code
IHOT	Integrated Hatchery Operations Team
INAD	Investigational New Animal Drug Permit
LFT	Limiting Factors and Threats
MS-222	Tricaine Methanesulphonate
NFCP	Native Fish Conservation Policy
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOR	Natural-origin Recruits
NPDES	National Pollutant Discharge Elimination System
NPPC	Northwest Power Planning Council
OAR	Oregon Administrative Rule
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Fisheries

ODFW	Oregon Department of Fish and Wildlife
OTC	Oxytetracycline
PA	Proposed Action
PHFHPC	Pacific Northwest Fish Health Protection Committee
pHOS	Proportion of Hatchery-origin Spawners
PIT	Passive Integrated Transponder
pNOB	Proportion of Natural-origin Brood
POH	Post-orbital Hypural Plate
ppm	Parts Per Million
PSM	Pre-spawning mortality
PVC	Polyvinylchloride
RM&E	Research, Monitoring, and Evaluation
RPA	Reasonable and Prudent Alternatives
SAFE	Select-Area Fisheries Enhancement
SAR	Smolt-to-Adult Return Ratio
SBA	Supplemental Biological Assessment
SCAB	Steelhead and Chinook salmon Above Barriers
SMU	Species Management Unit
STEP	Salmon and Trout Enhancement Program
TRT	Technical Recovery Team
TU	Temperature Unit
USACE	US Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	US Fish and Wildlife Service
UWR	Upper Willamette River
VSP	Viable Salmonid Population
WATER	Willamette Action Team for Endangered Species Recovery
WFMP	Willamette Fish Management Plan
WHMP	Willamette Hatchery Mitigation Program
WP	Willamette Project

Appendix B – FY 14 BASELINE HATCHERY MONITORING OBJECTIVES

The baseline M&E Plan is intended to ensure that methods used to implement the monitoring program are consistent with current state of science on hatchery reform in the Pacific Northwest.

Three overarching objectives encompass all program elements of the Plan: develop and maintain hatchery broodstocks to meet mitigation, conservation, and recovery goals and to comply with existing genetic guidelines as specified in hatchery program-specific HGMPs; rear and release high quality hatchery fish to minimize impacts on naturally produced fish and to ensure survival with an adequate potential for recovery of listed species; and manage adult returns to minimize impacts on naturally produced populations and to aid in conservation goals, consistent with survival and recovery of the ESU.

Tasks to Perform

Task 1. Conduct surveys to determine the abundance, distribution and percent natural and hatchery origin of CHS on the spawning grounds of each subbasin population.
The purpose of this task is to describe the abundance, distribution, and composition (i.e., hatchery- vs. natural-origin fish) of adult CHS returning to spawn in Upper Willamette Basin tributaries. Specifically, this task aims to describe the population of adult returns with respect to: run size and timing, numbers of natural and hatchery origin fish collected for broodstock and outplanting, peak spawning dates, redd distribution and density, estimated natural spawning escapement, pHOS, and PSM on spawning grounds, as well as the age structure of the natural spawning population, and harvest rates.

Spawning ground surveys conducted as part of the baseline M&E plan are aimed at characterizing the spawning population in accessible stream reaches downstream of USACE dams. Similar spawning ground surveys are also conducted above dams as well. This separation has been made in order to specifically monitor and evaluate outplanting efforts in inaccessible stream reaches and the potential of these stream reaches to serve as sanctuaries for wild fish populations. Comparisons of estimated spawning population parameters (e.g., peak redd counts, redd densities, pHOS, and PSM) between spawning areas downstream and upstream of USACE dams are useful for identifying reaches with relatively greater habitat potential and for evaluating hatchery management practices.

Methods for accomplishing Task 1 include operation of video counting stations in the McKenzie and North Santiam rivers and conducting spawning ground surveys in all four subbasins by boat and on foot following established protocols (Canon et al. 2012; Sharpe et al. 2013).

Essentially all encountered carcasses of unclipped fish are sampled for scales, otoliths (to permit identification of thermal marks), and spawning condition (for females: to estimate PSM rates). A representative sample ($N \geq 100$, generally) of carcasses from adipose-clipped fish, especially clipped fish with CWTs, are also sampled to obtain scales, snouts, sex, size, and spawning condition and to evaluate return rates and straying rates of hatchery-origin fish.

Recovery of CWTs is an important aspect of the monitoring effort as it permits estimates of stray

rates of hatchery-origin fish out of the subbasins into which juveniles were released without acclimation (e.g. Coast Fork Willamette River) into other subbasins. The HRME project will directly compare recovery rates of CWTs (collected at hatcheries and during spawning ground surveys) in adults from juveniles released directly from the hatcheries to recoveries from fish released off station. Monitoring the adults returning from the Coast Fork Willamette River releases is of particular interest because the release was intended to decrease hatchery-origin returns to the McKenzie subbasin (thus reducing pHOS). HRME staff will evaluate the effect of the off-station releases on pHOS in the McKenzie based on those partial returns.

Task 2. Conduct biological monitoring of fish at hatcheries and traps. This task incorporates two subtasks where (1) broodstock being incorporated into hatchery programs are sampled to obtain estimates of diversity (origin, size, age structure, run timing, spawn timing) and (2) during "Outplanting" operations which occurs coincident with acquisition of fish for broodstock. The purpose of the broodstock sampling is to ensure that broodstock used in UWR hatcheries closely resemble natural-origin fish in terms of age structure, size, run timing, and spawn timing. Sampling during outplanting activities provides essential support for ongoing or anticipated recovery efforts and research above UWR dams including prespawning mortality (PSM) and genetic pedigree studies, in addition to the work described in Task 4, below.

Methods for accomplishing Task 2 include (1) Recording date, marks, tags, fish disposition, sex and fork length and obtaining a DNA sample for essentially every outplanted fish, (2) obtaining a scale sample from a representative sample ($N \geq 100$) of outplanted fish, (3) obtaining all CWTs from adults spawned at the hatcheries, and (4) obtaining a scale sample from a representative sample ($N \geq 100$) hatchery-origin fish.

Task 3. Conduct biological monitoring of fish rearing in hatcheries and at release.
This task involves monitoring of fish performance both in-hatchery (survival, growth) and post-release (migratory performance). The purpose of this task is to ensure that UWR hatcheries release the programmed number of fish at a size and time intended to facilitate rapid emigration. Methods for this task include compilation of growth and survival records maintained at each hatchery including representative "pre-liberation" samples for each hatchery release where size distribution and QA/QC metrics of marks and tags are recorded.

Task 4. Determine the relative survival of outplanted fish and abundance of outplanted fish that spawn above USACE dams. This task includes: conducting spawning ground surveys in reaches where fish have been outplanted, collecting data on spawning population parameters (e.g., peak redd counts, redd densities, and PSM) and analysis of spawning population parameters at varying spatial scales.

In addition, genetic sampling of outplanted fish is conducted in support of ongoing (South Fork McKenzie and South Santiam rivers) and anticipated (North Santiam River) studies on productivity of outplanted Willamette CHS. Methods for the above-dam spawning ground surveys are identical to those described for Task 1, above, except that DNA samples are obtained from every fish sampled on the spawning grounds, regardless of natural- or hatchery-origin.

	CHS Monitoring Objectives							
	SC 1	SC 2	SC 3	SC 4	SC 5	SC 6	SC 7	SC 9
Task 1: Spawner Ground PSM and Spawner Surveys				X	X			
Task 2: Hatchery and Trap Adult Monitoring	X	X	X					
Task 3: Hatchery Juvenile Monitoring						X	X	X
Task 4: Outplant Monitoring				X	X			

Appendix C - ADAPTIVE MANAGEMENT PLAN FOR MCKENZIE HATCHERY SPRING CHINOOK

The primary concern of the hatchery spring Chinook program on natural-origin spring Chinook in the McKenzie River is from hatchery fish on the natural spawning grounds. Between 2002 and 2013, pHOS in the primary spawning areas above Leaburg Dam in the McKenzie River ranged from 16% to 45%, with a mean of 26%, based on spawning ground surveys. For the totality of the subbasin excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam, pHOS ranged from 20% to 54% with a mean of 36%.

In 2012, ODFW began a measure to adaptively manage the spring Chinook program to reduce pHOS by reprogramming the majority of its production from the McKenzie River to the Coast Fork Willamette. Approximately 1/3 of the total hatchery production, 339,000 of 1.2 million smolts, from the McKenzie Hatchery were relocated to the Dexter Fish Facility/Willamette Hatchery for release in the Middle Fork, or Coast Fork. Monitoring for straying into the McKenzie began in 2014 when the first return of adults is anticipated. Further reductions in smolt releases up to a total of 604,750 annually will occur for brood years 2013-17 to further reduce pHOS concerns in the McKenzie population. Overall, these reform measures will reduce hatchery CHS releases in the McKenzie River by approximately 50% compared to releases before 2012. This will reduce pHOS in the McKenzie natural spawning population. In 2018, a formal assessment of pHOS will occur as defined in section 11.1 of the HGMP.

Other measures to reduce pHOS in the subbasin that are proposed by the Corps to be implemented as part of this HGMP include improving homing and attraction at McKenzie Hatchery by increasing use of Cogswell Creek water and modifying the adult fish ladder entrance. The ladder improvement at McKenzie Hatchery will be completed by 2015. The water supply improvement will be completed in 2016 (see section 5 Facilities in the HGMP for further details).

The Corps and BPA will also implement actions for Cougar Dam downstream passage with the intent to restore access and productivity of habitats upstream of Cougar Dam. The effect of this measure will be to provide technologically feasible, biologically effective and cost-effective improved downstream fish passage at Cougar Dam, increasing spatial distribution by providing safe access to and from historical habitat... A crediting strategy will be developed cooperatively between Corps, BPA, NMFS, USFWS, and ODFW to offset the hatchery mitigation program.

The intended effect of these efforts is to reduce the overall pHOS level of the spring Chinook population to less than 10% in the entire McKenzie subbasin excluding the reintroduction areas upstream of Cougar and Trail Bridge dams. If the measures that have been implemented are found not to be effective at reducing the proportion of hatchery adults in the spawning population to less than 10%, additional measures will be taken to reduce the potential threat.

Appendix D. Reintroduction Planning: Management of Spring Chinook Salmon above Cougar Dam South Fork McKenzie River 2013-2017

The December 2012 Draft Reintroduction Plan, presented below, is subject to revision. The effort to develop and complete this plan will continue collaboratively with WATER in coordination with the fishery managers.

1. Planning for Reintroduction above Cougar Dam

1.1. Goals

Long Term:

- Re-establish natural production of spring Chinook salmon above Cougar Dam to ensure survival with an adequate potential for recovery of the McKenzie River UWR Chinook population and the ESU as a whole.
- Eliminate the need for continued hatchery supplementation above Cougar Dam because improved juvenile and adult survival allows for a self-sustaining run into the future.

Short Term:

- Ensure Chinook salmon escapement is sufficient to provide forage prey base for bull trout.
- Ensure adequate escapement of Chinook salmon (natural and hatchery origins) above Cougar Dam to allow for rebuilding of the run and to maintain sufficient juvenile production for research purposes.

1.2. Benefits of Reintroduction

- The habitat above Cougar Dam historically was a major production area for spring Chinook salmon. Re-establishing natural production in this area is essential to help ensure survival with an adequate potential for recovery of the McKenzie River population and ESU as a whole.

- Hatchery spring Chinook salmon have been (and are) readily available for a potential source of fish for reintroduction. The genetic pedigree analysis has demonstrated that outplanted hatchery Chinook salmon contribute returning adult progeny back to Cougar Dam. Nearly all of the natural origin Chinook salmon returns to Cougar trap in 2010-12 were adult progeny from hatchery Chinook salmon supplementation above Cougar Dam. These results demonstrate hatchery supplementation can produce returning offspring that may lead (due to other key limiting factors/threats) to the rebuilding of a natural-origin run above Cougar Dam.

- Re-instating natural production of spring Chinook salmon is essential for research purposes. Juvenile Chinook salmon provide valuable data on the life history, behavior, and survival while emigrating through Cougar reservoir and dam. This

research aids in the development of appropriate downstream fish passage structural fixes.

1.3. Risks of Reintroduction

- The primary risk factors for reintroduction include mining the source population (natural origin fish in the mainstem McKenzie River) that may pose demographic and genetic effects to established natural production.

- Because hatchery Chinook salmon have been used for supplementation above Cougar Dam, there may be domestication genetic risks of using hatchery fish. McKenzie hatchery and natural spring Chinook salmon are very similar genetically (Figure 3); so the risk of using hatchery fish for reintroduction should be very low in terms of impacting the genome.

- To date, the benefits of reintroduction using hatchery Chinook salmon have outweighed the known risks. Significant benefits to all VSP factors for the McKenzie River population occur from reintroduction (abundance, productivity, spatial structure and diversity).

1.4. Constraints

- Passage survival of juvenile Chinook salmon through Cougar reservoir and dam is presently poor. The effectiveness of interim operations (RPA 4.8) to increase downstream passage is uncertain. The long term fish passage solution is in development.
- Concerns about level of spring Chinook salmon adult outplanting to ensure sufficient forage for bull trout (Figure 1). It is unknown what the minimum escapement level of Chinook salmon should be to provide a sufficient prey base for bull trout. Therefore, management should err on the side of caution and strive for Chinook salmon escapement that exceeds the lowest numbers recorded (Table 1).
- Concerns about impacts of continued hatchery Chinook salmon releases to productivity and local adaptation of natural origin Chinook salmon in light of 1) recent returns of natural origin Chinook salmon to Cougar Dam have been several hundred fish, 2) McKenzie pHOS RPA requirements to reduce hatchery Chinook salmon spawning throughout the population. However, it is important to acknowledge the natural-origin returns were founded from 100% hatchery Chinook salmon supplementation.

1.5. Sequencing of Actions

- Successful reintroduction hinges upon reducing juvenile Chinook salmon mortality associated with Cougar reservoir and dam. Recent studies show substantial delay and mortality of emigrating Chinook salmon, whereas too few fish actually survive to below Cougar Dam and/or are significantly delayed. If downstream migrant survival is not

improved substantially, it is doubtful a self-sustaining, naturally produced run of Chinook salmon will develop above Cougar Dam.

- To date, the outplanting of hatchery Chinook salmon above Cougar Dam has shown promise in producing Chinook salmon offspring that survive and return back to Cougar Dam as adults (returns observed in 2010-12). Using local hatchery Chinook salmon appears to provide substantial VSP benefits for reintroducing fish back into historic habitat. However, based upon pedigree analysis, productivity rates are still too low to allow population rebuilding. Survival rates must increase.
- Given the recent success observed from hatchery Chinook salmon outplants, hatchery supplementation should continue into the near future until natural origin returns back to Cougar Dam trap are sufficient enough to maintain and increase the run into the future. Natural-origin Chinook salmon returns to Cougar trap have ranged from 219 to 496 fish from 2010-12, which includes a large number of adults that do not genetically assign to adults passed above the project. These returns of natural origin Chinook are encouraging, but still below the escapement deemed necessary by ODFW and NMFS in order to terminate hatchery supplementation., although it is not clear how many adults that originated from above Cougar Dam spawned beneath Cougar Dam Given the constraints stated above, ODFW and NMFS determined that 400 females and 200 males is a reasonable threshold above which additional hatchery supplementation is not necessary (see the appendix to the Draft Reintroduction Plan for further explanation on how these numbers were derived). These outplant numbers ensure sufficient juvenile Chinook salmon production for population rebuilding (given current downstream mortality rates) and maintain an adequate prey base for bull trout. The recovery goal for the area upstream of Cougar Dam is 3,000 Chinook salmon. See the "Adult Fish Passage Operations" section below for the implementation schedule for discontinuing hatchery supplementation.
- After implementation of the permanent downstream passage solution at Cougar dam/reservoir, juvenile passage survival will improve and resultant adult returns should increase substantially compared to 2010-12 returns. Once this occurs, the threshold for hatchery supplementation should be exceeded and hatchery Chinook salmon will no longer need to be outplanted to meet minimum escapement objectives. Fixing the key limiting factors so that natural production increases is essential in order to terminate hatchery supplementation.
- Management actions should be devised for the near term (before completion of downstream passage solution) and the long term (after completion of the downstream passage measures).

2. Implementation Plan

Proposed Actions in 2013-2016

<u>Interim Downstream Juvenile Fish Passage Operations</u>

1. Partial Reservoir Drawdown. Juvenile Chinook salmon downstream passage survival through Cougar reservoir and dam needs to increase substantially (cite Beeman, Normandeau estimates). Interim operations, with associated RME, should be taken to

improve juvenile Chinook salmon survival wherever possible. One operation is a drawdown to elevation 1500' which reduces head by 32 feet, which occurred in 2013.

2. Ongoing interim passage operations will be refined and improved through adaptive management based operations identified by OMET with review and approval by the WATER RM&E Team.
3. Implement interim passage operations, including partial drawdown in 2013, to inform refined and improved operations in subsequent years that optimize safe passage under the current project configuration until the permanent downstream passage solution is completed and operable.
4. Pass fry captured in screw traps above Cougar Reservoir to downstream of Cougar Dam. All juvenile Chinook salmon caught in smolt traps upstream of reservoir should be sampled, uniquely tagged (e.g. PIT) to facilitate survival evaluation, and then released downstream of Cougar Dam, as an interim improvement for survival and research/monitoring. Pass all juvenile Chinook salmon captured in the Portable Floating Fish Collector (PFFC) downstream of Cougar Dam. Specific details of the proposed operations will need to consider the effect on studies critical to assessing long-term passage solutions.

Adult Fish Passage Operations

5. Operate the Cougar Trap according to the Cougar Project Fish Collection Facility Standard Operating Procedure (Cougar SOP 2012). Collect and transport all natural origin Chinook salmon captured in the trap that assign to areas above Cougar Dam. Minimize impacts to natural origin adults captured at the trap that do not assign to production areas above Cougar Dam. Unassigned adults will be marked and recycled downstream to the mainstem McKenzie River. Transport fish using best management practices identified in the Cougar SOP (2012). The outplanting of hatchery Chinook salmon from McKenzie Hatchery shall use the same protocols and use only fish that are likely to survive to spawn. Emphasis is on the quality of hatchery Chinook salmon outplanted, not the quantity.
6. Transport all natural origin Chinook salmon (that assign to areas upstream from Cougar Dam) captured at Cougar Dam to release sites above the dam. If less than 400 natural-origin females are trapped and transported throughout the season, then outplant additional hatchery female Chinook salmon to total 400 females seasonally. Hatchery females will be outplanted in September from McKenzie Hatchery, after nearly all of the natural run at Cougar has occurred so that the appropriate number of hatchery females can be ascertained. Additional hatchery males will only be outplanted to ensure a sex ratio of one male for every two females released above Cougar Dam (natural and hatchery origin). If at least 200 natural origin males have been released from Cougar trap for 400 females, then no additional males will need to be outplanted from McKenzie Hatchery.
7. After completions of the permanent downstream passage fix all natural-origin Chinook salmon returning to the Cougar trap will continue to be passed upstream. The existing natural-origin Chinook salmon returning to the trap will continue to be the source stock for reintroduction. If natural-origin returns decrease dramatically for some unexpected reason, a new supplementation strategy will be initiated through WATER technical committees with the most appropriate stock(s) selected at that time.

Management Upstream of Cougar Dam

8. Angling regulations for the South Fork McKenzie River above Cougar reservoir are catch and release fishing for trout only, using artificial flies and lures only from late April through October. Salmon angling is prohibited.
9. Regulations in Cougar reservoir allow for fishing for trout. Five trout between eight and 24 inches may be harvested. No bull trout may be harvested. Residual Chinook salmon within this length slot limit may be legally harvested as part of the trout bag limit. It is unknown what level of harvest may occur on Chinook salmon in the reservoir. See RME section below for necessary evaluation of this.
10. No stocking of hatchery trout will occur in Cougar reservoir and waters upstream.
11. Continue working with Oregon State Police through the Cooperative Enforcement Program to monitor and conduct compliance checks in the reintroduction area.
12. Land management should focus on maintaining cold water attributes necessary for adult spring Chinook salmon holding throughout the summer.

Proposed Actions in 2017 and beyond

This will need to be described in further detail. It is important to acknowledge it may be several years after the downstream passage fix that natural-origin returns increase substantially, depending upon age at return (i.e. 1-4 years later). However, the outplanting numbers stated above (400 females, 200 males) would still be the threshold above which no additional hatchery supplementation is necessary above Cougar Dam.

3. Research, Monitoring, and Evaluation

Short Term (2013 – 2016)

13. USGS will monitor fish passage efficiency and survival of partial drawdown of Cougar Reservoir in October, November, and December of 2013. Data will be compared to last year's results.
14. Continue the pedigree study on all spring Chinook salmon outplanted above Cougar Dam to estimate productivity rates, effective population size, and adult genetic assignments. Pedigree analysis should also determine the percentage of unmarked fish spawning below the dam that assign to parents above the dam.
15. To determine productivity rates of Chinook salmon above Cougar Dam, the number of fish outplanted, prespawning mortality, and spawning escapement (redds) have to be monitored. Otherwise, with moderate to high prespawn mortality as observed in the past, productivity estimates differ tremendously depending on whether total number of fish outplanted or actual number of spawners are used in the calculations.
16. Monitor the timing, numbers, size, etc. of juvenile spring Chinook salmon captured in the PFFC.
17. Continue juvenile monitoring at screw traps above Cougar Reservoir and below Cougar Dam to estimate juvenile production and characterize emigration timing, size, and life-history type.
18. An assessment of the potential impacts of the trout fishery on juvenile Chinook salmon should be conducted. Available data should be analyzed on the fishing effort in the reservoir, likely harvest levels, and the expected proportion of the catch that may be Chinook salmon.
19. On an annual basis through the WATER technical committees, the results of the outplanting strategy will be assessed with any changes deemed necessary discussed and

finalized for the next trapping season. In addition, prespawn mortality rates, escapement levels, productivity rates, and pedigree analysis will also be reviewed and assessed to determine the success of the program, with appropriate changes made for the next season.

Supporting information: Reintroduction Planning: Management of Spring Chinook Salmon above Cougar Dam South Fork McKenzie River 2013-2017

Abundance Thresholds for Terminating Hatchery Supplementation

A critical component of the reintroduction plan for spring Chinook salmon above Cougar Dam is determining when hatchery fish supplementation is no longer needed. Hatchery Chinook salmon have been outplanted above Cougar Dam since 1992 (Figure 2). Originally, the intended purpose of outplanting was to re-establish a food source (carcasses and juveniles) for imperiled bull trout. However, since the ESA listing of spring Chinook, there is also a need to re-establish natural production in historic habitat that was blocked by the federal dams.

For spring Chinook salmon conservation, there becomes a point when natural origin returns increase to a level where additional hatchery supplementation is not necessary because the run is productive enough to grow on its own. Eliminating continual hatchery supplementation is important so that potential deleterious effects of hatchery fish can be reduced and a locally-adapted natural origin run can develop. Eliminating long-term hatchery supplementation is also important from a monitoring perspective. It is important to be able to assess the run in the wild (without continual artificial supplementation) to determine if it is self-sustaining.

The purpose of hatchery supplementation above Cougar Dam for spring Chinook salmon conservation is to provide an adequate spawner escapement of Chinook salmon to allow the re-colonization and rebuilding of a natural origin run above the dam. If spawning is too low, juvenile production will be low and the run will not be able to rebuild. If natural origin fish abundance increases and hatchery supplementation still occurs, then productivity may be reduced from continual hatchery impacts. There are risks and benefits to wild salmon conservation from hatchery supplementation that need to be acknowledged.

Even though hatchery spring Chinook salmon have been outplanted and likely produced returning offspring to Cougar Dam since 1992, spring Chinook have not been collected and transported above the dam until the collection facility was operational in 2010. In the first three years of operation (2010-12), natural origin Chinook salmon returns to Cougar Dam trap have been 222, 350, and 496 fish, respectively. Based on pedigree analysis, many of the natural origin

Chinook salmon at the trap were not born above Cougar Dam. From 2010 to 2013, on average, 83 adult females ChS returned to the trap that assigned to areas upstream from Cougar Dam. The hatchery fish outplants in 2006-2009 produced these returning natural origin salmon. These preliminary results are encouraging and demonstrate hatchery outplanting (100% of fish) can produce returning offspring to potentially rebuild an extirpated run. Similar findings in the Willamette Basin have occurred in Fall Creek and Clackamas River; using hatchery spring Chinook salmon to reintroduce above dams.

With the natural origin returns to Cougar Dam to date, it is important to determine at what point hatchery supplementation would be eliminated because natural production is sufficient to potentially allow for rebuilding of the run. Conceptually, survival rates through the project and throughout the individual life stages need to be sufficient to allow productivity rates (recruits per spawner) to be greater than one. If productivity does not exceed one, then the population will not rebuild. Productivity rate estimates for the adult returns in 2010-12 have been evaluated. Current productivity is likely not high enough to allow rebuilding of the natural origin run above Cougar Dam. If productivity is calculated based upon the total number of fish outplanted (parents) versus natural origin fish returns to the trap (progeny), the estimates range from 0.18 to 0.65. If productivity is estimated from the number of redds (spawning), productivity ranges from 0.41 to 1.7. The drastic difference in the productivity estimates comes from the high prespawning mortality observed from time of outplanting to spawning. These calculations are biased high because it assumes every natural origin Chinook captured at Cougar Dam are progeny from adults spawning above Cougar Dam, which we know is not the case. The pedigree analysis shows natural origin Chinook produced below Cougar Dam are entering the trap. Trapping protocols will be implemented to avoid passing those adults that don't assign to production areas upstream from Cougar Dam. Continuing RM&E (prespawning mortality and spawning escapement) is critical in order to be able to evaluate productivity into the future.

It is known the downstream passage survival of juvenile Chinook through Cougar reservoir and dam is poor. Any fish that pass the project do so through existing routes of the turbines and regulating outlets only during certain conditions. Providing a fish passage solution is a known need and required by RPA 4.12.1. Ensuring survival with an adequate potential for recovery will not occur without improvements to downstream passage survival of juvenile Chinook salmon.

However, even though downstream passage improvements are necessary, the return of natural origin Chinook salmon back to Cougar trap is the ultimate measure of success. If returns continue to increase, there comes a point where hatchery supplementation is not necessary. The WATER committees have discussed what the abundance threshold may be for the area above Cougar dam. There are a wide range of issues that need to be considered, and some are not related to spring Chinook salmon. Below is a summary of the findings for the recommendations provided above in the reintroduction plan.

The natural origin spring Chinook returns in 2006 through 2008 to the Willamette River Basin were some of the lowest since listing in the 1990's. For the area above Cougar dam, in these years the number of females outplanted and subsequent redd production was also very low (Table 1). There was consensus among ODFW and NMFS; if at all possible, production should remain above these levels to ensure adequate juvenile production for salmon conservation, bull trout conservation, and research purposes. In those years, the total number of females outplanted ranged from 243 to 288 (Table 1). In a previous draft of this plan, NMFS recommended 200 females and 200 males for the threshold for no additional hatchery outplanting. However, in subsequent assessments, this level could result in low redd production if prespawning mortality is high. Given the low productivity rates observed to date, this threshold was deemed too low. Maintaining sufficient egg production (with some additional hatchery fish spawning) was deemed lower risk than not having enough redd production (and reducing hatchery supplementation). ODFW recommended continuing to outplant 1,300 spring Chinook annually for salmon and bull trout recovery. This threshold was precautionary for bull trout conservation, but not necessary for spring Chinook.

After further discussions, ODFW proposed a minimum escapement of 400 females and 200 males (600 fish at 2:1 sex ratio) as the threshold for hatchery supplementation. If less than 400 females are captured at Cougar trap and transported upstream, then hatchery supplementation will contribute females in order to have at least 400 females outplanted. ODFW and NMFS desire to maintain sufficient juvenile production for potential population increase, for research purposes, and to maintain the bull trout prey base. It is acknowledged there may be hatchery related risks over the short term by continuing to outplant hatchery fish when natural origin returns are less than 400 females and 200 males. However, conversely there is also substantial

risk with not providing sufficient spawning to ensure adequate juvenile production given the known problems with prespawning mortality of adults and poor downstream passage survival of juveniles. The 600 Chinook salmon threshold (400 females and 200 males) is a reasonable threshold, considering all factors, above which hatchery supplementation will not be necessary. It is anticipated hatchery supplementation will only be required over the short term, with adequate fixes going into place to allow natural origin fish to increase to above 600 fish and therefore hatchery supplementation will not be necessary.

Figures and Tables

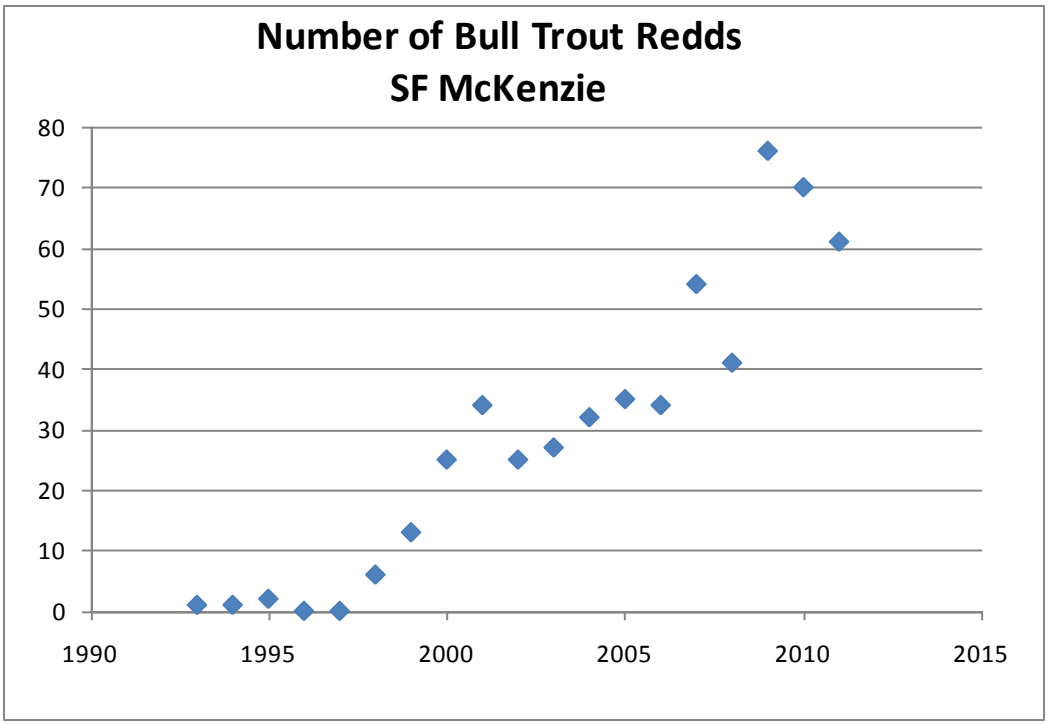

Figure 2. Number of bull trout redds observed in the South Fork McKenzie above Cougar Dam from 1993-2011.

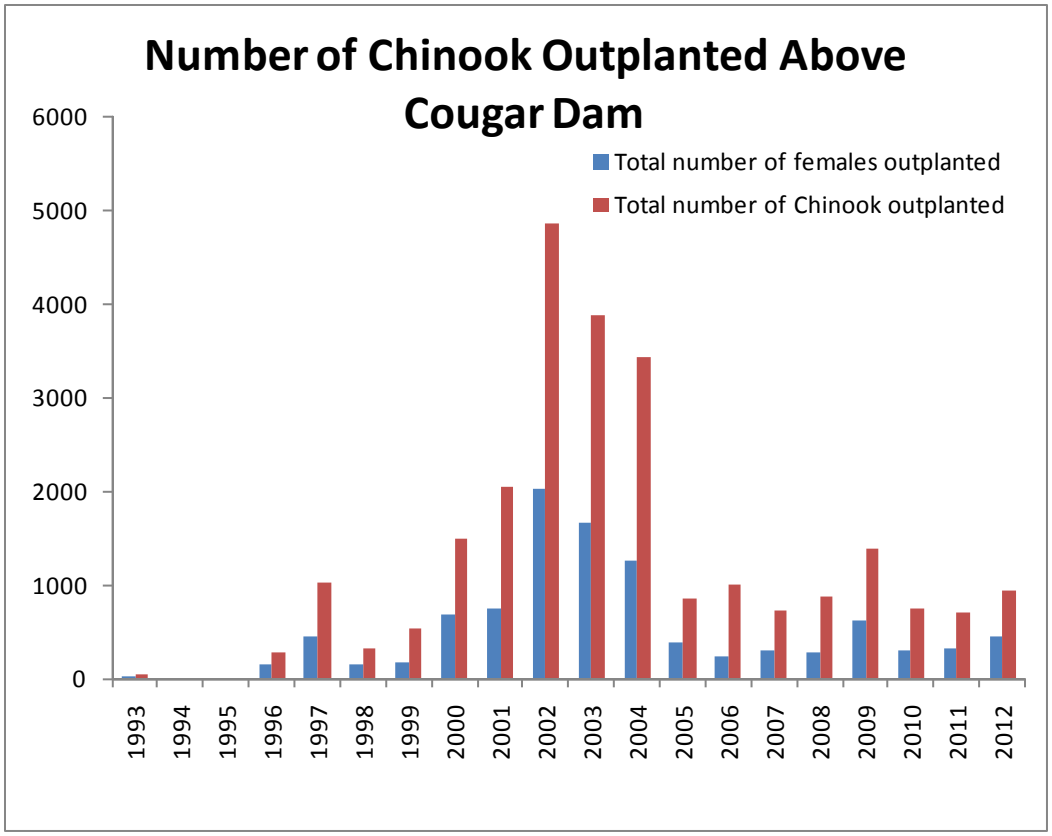

Figure 3. Total number of spring Chinook salmon outplanted above Cougar Dam, SF McKenzie.

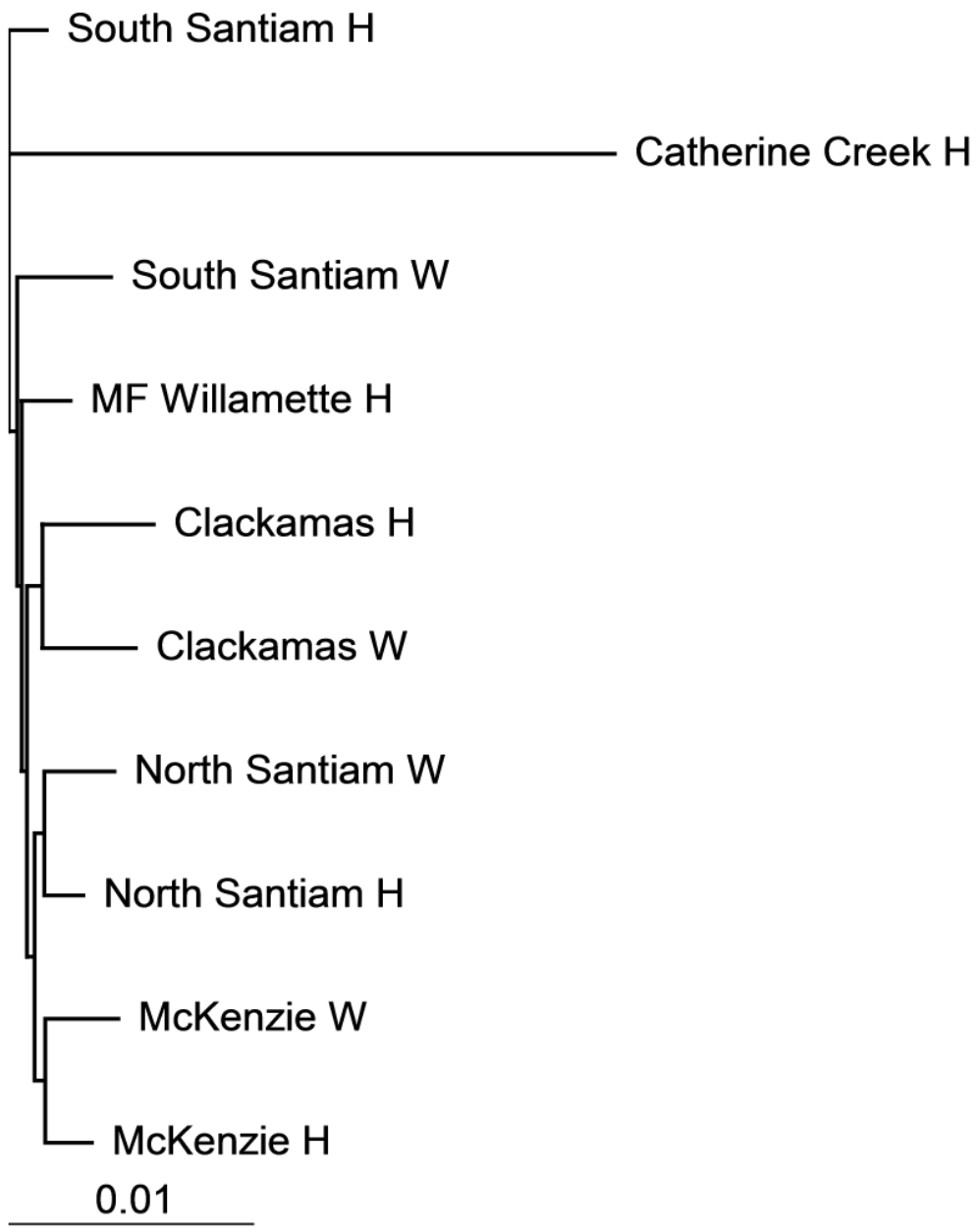

Figure 3. From Johnson and Friesen (2012). Maximum likelihood tree depicting genetic relationships among hatchery (H) and wild origin (W) spring Chinook salmon populations from the Willamette River and the Catherine Creek hatchery population (Grande Ronde River). Phylogeny inferred from genotypic data for 13 microsatellite loci. Branch lengths represent Cavalli-Sforza chord measures of genetic distances (Cavalli-Sforza and Edwards 1967).

Table 2. Data set for outplanting of spring Chinook salmon above Cougar Dam. The prespawn mortality estimate for 2010 (31%) is biased low because study fish outplanted later in the season.

Year	Hatchery origin adult females outplanted (trap & hatchery)	Hatchery origin adult males outplanted (trap & hatchery)	Hatchery origin jack males outplanted (trap & hatchery)	Natural origin adult females collected from Cougar Trap	Natural origin adult males collected from Cougar Trap	Natural origin jack males collected from Cougar Trap	Total number of females outplanted	Total number of Chinook outplanted	Estimated prespawn mortality from radio tagged chs above Cougar (Zymonas et al. 2011)	Number of redds observed (Zymonas et al 2011)	Life stage BY 2007
1993	33	22	1	0	0	0	33	56			
1994	0	0	0	0	0	0	0	0			
1995	0	0	0	0	0	0	0	0			
1996	160	127	7	0	0	0	160	294			
1997	465	572	1	0	0	0	465	1038			
1998	153	165	9	0	0	0	153	327			
1999	180	366	3	0	0	0	180	549			
2000	695	801	10	0	0	0	695	1506			
2001	765	1233	57	0	0	0	765	2055			
2002	2038	2767	56	0	0	0	2038	4861			
2003	1680	2140	64	0	0	0	1680	3884			
2004	1263	2143	24	0	0	0	1263	3430			
2005	387	462	14	0	0	0	387	863		110	
2006	243	765	10	0	0	0	243	1018		162	
2007	297	438	8	0	0	0	297	743	0.55	95	spawner
2008	288	573	13	0	0	0	288	874	unknown	128	fry
2009	629	651	107	0	0	0	629	1387	0.62	274	smolt
2010	251	275	1	64	155	3	315	749	0.31	175	jack return
2011	183	181	6	150	198	2	333	720	unknown	236	age 4 return
2012	257	182	8	190	306	0	447	943	unknown	282	age 5 return
2013				94	123	8					

<u>Appendix E.</u> McKenzie River: Summary of Hatchery Production Analyses (November, 2015).

As a part of the completion of the McKenzie River spring Chinook HGMP, the USACE (with support from BPA), NMFS, and ODFW analyzed a range of smolt production levels for this program that would meet two primary objectives: 1) to provide ESA conservation benefits, consistent with survival and recovery of the ESU, and, to mitigate for habitat lost or made inaccessible by the construction and operation of Blue River and Cougar Dams, which will provide adult returns to help meet harvest objectives for the McKenzie River, lower basin, and ocean fisheries, and 2) reduce pHOS in the McKenzie River Basin to less than 10% in the entire subbasin excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam (excluding the intentional hatchery supplementation areas upstream of Cougar and Trail Bridge dams). In order to complete this assessment, many factors and considerations were taken into account. Below is a summary of this work.

Established ESA Management Objectives in the McKenzie River:

1. The health or viability of a natural salmonid population is determined by four parameters: abundance, productivity, diversity, and spatial structure.
2. The 2008 Willamette Project BiOp, and the NMFS-adopted Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead, both highlight the need to increase population spatial structure and abundance. The BiOp commits the Action Agencies to outplanting salmonids above federal dams, including Cougar Dam in the McKenzie River. The Recovery Plan includes the concept of outplanting hatchery fish above Trail Bridge Dam, which is owned by the Eugene Water and Electric Board (EWEB).
3. The McKenzie spring Chinook salmon hatchery program is designed to serve an ESA conservation (broodstock and outplanting) and harvest purpose. Hatchery programs also pose risks, most notably the potential for genetic introgression and competition between hatchery fish and wild fish. Professional biologists seek to manage the McKenzie Spring Chinook hatchery program such that its benefits to the natural-origin population outweigh its risks.
4. In the McKenzie River, the hatchery program will be tailored to benefit population spatial structure and abundance while sufficiently limiting risks to diversity and productivity.
5. Reintroduction/Outplanting Objectives for Adult Chinook Salmon
    5.1. Upstream of Cougar Dam
        5.1.1. From 2010-2015, an average of 109 natural-origin female Chinook salmon have been captured at the Cougar Dam trap. Based upon the results of pedigree analyses from years 2012 and 2013 (the only years for which pedigree data are available), an average of 83 female Chinook that returned to the Cougar Adult Trap had originated from above Cougar Dam.
        5.1.2. The minimum number of female Chinook needed for outplanting above Cougar Dam is 400. Natural-origin Chinook from the Cougar Adult Trap are supplemented by additional hatchery females as needed to meet the minimum goal of 400 females.
    5.2. Upstream of Trail Bridge Dam (if surplus returning hatchery Chinook salmon adults are available)

5.2.1. The minimum seeding level of female Chinook above Trail Bridge Dam is 60 females.

5.3. Mohawk River (lowest priority for surplus returning hatchery Chinook salmon adults)

5.3.1. The minimum seeding level of female Chinook in the Mohawk River is 50 females.

6. Hatchery Chinook Spawning in the Wild

6.1. The proportion of hatchery Chinook spawning in the wild (pHOS) is a function of the number of hatchery-origin Chinook spawners AND the number of natural-origin Chinook spawners. Improving natural production of Chinook increases adult returns and also reduces pHOS.

6.2. Currently, pHOS is managed to be less than 10% hatchery Chinook spawning in the wild, excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam. The primary wild production area (>95%) is upstream of Leaburg Dam. However, if the natural-origin population continues to decline in the McKenzie River, the pHOS goal may need to be modified to respond to the latest demographic and genetic conditions of the natural population. The intentional outplanting of hatchery Chinook into reintroduction areas upstream of Cougar and Trail Bridge dams, are not included in pHOS calculations because hatchery fish are purposefully used for supplementation of natural spawning.

7. Downstream Passage Improvements at Cougar Dam and Reservoir

7.1. Willamette BiOp RPA 4.12.1 calls for long-term improvements at Cougar dam to increase downstream passage survival of juvenile Chinook salmon. This is essential for helping to reduce pHOS, because the population above Cougar Dam is not rebuilding. Currently, it is estimated to be at about a 0.4% replacement rate. This means that for every 10 Chinook outplanted above the dam, four return back to the Cougar Adult Trap. The ultimate success of the hatchery supplementation effort above Cougar Dam, in which natural-origin returns are restored and hatchery supplementation is no longer needed, depends upon successful downstream passage of Chinook salmon in the South Fork McKenzie River.

8. McKenzie Hatchery Broodstock Needs

8.1. The observed sex ratio of Chinook salmon returning to McKenzie hatchery is 43% female, 57% male.

8.2. Smolt production 787,000 = ~260 females

8.3. Smolt production level 604,750 = ~225 females.

Data Used in the Analyses:

9. Observed smolt-to-adult survival rates of McKenzie hatchery Chinook by month of release for Brood Years 1990-2007, which is the full record of data. Adult returns are complete five years later than the brood year.
10. Observed counts of hatchery and natural-origin Chinook salmon returning to McKenzie Hatchery, Leaburg Dam, and Cougar Dam.
11. Observed exploitation rates of Willamette spring Chinook salmon in ocean and freshwater fisheries.

Selection Criteria used in the Analyses:

12. Hatchery production changes must substantially reduce pHOS, with the preferred outcome being 10% or less for the McKenzie Subbasin excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam. More than 95% of the observed natural-origin Chinook salmon in the McKenzie River Basin are produced upstream of Leaburg Dam.
13. Management changes to reduce pHOS must also ensure that hatchery broodstock and reintroduction/outplanting needs are attained in most years. For an alternative to be viable it must result in the minimum female broodstock needs being attained more than 50% of the time.
14. The minimum female needs used in the analyses were: 317 female Chinook available for Cougar reintroduction/outplanting (400 females needed, of which, on average, 83 females have been produced from above Cougar Dam (400-83=317 hatchery females needed) and collected at the Cougar Trap. The number of females needed for hatchery broodstock depended upon the smolt release level and is reported in Table 1. Outplanting goals for the Mohawk River were not included in the analysis shown in Figure 1. Trail Bridge and Mohawk releases will occur only when surplus adult returns are available from the McKenzie Hatchery after South Fork McKenzie needs are met.
15. The analyses used pessimistic assumptions that would over predict pHOS in order to evaluate the worst case scenarios. To simplify calculations, the ODFW and NMFS analyses assumed all returning adults not entering the McKenzie hatchery stray above Leaburg Dam. Annual spawning survey information indicates that about 65% of the adults not entering the McKenzie hatchery stray above Leaburg Dam.

Summary of Analyses

16. There are two primary ESA considerations in the management of the McKenzie Hatchery program: 1) reduce pHOS to less than <10% in the McKenzie River (excluding the area upstream of Cougar and Trail Bridge dams), and 2) provide certainty that hatchery returns will be sufficient over the long-term to provide hatchery fish for reintroduction/outplanting needs above Cougar Dam.
17. The analyses clearly demonstrate that as the hatchery program is reduced, pHOS is also reduced. However, this comes at the cost of less certainty in providing enough returning hatchery Chinook to meet broodstock needs and the reintroduction/outplanting needs.
18. Conversely, increasing hatchery production up to the maximum poundage cited in the USACE/ODFW Cooperative Agreement (80,000 pounds or ~808,000 fish) provides greater certainty of attaining broodstock and reintroduction/outplanting needs every year, but does not meet the pHOS goal of less than 10%.
19. Therefore, there is a balancing of the risks to the natural population and the benefits of attaining broodstock and reintroduction needs that must be considered in order to meet the primary ESA management objectives for the McKenzie River and to make adult fish available for harvest.
20. Three independent analyses conducted by ODFW (2014; Figure 4), NMFS (2015; Table 4), and Peven/Corps/BPA (2015; Table 4) have all demonstrated the recent smolt production

reductions in the McKenzie River since 2011 will reduce pHOS in the McKenzie River (Figure 2). All of these analyses show that reducing hatchery Chinook to ~500,000-~700,000 fish annually is likely to reduce pHOS to less than 10%. This production level also provides returning adults needed for broodstock and reintroduction/outplanting 50% of the time.

21. Upgrading the McKenzie Hatchery ladder to improve its attraction flows, and improving acclimation/imprinting by using Cogswell Creek water through the rearing cycle will also help to reduce pHOS by attracting more hatchery Chinook back into the McKenzie Hatchery. In addition, the removal of hatchery Chinook adults at Leaburg Dam will add further confidence that pHOS will be reduced to less than 10% in the future.
22. Based upon these assessments, the McKenzie Chinook HGMP proposes a smolt production of 604,750 fish to be released annually.

Management Direction

The release of 604,750 spring Chinook smolts annually provides adequate hatchery adults for broodstock and outplanting above Cougar Dam approximately 50% of the time and minimizes stray rate risk by attaining on average pHOS <10% basin-wide. pHOS rates are further reduced by implementing hatchery improvements (ladder, imprinting, and acclimation) and removing hatchery adults from the Leaburg Dam fish ladder.

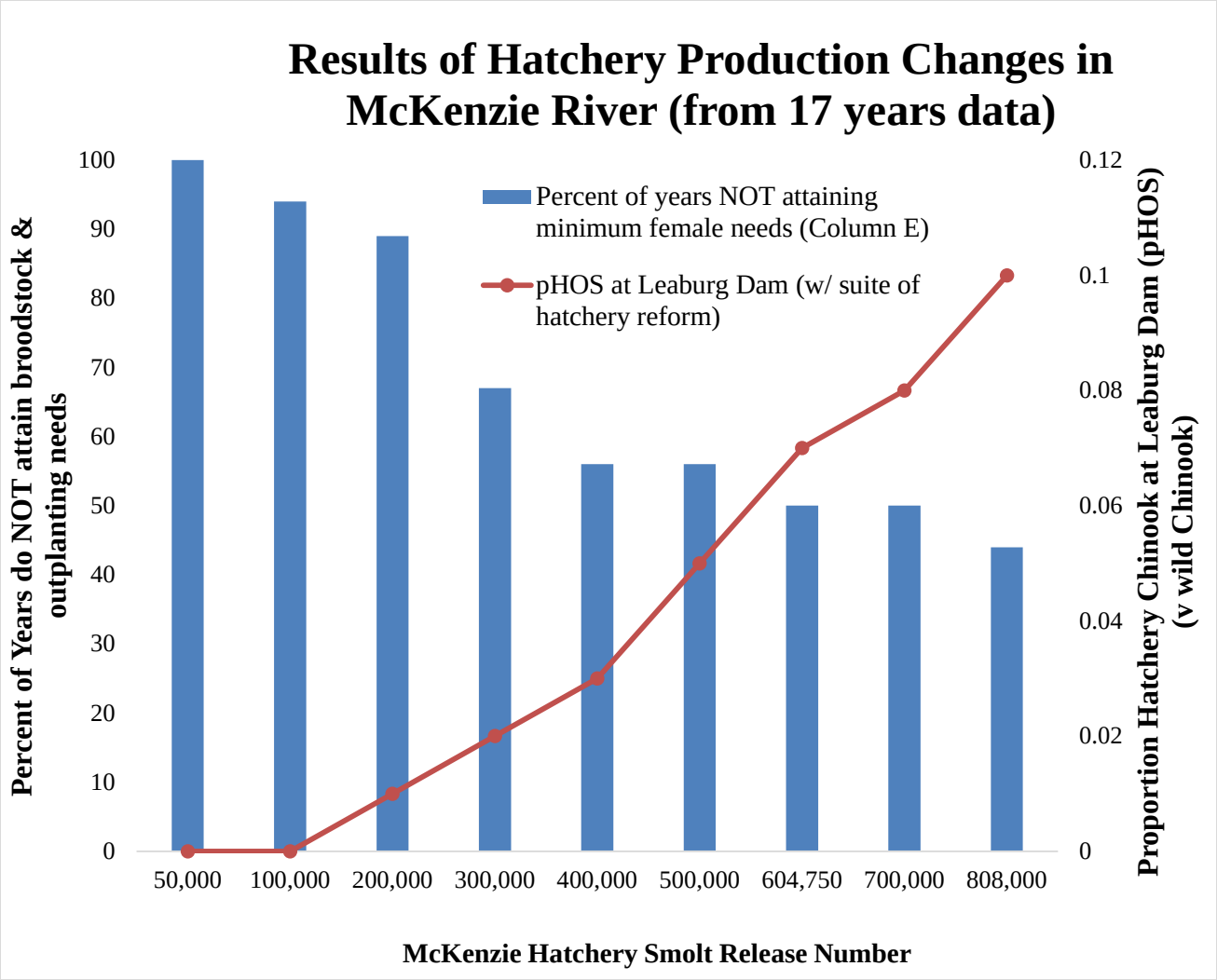

Figure1. Results from ODFW (2014) of the most conservative scenario of the minimum female needs for broodstock (based upon smolt production level), Cougar outplanting (317 females), and Trail Bridge outplanting (60 females).

Table 3. Data used by ODFW (2014) in Figure 1.

Hatchery smolt release number	pHOS at Leaburg Dam (w/ suite of hatchery reform)	Percent of years NOT attain minimum female needs (broodstock, 317 Cougar, 60 Trail Bridge)	Total number of females needed (broodstock, Cougar, Trail Bridge)	Cougar Dam females	Trail Bridge Dam females	Broodstock females needed
50,000	0	100	395	317	60	18
100,000	0	94	414	317	60	37
200,000	0	78	452	317	60	75
300,000	0.01	61	490	317	60	113
400,000	0.03	56	527	317	60	150
500,000	0.05	50	564	317	60	187
604,750	0.07	50	602	317	60	225
700,000	0.08	44	639	317	60	262
808,000	0.1	39	680	317	60	303

Table 4. Results of Peven/Corps/BPA (2015) and NMFS (2015) production ranges for various scenarios. The reintroduction goal applied was 317 hatchery Chinook salmon females for supplementation above Cougar Dam.

Scenario	Smolt release range	pHOS[b]
What is the smolt production level that will meet the reintroduction goals with existing harvest 50% of the time?	531,500-610,000	6-18%
What is the smolt production level that will meet the reintroduction goals without existing harvest 50% of the time?	330,000-451,400	5-18%
What is the smolt production level that will meet the reintroduction goals with existing harvest 100% of the time?	1,360,000-5,046,809 [a]	16-54%
What is the smolt production level that will meet the reintroduction goals without existing harvest 100% of the time?	1,140,000 – 3,734,639 [a]	18-54%

[a] The values for meeting the reintroduction goals for these two scenarios appears to be an overestimate at the high end of the range because of one extremely low SAR value that is used in the dataset. If apparent outliers are removed, the high end of the range is lower.

[b] The high end of the pHOS estimate range does not account for anticipated improvements in hatchery ladder attraction efficiency or the management action of removing 100 hatchery adults from the Leaburg ladder trap. If both of these actions consistently occur, it is likely that pHOS will be lower than the highest value listed for a given range.

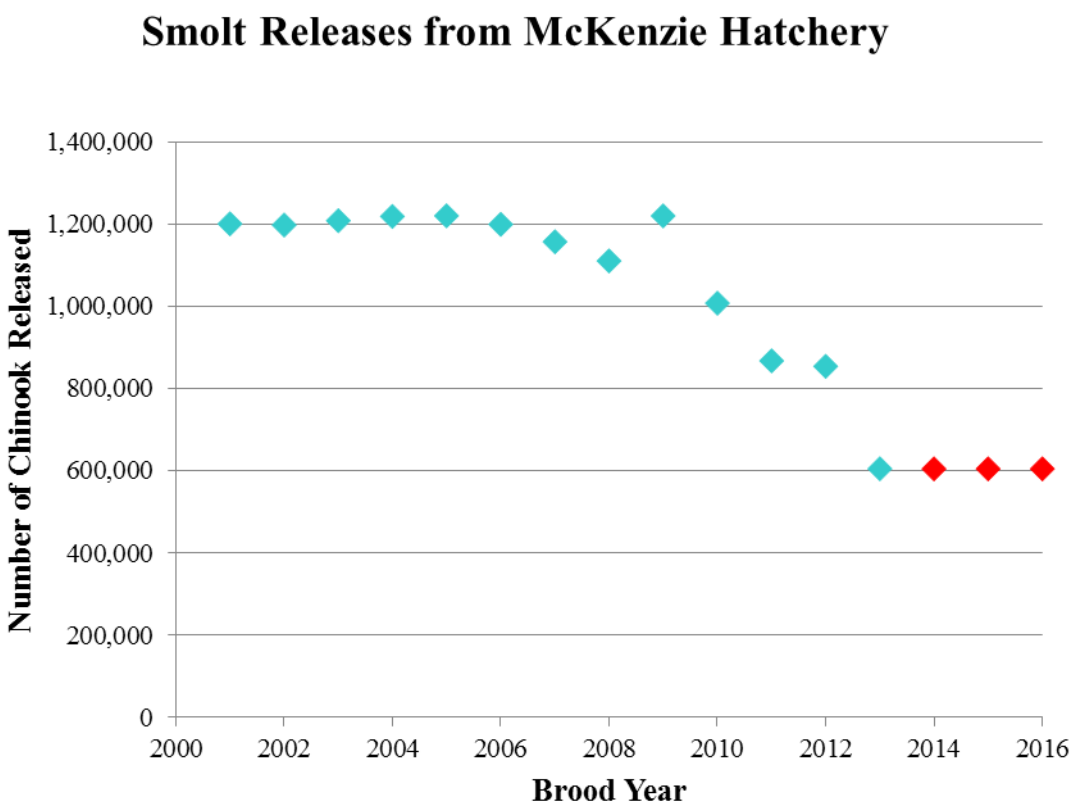

Figure 4. Releases of Chinook salmon from McKenzie Hatchery by brood year (adult returns are complete 5 years later). pHOS will be reduced from the reductions in hatchery production beginning in brood year 2010. The proposed future release in the McKenzie HGMP is 604,750 fish annually and is expected to reduce pHOS to less than 10%.

NMFS. 2015. Citation for this work.

Peven, Corps, BPA. 2015. Citation for this work.

ODFW. 2014. Citation for this work.

Appendix E. Cougar Adult Fish Facility Operations and Transport Protocols for Chinook Salmon:

1. Given ongoing concerns about declining run sizes in the McKenzie Basin, the poor flow and temperature conditions in 2015, and limited data on which to base long-term decisions, a protective approach to operations and transport protocols will be implemented at the Cougar Adult Fish Facility to try to limit the mining of the below-Cougar population to 2% or less. All natural origin Chinook captured in the trap will be floy tagged and released in the lower SF McKenzie or mainstem McKenzie below the SF confluence [at Forest Glen]. If floy-tagged fish re-ascend into the trap, they will be released above Cougar Dam. "Stray" adipose clipped fish captured at the Cougar Fish Facility will be transported above Cougar.

2. Pedigree results and other data (run size, timing at Willamette Falls, Leaburg Dam, and Cougar Fish Facility, etc.) will be reviewed annually to inform potential changes to this operation in the next year. The pedigree study results from the 2014 and 2015 samples will be of particular value for informing management in 2016. If this retrospective analysis indicates that impacts to the below-dam-origin Chinook population is less than 2% (number of below-dam-origin Chinook placed above Cougar/McKenzie NOR abundance estimate (excluding above Cougar), changes to the protocol will be considered.

a. Previous data indicates that the September 1st protocol may provide adequate protection for the below-dam population – that protocol will be considered in future years based on previous and new data:

i. Before September 1: Transport all natural origin Chinook salmon captured in the trap for release above Cougar Dam.

ii. After September 1st: Floy tag and transport all natural origin Chinook salmon capture in the trap for release in the lower SF McKenzie or mainstem McKenzie below the SF confluence [at Forest Glen]. Transport all natural origin Chinook salmon outfitted with a Floy tag captured in the trap for release above Cougar Dam.

b. Review of data may indicate other changes to the protocol may be warranted, and will be considered in the annual review. These may include lower or upper abundance thresholds that trigger recycling, changes in the date when recycling begins, or other options.

3. If less than 400 natural origin females are trapped and transported throughout the season, then additional hatchery female Chinook salmon will be outplanted to total 400 females seasonally. Hatchery females will be outplanted in September from McKenzie Hatchery, after nearly all of the natural run at Cougar has occurred so that the appropriate number of hatchery females can be ascertained. Additional hatchery males will only be outplanted to ensure a sex ratio of one male for every two females released above Cougar Dam (natural and hatchery origin). If at least 200 natural origin males have been released from Cougar trap for 400 females, then no additional males will need to be outplanted from McKenzie Hatchery. Outplanting of "stray" hatchery-origin Chinook salmon from the Cougar FCF will be included in the accounting. The outplanting of hatchery Chinook salmon from McKenzie Hatchery shall use the same protocols and use only fish that are likely to survive to spawn. Emphasis is on the quality of hatchery Chinook salmon outplanted, not the quantity.

4. It may be several years after a downstream passage fix that natural origin returns increase substantially, depending upon age at return (i.e. 1-4 years later). Data collected between now

and downstream passage implementation will inform appropriate outplant numbers to be included in a long-term reintroduction plan.

B. Adaptive Management:

1. Annually, tissue samples will be taken from all natural-origin adults entering Cougar Trap, all hatchery-origin Chinook outplanted above Cougar Dam, and from carcasses encountered during spawning surveys in the McKenzie subbasin below Cougar Dam and preserved for future genetic analysis. Funding will be sought for Pedigree study analyses and results from two years of sampled data (e.g. Banks et al.) and will be reviewed annually before Cougar Dam downstream fish passage is improved, and every other year for at least a total of 6 years following passage improvements, to evaluate the fish passage and reintroduction program. Annual trap protocols will be defined by April of each year, based on review of relevant data.

2. The seasonal trapping protocol should be reviewed and adjustments considered if impacts to the below-dam population are less than or greater than 2%. (as described in Section A #2 above) When the seasonal transport protocol is under review, additional factors should be considered including:

   a. contributions from above Cougar below the lower spawning reaches,
   b. adfluvial parents contribution to the unassigned fish,
   c. repeat male spawners from below entering trap late in season,
   d. impacts of recycling on returns to Cougar Trap (PSM, straying elsewhere after recycled)

3. If fitness of hatchery fish is statistically different from natural origin returns, then the thresholds for supplementation (400 females / 200 males) should be reviewed and changed as necessary to maximize fitness and encourage local adaptation, as balanced with the need to maintain production using supplementation until natural origin returns are above the thresholds.

4. A review of supplementation efforts (as described in #3 of Operations/Protocols above) will occur if annual abundance thresholds (>400 natural-origin females / >200 natural-origin males) are maintained on a three year rolling average or when R/S ratio is determined to be >1 for three consecutive years. The review would include examining population trends, potential impacts (negative and positive) of supplementation, and other relevant factors.

5. This document will be reviewed annually given the considerations described above, and updates will be made as necessary.