HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	North Santiam River Spring Chinook Salmon
Species or Hatchery Stock:	Spring Chinook Salmon (stock 21)
Operator/ Funding Agency:	Oregon Department of Fish and Wildlife/ U.S. Army Corps of Engineers
Watershed and Region:	North Santiam River, Willamette River, Columbia River
Date Submitted:	September 2016
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List of Acronyms

°C	degrees Celsius
°F	degrees Fahrenheit
AWS	Alternative Water Supply
SBA	Supplemental Biological Assessment
BiOp	Biological Opinion
BKD	Bacterial Kidney Disease
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
CHS	spring Chinook salmon
cfs	cubic feet per second
CSP	Conservation Supplementation Program
CWT	Coded Wire Tag
ELISA	Enzyme-linked immunosorbent assay
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FDA	Food and Drug Administration
FHMP	Fish Hatchery Management Policy
FMEP	Fish Management Evaluation Plan
FPT	Fish Passage Team
ft	feet
gal	gallon
gpm	gallons per minute
GSI	Genetic Stock Identification
HGMP	Hatchery Genetic and Management Plan
HMIS	Hatchery Management Information System
HMT	Hatchery Management Team
HMP	Harvest Mitigation Program
HMTT	Hatchery Management Technical Team
HSRG	Hatchery Scientific Reform Group
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
NPDES	National Pollutant Discharge Elimination System
NPPC	Northwest Power Planning Council
OAR	Oregon Administrative Record
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
PA	Proposed Action
PNFHPC	Pacific Northwest Fish Health Protection Committee
pHOS	Proportion of Hatchery-Origin Spawners

PIT	Passive Integrated Transponder
pNOB	Proportion of Natural-Origin Brood
pNOS	Proportion of Natural-Origin Spawners
PSM	Pre-spawning mortality
PVC	polyvinylchloride
RM&E	Research, Monitoring, and Evaluation
RPA	Reasonable and Prudent Alternative
R.s	*R. salmoninarum*
SAR	Smolt to Adult Return Ratio
SBA	Supplemental Biological Assessment
SCAB	Steelhead and Chinook Salmon Above Barriers
SMU	Species Management Unit
TBD	To be determined
TU	Temperature Unit
USACE	US Army Corps of Engineers
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	US Fish and Wildlife Service
UWR	Upper Willamette River
VSP	Viable Salmonid Population
WATER	Willamette Action Team for Ecosystem Restoration
WFMP	Wild Fish Management Policy
WFOP	Willamette Fish Operations Plan
WHMP	Willamette Hatchery Mitigation Program
WBFMP	Willamette Basin Fish Management Plan
WP	Willamette Project
WVP	Willamette Valley Project

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

North Santiam 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 Marion Forks Hatchery (stock 21) originated from the wild stock of CHS in the North Santiam River. The natural origin spawning population and the Marion Forks Hatchery population of CHS in the North Santiam River are part of the Upper Willamette Evolutionarily Significant Unit (ESU) for CHS and are listed as threatened under the ESA.

1.3) Responsible organization and individuals.

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

Funding:

Marion Forks Hatchery - Cost responsibilities for Marion Forks 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 Detroit and Big Cliff Dams) and Oregon Department of Fish and Wildlife (ODFW). The federal/state funding split is determined under the USACE and ODFW Cooperative Agreement (2012) based on production levels. The Cooperative Agreement states that the USACE will fund up to 84,000 lbs of CHS and/or steelhead *O. mykiss* for release into the North Santiam Subbasin. Currently (2016), the USACE funds (in accordance with the Cooperative Agreement percentage split) the adult collection, smolt production, and smolt release, of approximately 58,667 pounds of Chinook salmon for the North Santiam Spring Chinook program, where adults are collected and smolts are released in the North Santiam. ODFW funds 100% of smolt production and release of an additional 7,140 pounds of Chinook salmon for its Molalla River Chinook recovery program, where adults are collected in the North Santiam and smolts are released in the Molalla River.

Table 1.4-1. Adult Collection and Smolt Release Location, Program/Action, and Funding Source for Spring Chinook Production

Maximum Poundage of spring Chinook Salmon	Collection Location	Release Location	Program/Action	Funding Source
84,000[1]	North Santiam	North Santiam	North Santiam Spring Chinook program (RPA 6.1.1; 6.2.1-3)	USACE
7,140	North Santiam	Molalla	Molalla River Chinook recovery (RPA 6.1.1; 6.2.5)	ODFW
Egg take as available	North Santiam	Lower Columbia	SAFE program (non-BiOp)	ODFW/NMFS[2]

[1] The SAFE program is a separate action outside the umbrella of the Willamette BiOp, and is the subject of a separate consultation.
[2] NMFS may assist with transportation, release (net pens), and indirectly with some fish health expenses.

Minto Fish Facility - Cost responsibilities for Minto are developed between the USACE and ODFW according to the Cooperative Agreement (2012), depending on what

[1] Total production salmon and steelhead per 2012 Cooperative Agreement between ODFW and USACE

broodstock collection, adult outplanting, and juvenile acclimation and releases occur at the facility for the three different programs noted above.

Staffing Level: Minto Fish Collection Facility and Marion Forks Hatchery have a combined 7 FTEs and a budget of approximately $1.2 million.

Budget: The annual operation and maintenance budget for the CHS program at Marion Forks/Minto for the calendar year 2016 was $1.2 million (including indirect costs). Per the 2012 Coop Agreement, in 2016, these costs were paid 100% by the USACE. Funding for fish pathology, fish identification (marking), electricity, and Research, Monitoring, and Evaluation (RM&E) is separate from the operation and maintenance budget.

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

- Marion Forks Hatchery is located 17 miles east of Detroit, Oregon, between Horn Creek and Marion Creek, near the confluences of those creeks with the North Santiam River (at river mile 73). The elevation of the hatchery is 2,580 ft above sea level (Section 15, T 11S, R 7E (44° 36' 46" N, 121° 56' 47" W)).

- The Minto Fish Collection Facility is located in Section 30, T 9S, R 4E at River Mile 42 (44° 45' 27" N, 122° 21' 52" W).

Activities:

*Adult Collection***:** CHS adults are collected and spawned at the Minto Fish Collection Facility that is located about 31 miles downstream of Marion Forks Hatchery. Minto Dam is situated on the North Santiam River, approximately 4 miles below the USACE's Big Cliff Dam. Minto Dam on the North Santiam River helps direct returning adult Chinook salmon into the Minto Fish Collection Facility. The elevation of the Minto Fish Trapping Facility is 1,000 ft. above sea level. This facility was rebuilt in compliance with Reasonable and Prudent Alternative (RPA) 4.6 of the National Marine Fisheries Service's (NMFS') 2008 Willamette Valley Project Biological Opinion (WP BiOp; NMFS 2008), to improve collection and release of adult fish (i.e., minimizing fish stress and injury) and result in improved upstream passage to historical habitat for the purpose of supporting increased productivity and spatial structure (i.e., trap and haul above Big Cliff and Detroit dams) (Table 1.15-1).

Juvenile Rearing: All North Santiam stock CHS are reared at Marion Forks Hatchery from early egg incubation to 12-15 fish per pound.

Pre-release Acclimation: The goal is to acclimate and release all North Santiam CHS from the Minto Fish Collection Facility. Juvenile CHS are trucked (transferred) from Marion Forks Hatchery to the Minto Fish Collection Facility where they are acclimated and released as smolts into the North Santiam River. The new facility was mostly completed in spring 2013 and allows for acclimation of juvenile CHS during most flow conditions.

1.6) Type of program.

The North Santiam CHS hatchery program is managed as an integrated program meant to provide harvest and mitigation for habitat lost or made inaccessible by the construction and operation of Detroit and Big Cliff dams, and provide ESA conservation benefits, consistent with survival and recovery of the ESU[2]., which will provide adult returns to help meet harvest objectives for the North Santiam River, lower basin and ocean fisheries.

The hatchery program was founded on the wild stock of CHS in the North Santiam River and uses integration to avoid genetic drift and maintain stock suitability for outplanting to assist with conservation consistent with survival and recovery of the ESU, 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 Big Cliff and Detroit Dams, which will provide adult returns to help meet harvest objectives for the North Santiam 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."

The purpose of the hatchery program is to maintain spring Chinook salmon runs as mitigation for lost natural production due to habitat loss and population impacts resulting from construction and operation of Detroit and Big Cliff Dams, which was included when Congress authorized the Corps to construct the projects to reduce the damage associated with flooding in the Willamette Valley.

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

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USACE mitigation was developed prior to ESA listing of Upper Willamette River (UWR) spring Chinook. Since the ESA listings, it also became important to manage the North Santiam hatchery program consistent with the ESA. As a result, the program is managed to meet goals for both harvest and conservation needs, consistent with survival and recovery of the ESU.

The North Santiam spring Chinook salmon hatchery program provides harvest opportunities in the North Santiam River and contributes, along with other upper Willamette hatchery programs, to sport, commercial, and tribal fisheries in the Pacific Ocean, lower Columbia River, lower Willamette River, and mainstem and tributary fisheries. ODFW's harvest goal for the mainstem and North Santiam River is 1,400 hatchery-origin CHS adults (ODFW 1998a). Over 27,000 hatchery CHS were harvested in sport and commercial fisheries in the lower Willamette and Columbia rivers in 2011 (FMEP 2012).

Outplanted CHS serve conservation and RM&E purposes by informing managers about the feasibility and details of future reintroduction efforts of natural-origin fish. RPA 9.5.1 directs the use of hatchery fish to evaluate migration and passage through the project reservoirs until risks are deemed acceptable for use of wild fish. Further details on the reintroduction efforts using hatchery fish are included in Section 15 of this HGMP. Annual fish disposition and protocols are discussed and formalized by the fishery co-managers (ODFW, NMFS, and USFWS) with suggestions from the Willamette BiOp Willamette Action Team for Ecosystem Restoration (WATER) forum.

1.9 & 1.10) List of program "Performance Standards" and "Performance Indicators", designated by "benefits" and "risks."

Category 1: Legal Mandates

Standard 1.1: Meet production levels for mitigation, fisheries, and ESA conservation objectives consistent with survival and recovery of spring Chinook salmon, consistent with the Cooperative Agreement (2012). The Cooperative Agreement provides for federal funding of up to 84,000 pounds of Chinook and/or *O. mykiss* for release into the North Santiam Subbasin or other waterbodies pertinent to fulfilling federal mitigation requirements for habitat losses and fishery impacts from construction and operation of Detroit and Big Cliff dams.

Indicator 1.1.1: Produce and release up to 704,000 of spring Chinook salmon smolts (58,667 pounds) into the North Santiam River basin. ***Benefit***

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

Indicator 1.2.1: Program complies with the Willamette BiOp (NMFS 2008), and considers the recommendations in the Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NMFS 2011). ***Benefit***

Category 2: Harvest

Standard 2.1: Provide sufficient hatchery production to mitigate for lost spawning and rearing areas, and population impacts from the construction and operation of Detroit and Big Cliff dams while minimizing impacts to natural-origin Chinook salmon. The program provides adult returns to meet harvest objectives for the North Santiam River, and help lower basin and ocean fisheries. Take of listed fish associated with harvest is covered through the Fisheries Management and Evaluation Plan (FMEP) for upper Willamette CHS (ODFW 2001).

Indicator 2.1.1: Number of hatchery CHS available for harvest in the Santiam River sport fishery. This program also aids sport and commercial fisheries in the ocean, Columbia River, and Willamette River. ***Benefit***

Category 3: Conservation

Standard 3.1: Maintain genetic diversity in hatchery broodstock that is similar to natural-origin fish by integrating natural-origin broodstock at an average rate of 5-10% at times when the wild run is greater than 1,000 adults based on projections from counts of fish over Willamette Falls and the Bennett dams.

Indicator 3.1.1: Compare genetic diversity between hatchery- and natural-origin fish. Potential phenotypic characteristics that are representative of genetic diversity are: age at maturity, run timing, sex ratio, size, fecundity, etc. ***Benefit***

Standard 3.2: Reduce opportunity for negative ecological interactions between hatchery and naturally produced adults

*Indicator 3.2.1***:** Specific interactions to look for are: Evidence of 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 recruit Chinook fry.

Indicator 3.2.2: Flow management to promote efficient downstream migration of hatchery smolts, protect eggs deposited during spawning and provide juvenile rearing habitat.

Standard 3.3: Produce and release sufficient numbers of hatchery fish to support successful outplanting of adult spring Chinook salmon upstream from Detroit Dam for RM&E and reintroduction efforts. The intent is to inform passage studies to aid design of passage alternatives and reintroduction protocols and strategies.

Except in low run years, this goal is expected to be routinely met under the current program.

Indicator 3.3.1: Abundance and productivity of hatchery returns available for outplanting (target 1500 adults/750 females).

Indicator 3.3.2: Abundance and productivity of fish returning from outplants are adequate to support passage research to determine: for example passage efficiency and survival rates, spawning success (including pre-spawning mortality (PSM)), Smolt-to-Adult Return Ratio (SAR), recruits per spawner (productivity), adult spawn and migration timing and distribution, number of juveniles emigrating from spawning areas, and genetic diversity. ***Benefit***

Standard 3.4: Reduce potential for negative ecological interactions between hatchery and naturally produced juveniles.

Indicator 3.4.1: Specific interactions to look for are: evidence of 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 Chinook fry. ***Risk***

*Indicator 3.*4.2: Flow management to support and expedite smolt outmigration. Specific targets to be developed through the Flow Management Team and supported by RM&E.

Standard 3.5: Use best management practices to meet or exceed benchmarks for rearing and releasing high quality fish to minimize impacts on naturally produced fish.

Indicator 3.5.1: Performance targets for benchmarks for rearing and release as indicated in Table 1.9-1. ***Benefit***

Standard 3.6: 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 3.6.1: Performance targets for benchmarks for returning hatchery fish as indicated in Table 1.9-2. ***Benefit***

Standard 3.7: Meet benchmarks and protocols for broodstock.

Indicator 3.7.1: Performance targets for benchmarks for hatchery broodstock as indicated in Table 1.9-3. ***Benefit***

Standard 3.8: The long-term target for the percentage of spring Chinook hatchery-origin spawners (pHOS) on all spawning grounds within the North Santiam subbasin is less than 10%. However, the long-term projected pHOS below the dams to meet desired viability is 21%, which means the pHOS target upstream of Detroit Dam will ultimately need to be much less than 10% (ODFW and NMFS, 2011). Overall, the goal is to manage hatchery activities (production,

release, adult collection, and outplanting) and habitat above and below the Detroit/Big Cliff complex for ESA conservation (see HGMP federal regulations), consistent with the survival and recovery of the Upper Willamette River spring Chinook ESU. In the short term, pHOS will be intentionally high because of intense hatchery supplementation necessary for reintroduction of salmon; pHOS will be high for an extended period until survival improvements are made that allow higher survival (see Section 15).

Indicator 3.8.1: This HGMP incorporates pHOS targets identified in the Recovery Plan (ODFW and NMFS 2011). The pHOS target, when combined with other recovery actions, is <10% pHOS for the entire North Santiam CHS natural population over the long term. Hatchery-related risks will be reduced as natural production is restored above and below Big Cliff/Detroit Dams. The goal is to minimize pHOS to less than 10% above Big Cliff/Detroit once successful natural production is demonstrated (see Section 15 for more details). The hatchery mitigation program for CHS will be reduced commensurate with restoration of natural production above these dams to help achieve pHOS objectives. For the production areas below Detroit/Big Cliff Dams, pHOS will be higher due to the location of the hatchery facility and reduced natural production due to the adverse effects from the operation of the dams to downstream areas, and other habitat effects not related to the dams.

The area downstream from Big Cliff Dam will be managed as follows:

- Continue to operate Minto to increase the proportion of hatchery-origin fish entering the Minto Fish Collection Facility, fish that would otherwise spawn below Minto Dam and contribute to high pHOS downstream from Big Cliff dam. The acclimation of juvenile Chinook salmon at the new Minto facility began in 2014 and efforts to increase capture efficiency should therefore be in place as early as 2016 to effect increased removal of four-year-olds returning that year that were imprinted as juveniles to the new facility. By 2019 the first full cohort of hatchery fish that were acclimated at the "New Minto" should return as adults and provide initial data regarding the effects of rebuilding Minto on pHOS. By 2020 there should be data to begin to ascertain the effects of improved homing to the new Minto and its effects on pHOS and associated strategies; however, it could take a minimum of 3-5 years of data collection to sufficiently ascertain effects on pHOS from the above actions.

Benefit

- Use the genetic pedigree analyses, the Bond (Zabel et al, 2016) analysis and other research currently in progress and others in future years as necessary to aid in determining spawning success and potential carrying capacity downstream from the flood control/hydroelectric projects.

Category 4: Life History Characteristics

Standard 4.1: Maintain life history characteristics of broodstock that are as similar as possible to natural-origin CHS (e.g. within 10%).

Indicator 4.1.1: Compare life history characteristics of the broodstock to natural-origin adults. Indicators include: morphometrics (length and weight), sex ratio, average number of eggs per female by age class, age structure, adult migration, and spawn timing (Table 1.9-3). ***Benefit***

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 at a time and place that minimizes the interaction with listed fish. ***Risk***

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

Indicator 4.3.1: Indicators are: residualism rates, rates of outmigration, precocial rates, and proportion of fish that migrate per day. ***Risk***

Category 5: Genetics

Standard 5.1: Manage genetic risks of hatchery CHS spawning with naturally produced CHS in the North Santiam population to promote natural selection and local adaptation. Also see Standard 3.8.

Indicator 5.1.1: This hatchery program will be used to reintroduce CHS above Detroit Dam. As natural production increases, the proportion of hatchery CHS outplanted above Detroit Dam will decrease in order to reduce and minimize genetic effects. Once natural-origin CHS returns to Minto trap average more than 500 female adult spring Chinook salmon with a R/S ratio >1 over two life cycles (assigned to production areas above Detroit Dam by pedigree analysis), then no hatchery CHS are anticipated to be needed for supplementation above the dams. The natural population above Detroit Dam will be entirely natural-origin CHS with no hatchery-related genetic effects. A current pedigree analysis will be used to assign what proportion of these natural-origin CHS were produced upstream of Big Cliff/Detroit Dams. ***Risk***

Standard 5.2: Ensure broodstock collection maintains the genetic diversity of the naturally spawning population (e.g. diversity shows no more than a 10% divergence).

Indicator 5.2.1: Genetic diversity of natural and hatchery stocks; and Proportion of Natural-Origin Brood (pNOB). ***Risk***

Standard 5.3: Integrate natural-origin broodstock at a rate averaging 5-10% when wild returns to the North Santiam River are expected to exceed 1,000 adults.

Indicator 5.3.1: Proportion of natural-origin fish in the broodstock. ***Benefit***

Category 6: Operation of Artificial Production Facilities

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

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

Standard 6.2: Marion Forks Hatchery and Minto Adult Fish Collection Facility effluent will not negatively impact natural populations.

Indicator 6.2.1: Determine if facilities are operated under a National Pollutant Discharge Elimination System (NPDES) permit, and monitored to comply with the permit, to maintain Oregon Water Quality Standards for protection of aquatic life. ***Risk***

Standard 6.3: Water withdrawals and instream water diversions will minimize the impact on natural, ESA-listed populations, and comply with NMFS criteria when appropriate

Indicator 6.3.1: Install and maintain fish screens at Minto Fish Facility water intakes consistent with ODFW and NMFS criteria. ***Benefit***

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 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 Minto Fish Collection Facility 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: Pre-spawn mortality rates of trapped fish in hatchery or after release. ***Risk***

Standard 6.6: Provide sufficient acclimation to maximize homing to hatchery or release location. The current strategy is to transfer production to the Minto Adult Collection Facility in October or November for acclimation until release in February or March.

Indicator 6.6.1: Assess optimum acclimation period to achieve standard. ***Benefit***

Category 7: Socio-Economic Effectiveness

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

Indicator 7.1.1: Annual budget expenditures and findings of socio-economic study. ***Neutral***

Indicator 7.1.2: The number of spring Chinook to support sport, tribal, and commercial fisheries in the Pacific Ocean, Lower Columbia and Willamette rivers, and Santiam 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 North Santiam 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 hatchery rearing and release of hatchery fish.

Variables	Performance Target (benchmark)
Size-at-release	Target size at release is 12 fpp. It is a goal to raise larger smolts, but growth is currently limited by water temperatures.
Release timing	February and March
Acclimation time	Minimum 1 month
Migration timing	Similar to naturally produced fish
Level of disease occurrence in hatchery smolt releases	Below IHOT standard

Total number of fish released	704,000 smolts[3]
Number of fish required for broodstock and conservation needs	630,000 smolts
In-hatchery life stage survival	Maximum survival
Rearing density	Implement best management practices
Growth rate	Achieve target size at release
Residualism rate	< 10%
Precocial rates	< 10%

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

Variables	Performance Target (benchmark)
Number of hatchery produced adults required for broodstock	Approximately 541 total adults spawned. This number accounts for in-hatchery PSM (8.5%) and females representing 40% of adult returns.
Number of hatchery produced fish harvested	State of Oregon goal of 1,400 minimum within North Santiam 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 Detroit Dam	Target 1500 adults (750 female and 750 male), with 900 adults for mainstem North Santiam and 600 adults for the Breitenbush. Target 1,875 adults collected at Minto FCF to account for females representing 40% of adult returns.
Age structure	Similar to naturally produced fish
Sex Ratio	Similar to naturally produced fish
Fecundity	Similar to naturally produced fish
pHOS	Projected level to meet desired long-term viability goal < 10% pHOS for targeting minimal interactions in core spawning and rearing areas above Detroit Dam (see Recovery Plan). Projected level to meet desired status below the dam is ≤ 21% pHOS.
Abundance	Total return target to Minto FCF is 3,256 adults.
Genetic diversity	Maintain genetic diversity and avoid genetic drift

[3] This HGMP outlines performance targets for conservation needs and allows for flexibility and adjustments in the total number of fish released, to account for mitigation agreements as described in contractual arrangements. With a release of 704,000 smolts, analyses show broodstock goals are met 99% of the time, with outplanting and harvest goals met 50% and 46% of the time, respectively.

Variables	Performance Target (benchmark)
Adult migration and spawn timing	Similar to naturally produced fish (e.g. within 10% of naturally produced fish).
SAR	0.44% See Appendix E for further information

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

Variables	Performance Target (benchmark)
Number of naturally produced fish spawned	5-10% contingent on achieving returns of at least 1,000 NOR adults to the North Santiam River. Integration will occur with N. Santiam stock only (not Molalla or SAFE CHS).
Number of hatchery fish spawned	Approximately 540
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
Genetic diversity	Maintain heterozygosity and avoid genetic drift
Sex ratio	Similar to naturally produced fish – ±5-10% (incorporate natural-origin to hatchery)
Age structure	Similar to naturally produced fish
Average number of eggs per female by age class	Similar to naturally produced fish
Average size (POH and fork length) per age class	Similar to naturally produced fish

1.11) Expected size of program.

1.11.1) Proposed annual broodstock collection level.

The North Santiam Spring Chinook Hatchery Salmon Program collects and spawns approximately 540 adults (200 females) to meet production goals for the North Santiam River and the Molalla River program including BKD culling and mortality.

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

Approximately 685,000 smolts were released into the North Santiam River on an annual basis. Proposed annual fish release levels, life stage, release time and locations are described in Table **1.11.2-1**. Smolt releases from Minto were increased to approximately 704,000 when the Detroit fingerling program was discontinued in 2014 and production transferred to the smolt release in the lower North Santiam below Minto.

Table 1.10.2-1. Proposed annual releases of North Santiam spring Chinook salmon (NMFS 2008)

Life stage	Release location	Release period	Mean size at release (fish per lb)	Number of fish released	Total lbs released
Fingerling	Detroit Reservoir	May/June	120	190,000*	1,583
Yearling (age-1 smolts)	N Santiam R (at Minto)	March/April	12	685,000**	57,083
Total		876,500		58,696	

a 685,000 smolts are released annually.

*The Detroit release was discontinued in 2014 with production incorporated into the North Santiam River release.

**Increases to approximately 704,000 in 2014 with elimination of the Detroit fingerling release.

1.11.1) Proposed annual broodstock collection level.

The North Santiam Spring Chinook Hatchery Salmon Program collects and spawns approximately 540 adults (200 females) to meet production goals for the North Santiam River and the Molalla River program including BKD culling and mortality.

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

Approximately 704,000 smolts are released into the North Santiam River on an annual basis. Proposed annual fish release levels, life stage, release time and locations are described in Table 1.11.2-1. Since 2003, adult returns to support broodstock and conservation needs were attained in 6 of 10 years from releases ranging from 60,000 to 100,000 higher than proposed in this HGMP which included releases for research purposes. Future research releases will need specific coverage outside of this HGMP.

Table 1.11.2-1. Proposed annual releases of spring Chinook salmon into the North Santiam River

Life stage	Release location	Release period	Mean size at release (fpp)	Number of fish released	Total lbs released
Yearling (age-1 smolts)	N Santiam R (at Minto)	March/April	12	704,000	58,667

1.12) Current program performance.

Performance of the North Santiam CHS hatchery program can be evaluated through hatchery returns, smolt-to-adult survival rates, impacts to wild salmonids, and contributions to the fisheries.

The number of adults returning to Minto Pond since 1990 is presented in Table 1.14-1. From 1992 to 1994, adult returns to Minto declined and remained low through 1999. Since then, the number of adults returning has generally increased, with peak counts occurring in 2002; however, in 2005 and in 2007, the returns to Minto Pond declined again and remained low in 2008. Returns increased significantly in 2009 and were comparable to the 2002 peak in 2010. Based on CWT data collected since 1990, there is no difference in survival rates between fish released in March and those released in April (Table 1.12-1).

Table 1.12-1. Smolt-to-adult returns based on run reconstruction, coded wire tag recoveries and adult returns to the Minto Trap.

Run Year	From Run Reconstruction (Minto Returns, In-River Harvest, Hatchery-origin Escapement, and Prespawn Mortality)	From Columbia Basin Research Coded Wire Tag Recoveries	From Returns to the Minto Trap (Based on smolt releases 4 yrs. earlier)
1990			0.2%
1991			0.4%
1992			0.6%
1993			0.5%
1994			0.1%
1995			0.1%
1996			0.1%
1997			0.1%

1998				0.3%
1999				0.2%
2000				0.4%
2001				0.5%
2002	1.5%	1.8%		0.6%
2003	2.3%	0.7%		0.6%
2004	1.4%	0.3%		0.6%
2005	0.6%	0.2%		0.2%
2006	0.8%	0.7%		0.5%
2007	0.7%	0.1%		0.2%
2008	0.2%	0.3%		0.1%
2009	0.6%	0.7%		0.3%
2010	1.2%	0.9%		0.6%
2011			No Minto	
2012			No Minto	
2013				0.3%
2014				0.5%
2015				0.5%
Mean	1.0%	0.6%		0.4%

The ODFW harvest goal for the North Santiam River sport fishery is 1,400 CHS, however this does not include harvest associated with ocean, lower Columbia River, and lower Willamette River fisheries. According to harvest statistics gathered in the N. Santiam from sports harvest angler tags (i.e. punch cards),for 2000 – 2013, an average of 1,015 hatchery CHS were caught, 400 fewer on average than the minimum harvest goal. The harvest goal has been met or exceeded in only three of the past fourteen years. Since 2002, the average number of female returns to the Minto trap has exceeded those needed for brood and conservation purposes approximately 60% of the time.

1.13) Date program started.

The North Santiam River CHS program (stock 021) began in the 1950s. Marion Forks Hatchery began operating in 1951 as a state-funded facility. After the construction of Detroit and Big Cliff dams in the early 1950s, the USACE began funding mitigation production at the hatchery.

1.14) Expected duration of program.

The program will continue for an undefined period into the future. It is expected that as natural production is restored above Detroit Dam that the hatchery program will be reduced.

Table 1.14-1. Adult spring Chinook salmon returning to Minto pond, 1990-2014. (ODFW) [/1]

	Adults at Bennett		Adults counted at Minto pond					
Run Year	**Total Bennett Hatchery Estimate**	**Total Bennett Wild Estimate**	**Total Minto Count**	**Minto Number Clipped**	**Minto Number Unclipped**	**Percent Unclipped with Otolith Mark**	**Number Natural-Origin[/2]**	**Minto Percent Natural-Origin**
1990			1,084					
1991			2,152					
1992			2,894					
1993			2,595					
1994			683					
1995			798					
1996			634					
1997			875					
1998			1,925					
1999			1,943					
2000			3,004					
2001	6,152	237	3,410					
2002	7,422	631	4,948	4,362	586	64	211	4.3
2003	12,293	287	4,441	4,032	409	89	45	1
2004	13,044	487	4,052	3,559	493	52	237	5.9
2005	4,217	666	1,812	1,427	385	47	204	11.3
2006			3,636	3,148	488	6	458	12.6
2007			1,989	1,619	370	10	333	16.7
2008			1,126	768	358	4	345	30.6
2009	2,197	311	2,355	2,068	287	44	160	6.8
2010	5,388	568	4,948	4,274	674	39	411	8.3
2011	4,329	2,129	NA[/3]					
2012	2,908	1,133	NA[/3]					
2013	3,418	1,115	2,875	2,251	624	9.1	567	19.7
2014	5,630	1,599	3815	3029	786	10.1	714	18.7

[/1] Hatchery fish returning prior to 2002 were not 100% marked.

[/2] Adjusted number of natural-origin fish based upon proportion of unclipped fish with an otolith mark.

[/3] Due to facility reconstruction, adults were not collected at Minto in 2011 and 2012; broodstock collection occurred at Bennett traps during this period.

1.15) Target watersheds.

Spring Chinook salmon smolts are released into the mainstem North Santiam River from the Minto Adult Collection Facility.

1.16) Alternative actions considered.

1.16.1) Key issues and alternatives

The existing hatchery program supports both harvest and conservation goals for spring Chinook salmon, consistent with survival and recovery of the ESU, for the North Santiam River. As described above, the program was developed to maintain spring Chinook salmon runs as mitigation for loss of spawning and rearing areas and population impacts due to construction and operation of Detroit and Big Cliff dams; however, it is anticipated that hatchery production associated with the federal mitigation responsibility will be reduced in the future commensurate with restoration of natural production above Detroit Dam following implementation of the 2008 BiOp and objectives and strategies of the 2011 Recovery Plan, as those documents inform the best available scientific and commercial data. Reducing the production and/or closing the hatchery is not proposed at this time because the program is necessary to meet federal mitigation responsibilities and reintroduction in the North Santiam. Similarly, expanding hatchery production is also not an action proposed at this time due to concerns about impacts of hatchery fish on the natural population.

Fisheries management in the North Santiam is confounded by the lack of a pedigree analysis on natural-origin CHS returns. This analysis has been funded by the USACE and will continue to inform what proportion of natural-origin CHS are being produced above Detroit and Big Cliff Dams. Presently, it is unknown if the natural-origin CHS were produced above or below the dams.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS

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

This HGMP and the resulting 4(d) determination will serve as the authorizing documents under the ESA for direct and incidental take of listed CHS for the North Santiam River hatchery CHS program. The program already has incidental take authorization via the 2008 Willamette Project BiOp (Section 11.1.5), but the new authorization will supersede the BiOp coverage for this hatchery program.

At this time, several other ESA documents provide additional analysis relating to the CHS resources in the North Santiam River. Citations for the documents follow.

NMFS (National Marine Fisheries Service). 2008. 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.

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), Bonneville Power Administration, Bureau of Reclamation. 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 NMFS 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>

Spring Chinook salmon is the only salmon stock native to the Santiam River basin. Historically, the basin was highly productive for CHS, accounting for approximately 33% of the naturally produced CHS in the Willamette Basin above Willamette Falls (unpublished department memorandum dated November 22, 1977 from W. Saltzman, ODFW Portland, Oregon). Spawning ground surveys conducted during 1946 and 1947 indicated that CHS production areas in the North Santiam system were primarily in the North Santiam, the Little North Santiam and Breitenbush rivers, Marion Creek, and Blowout Creek (Mattson 1948). An estimated 71% of the CHS production in the North Santiam system occurred above the present location of Detroit Dam (Mattson 1948).

The Upper Willamette River (UWR) Chinook salmon ESU, listed as threatened under the ESA on March 24, 1999 (64 FR 14308) and reaffirmed on June 28, 2005 (70 FR 37160),

includes all naturally spawned populations of spring-run Chinook salmon upstream from Willamette Falls and in the Clackamas River. Natural populations include CHS in the North Santiam, the South Santiam, the McKenzie, the Middle Fork Willamette, and the Clackamas basins. Natural-origin CHS are commingled with hatchery CHS released from hatcheries located on the Clackamas, North Santiam, South Santiam, McKenzie, and Middle Fork Willamette rivers. The National Marine Fisheries Service designated these five hatchery stocks as part of the ESU.

Adult Run Timing and Size. The run timing of CHS in the North Santiam River is similar to other Willamette River stocks. Spring Chinook salmon arrive in the Santiam River basin in mid-May, with the peak of the spawning migration occurring from late May through early June. Adults are present at Minto Dam from late June through early October, with peak entry into the collection facility in July or August as spawning season approaches (Howell et al. 1985, unpublished ODFW data). Improved temperature regimes associated with changes to USACE project operations should result in fish arriving earlier to the collection facility. This, combined with structural improvements to the Minto Fish Collection Facility, should facilitate significantly earlier adult collection.

The run size of naturally produced CHS entering the Santiam Basin was estimated at approximately 1,600 fish annually from 1975-1989, and the majority of these naturally produced fish are believed to enter the North Santiam subbasin (Wevers et al. 1992). More recently the North Santiam River CHS run has been estimated by counts at the Upper and Lower Bennett dams (RM 31.5 and 29.0, respectively). Lower Bennett Dam blocks the north channel and Upper Bennett Dam blocks the south channel around Stayton Island. The remaining channel open for fish passage is the overflow channel at the Power Canal headgate that, when conditions are favorable, allows fish to enter the north channel above Lower Bennett Dam.

Between 2001 and 2005, Bennett dam estimates (without upgraded video system) ranged between 4,885 CHS (hatchery and natural-origin) in 2005 to 13,531 fish in 2004 (Schroeder et al. 2005). Counts were unavailable for 2006-2009. The 2011 run was monitored at Upper Bennett Dam and count data was provided by ODFW South Willamette District Staff (Mamoyac, personal comm.). Because dam counts for the North Santiam are not available for the 2006-2009 runs, ODFW interpolated the counts based on past data.

From 2001-2005, counts of total fish to the North Santiam ranged from 12.6% to 20.9% of the total passage at Willamette Falls, and averaged 16.0%. During 2001-2014, an average of 85% of fish returning to the North Santiam were hatchery fish (Table 1.14-1). In 2011, a total of 6,458 fish were estimated passing the Bennett Dams site. Of these, 4,329 were hatchery fish, and the remainder of the run (2,129 fish) was assumed to be wild.

Spawning Distribution. Spring Chinook salmon spawning occurs from early September through early October with peak spawning in mid-September (Grenbemer personal comm. 2012; Mattson 1962). Most of the core natural spawning and rearing areas in the

North Santiam have been blocked by construction of Detroit and Big Cliff dams. Currently accessible spawning areas are from Stayton up to Minto Dam (RM 17 to RM 42), however all NOR adults entering the Minto Collection Facility are passed above Minto Dam. Habitat in these areas continues to be impacted by high TDG, regulated streamflows, and temperature modification from Detroit and Big Cliff dams. Some spring Chinook salmon also spawn and rear in the Little North Santiam as far upstream as Henline Creek (RM 18).

Age Structure. The age distribution of CHS in the North Santiam River is based on scale analysis. For naturally spawning fish, scales are collected from carcasses during spawning surveys. Age 4 and age 5 adults predominate in the population (Table 2.2.1-1). Scales were collected for hatchery-origin CHS at the Minto Pond Facility from 1995-2001 and 2007-2008. Scales were randomly selected at the time of spawning and from adult mortalities prior to spawning. As with the natural-origin fish, hatchery origin fish returning to the Minto Pond Facility were predominantly ages 4 and 5. In 2011, scales from hatchery-origin fish were collected from carcasses on spawning ground surveys (Table 2.2.1-2).

Spawning and Incubation. Naturally-produced juveniles below the projects emerge several months earlier in the North Santiam River compared to historic conditions because warm water discharged from Detroit Reservoir in the fall shortens the incubation time of CHS eggs. Naturally spawned fry emerge as early as the third week of November in the North Santiam River based on trap catches in the Stayton power canal (Wevers et al. 1992).

In recent years, operational temperature control has been implemented and has improved (later) emergence timing below Detroit Dam (Table 2.2.1-3). North Santiam River temperature data indicates that the operation in 2012 successfully delayed emergence compared to years of no temperature control operations (2002, 2005 and 2006) by up to a month depending on spawning date. The difference is more pronounced for the fish that spawn later in the season. Thermal units used in this assessment were provided by Willamette Hatchery and Marion Forks Hatchery based on the spring Chinook emergence average thermal units (ATU's) of 1650-1850 ATU's. For the purpose of this assessment, an average value of 1750 ATU's was selected. Spawn dates applied were based on spawning survey data that indicates that spawning is typically initiated on September 1, peaks on September 20, and is completed by October 15.

Table 2.2.1-1. Age composition by return year of natural origin spring Chinook salmon in the North Santiam River basin, 2001–2013 (Source: Schroeder et al. 2007; K Schroeder, unpublished data).

Return year	Percent of Sample				Sample size
	Age 3	Age 4	Age 5	Age 6	
2001	12.0	48.0	40.0	0.0	25
2002	14.0	62.8	18.6	4.7	43
2003	0.0	19.4	75.0	5.6	36
2004	0.0	73.5	26.5	0.0	49
2005	2.9	27.9	67.6	1.5	68
2006	0.0	59.6	40.4	0.0	52
2007[a]	1.1	53.4	42.5	2.9	174
2008	5.5	48.4	45.6	0.5	182
2009	5.7	40.0	51.4	2.9	70
2010	13.8	55.0	30.0	1.3	80
2011	0.6	79.8	19.7	0.0	356
2012	1.0	16.5	75.7	6.8	103
2013	24.0	50.0	24.0	2.0	50

[a] *Includes 127 natural origin fish incorporated into the hatchery broodstock (1.6% age 3, 63.0% age 4, 34.6% age 5, 0.8% age 6).*

The above data are based on analysis of scales collected from carcasses recovered on spawning grounds, except in 2007 which include scales collected at the hatchery. The origin of fish (natural or hatchery) was determined by the absence of fin clips and absence of thermal marks in otoliths.

Table 2.2.1-2. Age composition by return year of hatchery origin spring Chinook salmon in the North Santiam River basin, 1995-2001, 2007-2008, and 2013 (Source: Boatner and Foster 2001; K. Schroeder, personal communication; Cannon et al. 2012; ODFW unpublished data).

Return year	Percent of Sample				Sample size
	Age 3	Age 4	Age 5	Age 6	
1995	0.3	49.9	49.9	0.0	798
1996	0.3	55.6	44.0	0.0	636
1997	0.0	68.9	31.1	0.0	875
1998	2.4	20.2	77.4	0.0	1,924
1999	1.0	79.0	19.0	1.0	1,943
2000	1.5	59.0	39.5	0.0	3,004
2001	1.0	59.8	39.2	0.0	3,920
2007	4.2	16.7	79.2	0.0	24
2008	2.0	84.0	14.0	0.0	50
2011	0.0	65.0	33.5	1.5	131
2012	0.0	26.7	73.3	0.0	15
2013	20.0	40.0	40.0	0.0	5

The above data are based on analysis of scales from randomly selected adults at the time of spawning and from mortalities prior to spawning, except in 2011 when scales were collected from carcasses on spawning ground surveys.

Table 2.2.1-3.	Estimated Emergence Timing								
Spawn Time	**2002-2003**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**
1-Sep	20-Nov	23-Nov	23-Nov	9-Dec	1-Dec	1-Dec	15-Dec	1-Dec	8-Dec
20-Sep	13-Dec	20-Dec	22-Dec	17-Jan	4-Jan	9-Jan	31-Jan	13-Jan	26-Jan
15-Oct	2-Feb	17-Feb	6-Mar	17-Mar	7-Mar	5-Mar	28-Mar	9-Mar	18-Mar

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

The following populations may be incidentally affected by the program:

<u>Upper Willamette River Steelhead</u>

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. Core populations of winter steelhead occur in the North Santiam, South Santiam, Molalla, and Calapooia rivers. Smaller natural populations occur in several West Valley tributaries (Tualatin, Yamhill, Luckiamute rivers; Rickreall Creek). There are no winter steelhead 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).

<u>Columbia River Bull Trout</u>

Columbia River bull trout *Salvelinus confluentus* were listed as "threatened" under the federal ESA in June 1998. Bull trout are native to the North Santiam River; however, populations were last observed in 1945 and have likely been extirpated. There is interest in restoring populations of bull trout in the North Santiam River subbasin but no active efforts are underway. If reintroduced, bull trout may benefit from the North Santiam CHS hatchery program due to the increased prey base, or could be incidentally affected by spring Chinook smolts through competitive interactions for food and space.

<u>Lower Columbia River Steelhead</u>

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 in Washington, inclusive, and the Willamette and Hood rivers in Oregon, inclusive.

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 Chinook salmon 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.

Lower Columbia River Chum Salmon

The Lower Columbia River chum salmon 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 listed natural population(s) relative to "critical" and "viable" population thresholds.

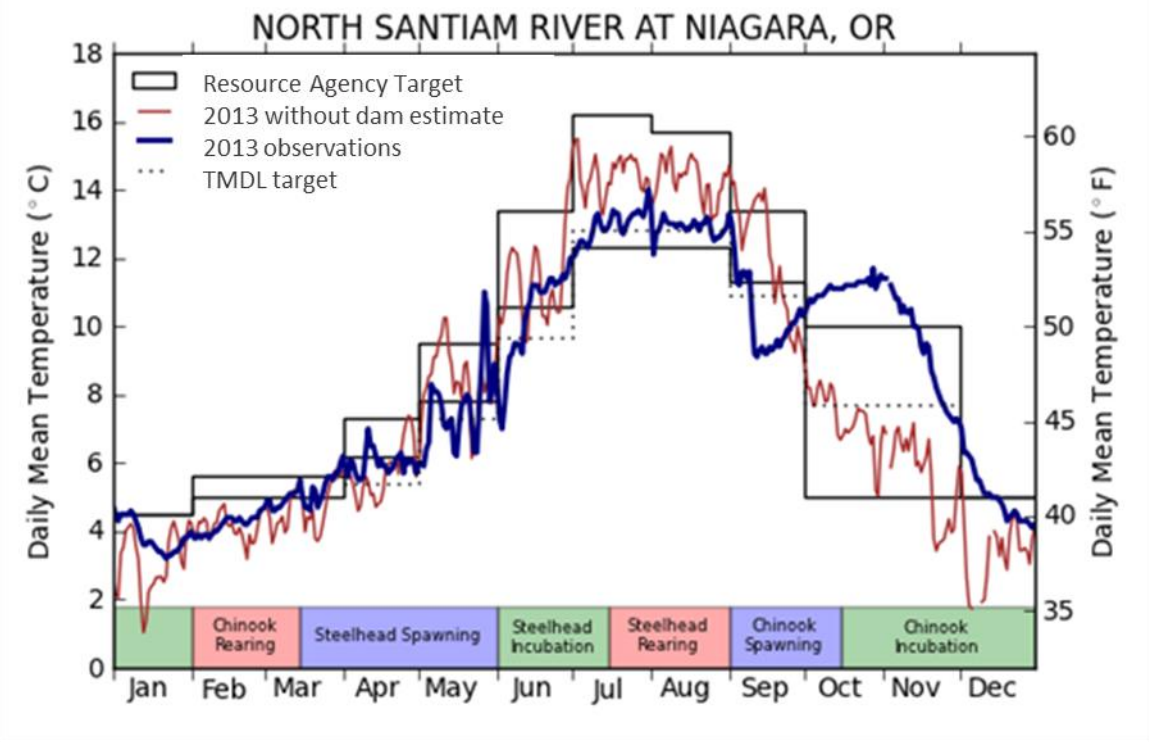
The Conservation and Recovery Plan for the Upper Willamette River (UWR) Chinook salmon ESU specifies the objectives and strategies for recovery and delisting of CHS and winter steelhead in the Upper Willamette basin (Oregon and NMFS 2011). This plan contains standards for a "viable salmonid population" (VSP) of North Santiam River CHS in terms of abundance, productivity, distribution, and diversity. Along with the Willamette Project BiOp (NMFS 2008), the Recovery Plan informs conservation, consistent with survival and recovery of the CHS ESU, as part of the best scientific and commercial data available.

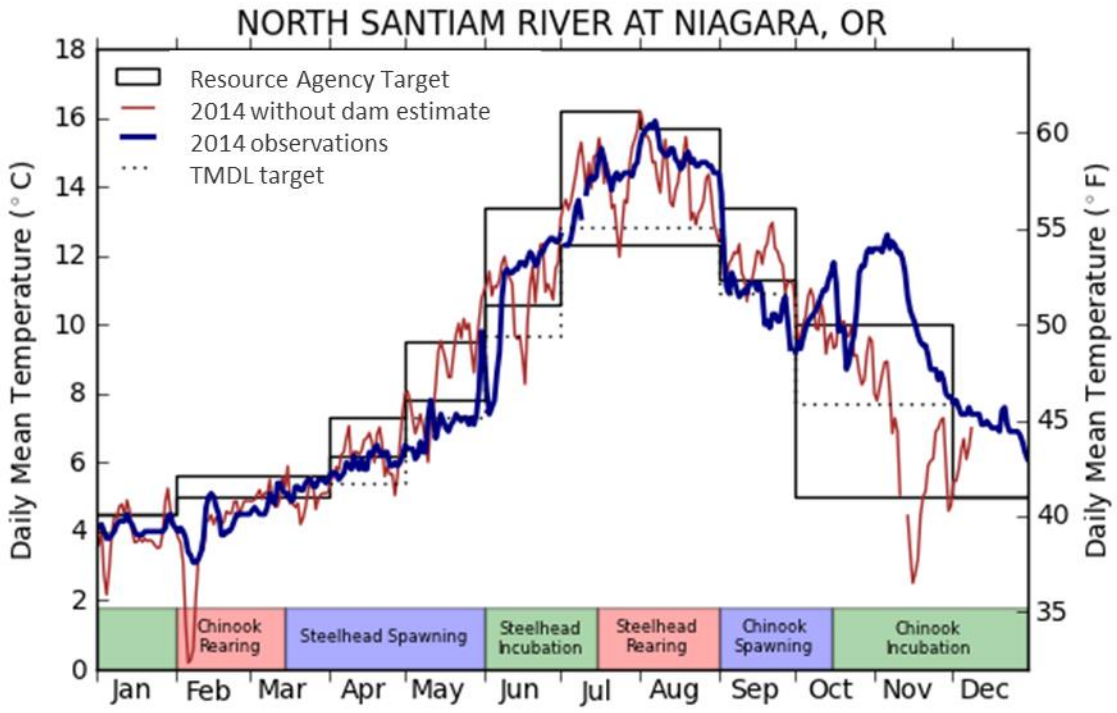
North Santiam CHS are currently at a very high risk of extinction in terms of abundance and productivity. The desired status is a low risk of extinction (<5% extinction risk over a 100 year period; Table 2.2.1-1). This equates to an additional 5,400 natural origin spring Chinook salmon in the North Santiam River population (Oregon and NMFS 2011).

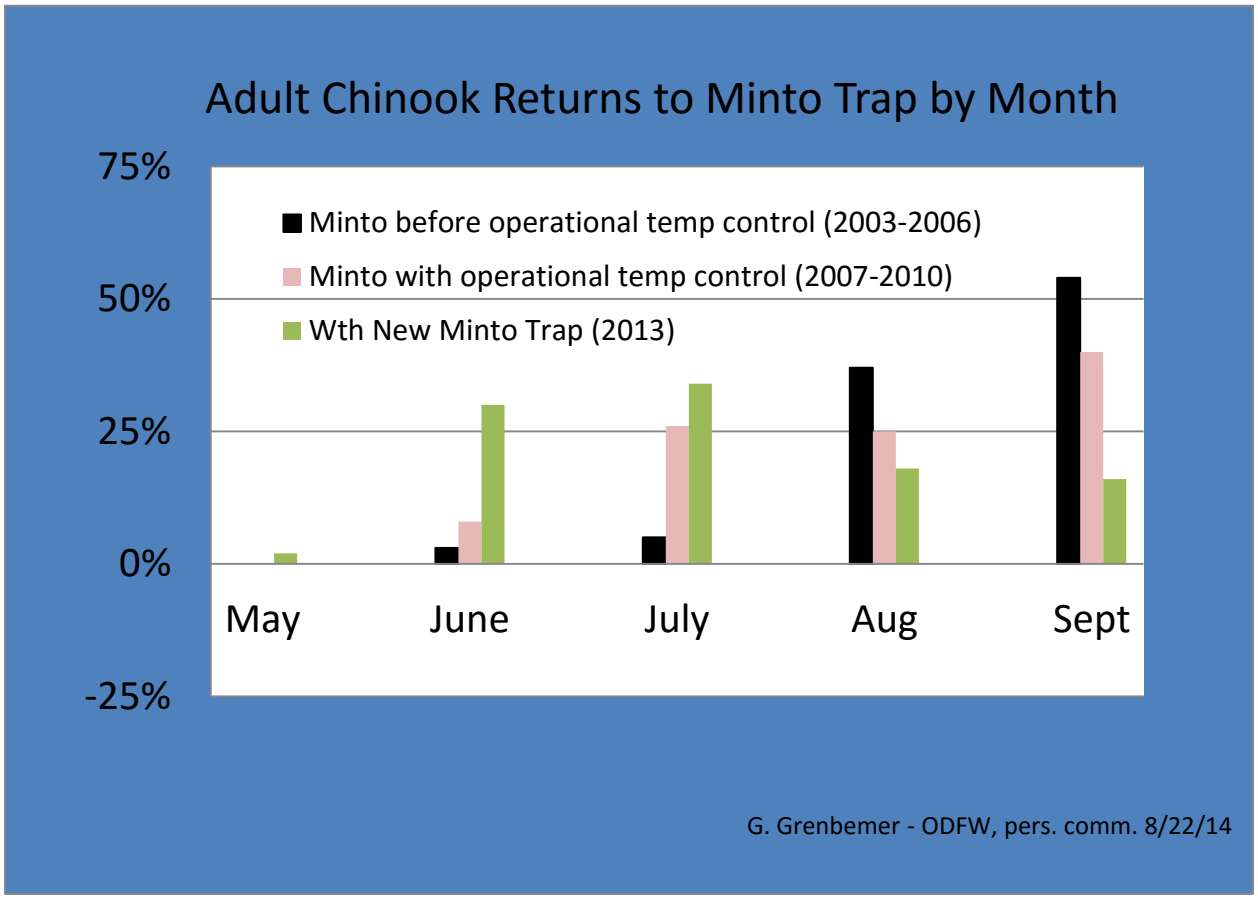
The Recovery Plan establishes measurable criteria for delisting spring Chinook salmon with a focus on reducing those threats that contributed to the species decline and listing. Multiplying the percent relative mortality for each threat category under baseline conditions by the conservation gap provides an estimate of the contribution by each key limiting factor type to achieve delisting recovery.

The NMFS (2008) partially based its jeopardy and adverse modification conclusion for the UWR ChS ESU on the decline of the North Santiam population, where the primary cause of decline for that population included loss of access to historical spawning and rearing habitat due to construction of Detroit and Big Cliff Dams. NMFS determined that the North Santiam hatchery program will be important to minimize risk of extinction over the short-term.

> Recent natural-origin spawning escapements in the North Santiam River do not meet critical and viable thresholds for abundance and productivity and may continue to fall short regardless of fishery and hatchery management actions. The availability of areas historically used for spawning by CHS in the North Santiam was severely reduced by construction of Detroit and Big Cliff dams in 1953. Mattson (1948) estimated that over 70% of spawning CHS in 1947 were located upstream of these dams.
>
> The river downstream of Big Cliff Dam to the town of Stayton was the farthest downstream extent of the historic core spring Chinook spawning area and provided < 30% of the UWR spring Chinook habitat in the North Santiam subbasin. Critical habitat was designed by NMFS in 2005 (70 FR 52630, 52721, Sept. 2, 2005), after the Critical Habitat Analytical Review Team (CHART) had identified the area below Big Cliff Dam as having medium or high conservation values for the ESU due to the presence of spawning and rearing PCEs in occupied critical habitat, and essential spawning and rearing habitat for recovery of Chinook above Big Cliff/Detroit Dam (unoccupied critical habitat). The occupied critical habitat below Big Cliff Dam is spawning and rearing area that wild fish currently use. Detroit/Big Cliff dams are currently being operated to the extent possible under RPA 2.4 of the Willamette BiOp (NMFS 2008) to provide flows that allow adult fish access to existing habitat downstream of Big Cliff, protect eggs deposited there during spawning, and provide juvenile rearing and adult habitat for listed salmonids. In addition, since 2008 Detroit/Big Cliff Dams have been operated to provide more normative water temperatures downstream of Big Cliff Dam which has shown some improvements to egg incubation and adult run timing; but the available habitat continues to be severely impacted by the dams and habitat capacity and productivity for spring Chinook salmon is less than what it was historically. In 2023 a temperature control tower is scheduled to be completed at Detroit Dam that will provide beneficial downstream water temperatures under almost all hydrological conditions.
>
> The effects of the current Temperature Control Spill Operation on thermal regimes below Big Cliff Dam are summarized and compared to modeled “no dam” thermal regimes in the following graphs:


NORTH SANTIAM RIVER AT NIAGARA, OR
Resource Agency Target
2013 without dam estimate
2013 observations
TMDL target
Daily Mean Temperature (°C)
Daily Mean Temperature (°F)
Chinook Rearing
Steelhead Spawning
Steelhead Incubation
Steelhead Rearing
Chinook Spawning
Chinook Incubation
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


NORTH SANTIAM RIVER AT NIAGARA, OR
Resource Agency Target
2014 without dam estimate
2014 observations
TMDL target
Daily Mean Temperature (°C)
Daily Mean Temperature (°F)
Chinook Rearing
Steelhead Spawning
Steelhead Incubation
Steelhead Rearing
Chinook Spawning
Chinook Incubation
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec



Currently, most of the natural spawning of CHS in the North Santiam River occurs in the uppermost accessible reach, which is immediately below Minto Dam (RM 44; Table 2.2.2-1). Redd densities in the reach between Minto Dam and the Bennett dams ranged from 3.5 redds per kilometer in 2008 to 10.6 redds per kilometer in 2011, with an annual average of 5.9. Wild adults will be outplanted above Minto Dam to reduce interactions between hatchery and wild spawners. It is assumed that if the habitat above Minto exceeds carrying capacity, then fish will drop below Minto to spawn.

Table 2.2.2-1. Summary of spawning surveys for spring Chinook salmon in the North Santiam River, 2002 - 2015. Spawning in areas downstream of Stayton may include some fall Chinook salmon (Schroeder et al. 2008; Sharpe et al. 2012). Redds between Minto and Big Cliff dams are included for 2014 (N = 80) and 2015 (N = 28) but systematic surveys were not conducted in that reach in prior years.

Run Year	Below Detroit			Above Detroit		
	Total Redds	Spawner Estimate (redds * 2.5)	Redd Density (redds/km)	Total Redds	Spawner Estimate (redds * 2.5)	Redd Density (redds/km)
2002	326	815	3.1	--	--	--
2003	680	1,700	6.4	--	--	--
2004	338	845	3.2	--	--	--
2005	329	823	3.1	--	--	--
2006	259	648	2.4	--	--	--
2007	494	1,235	4.7	164	410	2.7
2008	226	565	2.1	--	--	--
2009	281	703	2.6	107	268	1.8
2010	461	1,153	4.3	503	1,258	8.4
2011	599	1,498	5.6	23	58	0.4
2012	557	1,393	5.2	78	195	1.3
2013	362	905	3.2	269	673	4.5
2014	484	1,210	4.6	198	495	3.3
2015	242	605	2.3	297	743	4.9

Analysis of fin clips and otolith marks on unclipped fish indicate that pHOS varies among years and was considerably greater than the proportion of natural-origin spawners (pNOS) during 2002 to 2007. However, in 2008, the trend was reversed where pNOS (at 73%; Table 2.2.2-2) was considerably greater than pHOS but the sample size for hatchery-origin fish sampled in 2008 was relatively low (N = 12) and therefore the results should be viewed with caution.

In short, below dam reproduction is not meeting replacement under current hydrologic conditions (O'Malley et al. 2015). Given limitations of the habitat below the dams, continuing the outplanting program on the N. Santiam is an important component of recovery. Ensuring sufficient returns of hatchery adults for outplanting is fundamental to this effort.

Pedigree analysis for the N. Santiam, while preliminary, indicate that habitat above Detroit Dam produces a higher proportion of returning adults than habitat below the dam despite less than 50% of redds being above the dam. Successful above-dam adult return numbers is dependent upon safe juvenile passage past Detroit and Big Cliff dams.

(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.

Genetic analyses providing estimates of reach-specific productivity have only recently begun but the data indicate that productivity of fish spawning above Detroit Dam exceeds that of fish spawning below the dam (O'Malley et al. 2015).

(c) Provide the most recent 12-year annual spawning abundance estimates or any other abundance information.

Table 2.2.2-1 provides redd counts, densities, and spawner abundance estimates for survey sections in the North Santiam River basin.

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

The composition of natural-origin recruits, as determined by otolith analysis of carcasses recovered on the spawning grounds between Minto and Bennett dams, ranged from 3 % in 2003 to 73% in 2008 (Table 2.2.2-2).

Table 2.2.2-2. Composition of spring Chinook salmon in the North Santiam subbasin based on carcasses recovered weighted for distribution of redds among survey areas within a watershed (except as indicated in table. Modified from Cannon et al. 2011 and ODFW unpublished data)

River (section), run year	Fin-clipped	Unclipped[a]		% wild[b]	pHOS
		Hatchery	Wild		
North Santiam (Minto–Bennett dams[c])					
2002	230	44 (49)	45	14 (13)	0.86
2003	855	89 (77)	27	3 (4)	0.97
2004	321	21 (27)	56	14 (15)	0.86
2005	163	25 (24)	80	30 (30)	0.70
2006	109	12 (17)	59	33 (32)	0.67
2007	136	7 (14)	42	23 (25)	0.77
2008	9	3 (9)	32	(73)	0.27
2009	53	9 (12)	65	51 (51)	0.49

2010	146	20 (27)	54	25 (24)	0.75
2011	470	16 (6)	262	(35)	0.65
2012	281	13 (14)	86	(23)	0.77
2013	76	5 (9)	47	(40)	0.60

[a] The proportion of hatchery and wild fish was determined by presence or absence of thermal marks in otoliths. Number in parentheses is the percent of unclipped fish that had a thermal mark (unclipped hatchery fish).

[b] Percent not weighted for redd distribution is in parentheses. In 2003, 2008 and 2010 redd and carcass distributions did not differ and percent wild was not adjusted.

[c] Including Little North Fork Santiam.

2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research program that may lead to the take of NMFS-listed fish in the target area, and provide estimated annual level 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 the Minto Fish Collection Facility occurs between mid-June and early October. All CHS captured (natural-origin and hatchery) at the Minto Facility 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 associated with lost access to historic habitats from construction and operation of Detroit and Big Cliff dams. 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 540 adults for broodstock needs to mitigate lost production from the project and initiate actions to reintroduce CHS habitats above the dams including an integration rate averaging 5-10% natural-origin adults when natural origin returns are expected to exceed 1,000 fish. Competition, disease, predation, and genetic interactions between hatchery and natural-origin fish in the North Santiam River may result in additional indirect take; however, these effects have not been quantified. Interactions between hatchery-origin Chinook salmon smolts and naturally-produced juveniles are minimized by release strategies which promote rapid emigration.

Baseline monitoring is included as part of the Cooperative Agreement for hatchery funding through the USACE. In addition, the USACE has developed an RM&E plan that recommends a framework for RM&E activities related to the Willamette Hatchery Program in general and the North Santiam River CHS Hatchery Program specifically. The hatchery RM&E plan identified variables important for evaluating hatchery performance. 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) Provide information regarding past takes associated with the hatchery program, including numbers taken and observed injury or mortality levels for listed fish (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Prior to 2001, not all of the returning hatchery fish were marked and, therefore, wild CHS were not readily distinguishable from hatchery fish. Consequently, there is little specific information on the level of past takes associated with the adult trapping and holding before that time. Table 2.2.3-1 gives the mortality of adult CHS at Minto Pond from 1990 to 2010. Assuming the proportion of natural-origin fish in the spawning population between Minto and Bennett dams in 2001 (Table 2.2.2-2) is representative of adults captured at Minto Pond prior to 2001, then approximately 12% of the broodstock prior to 2001 may have been natural-origin fish. However, this estimate could be biased high because natural-origin fish may be less inclined to enter the trap than hatchery origin fish. As noted earlier, all wild adults entering the hatchery have been outplanted above Minto Dam or other accessible areas of the North Santiam to maintain productivity. In 2015, a portion of the NOR run was outplanted above Detroit Dam based on preliminary pedigree results showing higher productivity of adults passed above the project than below. Take of wild adults for broodstock will follow protocols and limits identified in this document. 2015 saw an increase in mortality due to water temperature issues brought on by low reservoir and river levels. Columnaris was the main disease issue with a higher mortality loss (6.2%) than the prior two years at the Minto Facility (2.9% and 3.01% respectively)

Table 2.2.3-1. Numbers of spring Chinook salmon taken for broodstock and holding mortality at Minto Pond-Marion Forks Hatchery since 1990.

Brood Year	Fish Held (No.)			Holding Mortality					
				Males		Females		Total	
	Males	Females	Total	(No.)	%	(No.)	%	(No.)	%
1990	616	468	1,084	96	15.6	82	17.5	178	16.4
1991	1,343	694	2,037	350	26.1	168	24.2	518	25.4
1992	2,152	713	2,865	243	11.3	88	12.3	331	11.6
1993	1,463	1,080	2,543	112	7.7	99	9.2	211	8.3
1994	432	251	683	59	13.7	16	6.4	75	11.0
1995	421	379	800	51	12.1	33	8.7	84	10.5
1996	342	292	634	85	24.9	36	12.3	121	19.1
1997	598	277	875	176	29.4	40	14.4	216	24.7
1998	1,028	895	1,923	213	20.7	126	14.1	339	17.6
1999	1,235	728	1,963	76	6.2	56	7.7	132	6.7
2000	1,804	1,200	3,004	100	5.5	68	5.7	168	5.6
2001	2,217	1,193	3,410	435	19.6	338	28.3	773	22.7
2002	3,141	1,807	4,948	100	3.2	68	3.8	168	3.4
2003	2,416	2,025	4,441	58	2.4	45	2.2	1,032	2.3
2004	2,469	1,583	4,052	42	1.7	69	4.4	111	2.7
2005	1,052	760	1,812	74	7.0	72	9.4	146	8.1
2006	2,230	1,406	3,636	40	1.8	24	1.7	64	1.8
2007	1,006	983	1,989	15	1.5	18	1.8	33	1.7
2008	704	422	1,126	30	4.3	69	16.4	99	8.8
2009	1,502	566	2,068	13	.87	22	3.9	35	1.7
2010	2,836	2,112	4,948	24	.85	72	3.4	96	1.9
2013[1]	1,574	1,301	2,875	32	2.0	54	4.1	86	2.9
2014	2,315	1,500	3,815	32	1.4	83	5.5	115	3.01
2015	2,626	1,909	4,535	61	2.3	220	11.5	281	6.2
Ave.	1,563	1,023	2,586	105	9.3	82	9.5	226	9.3

[1]Adults were not held at Minto in 2011 and 2012 due to facility reconstruction. Fish were collected at Bennett traps and transferred/held at McKenzie Hatchery. 2013 was the first year of long term holding of adults at the new Minto facility. No formalin treatments were performed other than one test in 2013.

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

Projected incidental take levels for CHS are presented below in Tables 2.2.3-2 and 2.2.3-3. 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. Take estimates should be reviewed annually as part of baseline monitoring as identified in the hatchery mitigation agreement.

Table 2.2.3-2. Estimated annual incidental take of adult spring Chinook salmon associated with trapping at Minto Fish Collection Facility and transport for outplanting[1] or broodstock.

Listed species affected: Spring Chinook Salmon ESU/Population: Upper Willamette
Activity: Adult Trapping

Location of hatchery activity: Minto Facility Dates of activity: April-September (may be expanded into October) Hatchery program operator: ODFW

	Annual Take of Listed Fish *(Number of Fish)*	
Type of Take	**Hatchery-Origin**	**Natural Origin**
Removal (e.g., broodstock)[2]	540	0-30
Unintentional lethal take[3]	<10%	< 5%

[1] Outplanting currently relies on hatchery adults.
[2] Listed fish removed from the wild and collected for use as broodstock will generally average 5-10%. Emergency provisions allow integration exceeding 5-10% when integration has not occurred in 5 consecutive years. Does not include unintentional take from holding estimated at <10% for hatchery adults. Only natural-origin mortalities associated with broodstock collection will be counted as take for the hatchery program.
[3]Unintentional mortality of listed fish associated with holding of broodstock and does not include loss of fish during transport for outplanting or prior to release into the wild.

(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.

The contingency plan for natural-origin CHS adults collected at the Minto Facility is to pass them above Minto Dam, and/or outplant them in the mainstem North Santiam below Minto Dam (e.g. Wiseman Island area), or pass them above Detroit Dam if research continues to reflect higher productivity rates for fish passed upstream.

Eggs in excess to production needs are collected, fertilized, and incubated as a contingency for unusual or unexpected mortality during the early rearing life phases. Starting with the 2004 brood year, eggs from both hatchery and naturally produced females have been tracked to allow identification and culling of eggs found infected with BKD. There is no option but to destroy infected eggs. It is expected that mortality rates for alevins, fry, and pre-smolts in the hatchery environment will be the same for both hatchery and wild offspring. If average mortality rates in the hatchery rearing program increase, fewer naturally produced adults may be taken for broodstock purposes.

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.

The program shall be operated in alignment with the following regionally accepted policies.

Upper Willamette River Conservation and Recovery Plan for Chinook salmon and steelhead:

In August 2011, ODFW adopted the Recovery Plan for the Upper Willamette River Chinook ESU and steelhead DPS. The Upper Willamette River Chinook ESU includes the North Santiam River spring Chinook population. The Recovery Plan provides the primary guidance for recovery of Willamette River CHS including delisting criteria. It also informs analysis of effects and actions to avoid jeopardy and destruction or adverse medication of critical habitat where it informs the best scientific and commercial data available. Chapters 4 and 6 of the plan documented the current status of the population across the DPS and desired status goal for the population based on interrelations of the populations, limiting factor threats, and recovery potential by subbasin. The North Santiam CHS population is currently at very high risk of extinction for abundance and productivity, and the desired status is to improve it to low extinction risk. 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

Willamette Hatchery Mitigation Program RM&E Plan:

In January 2010, the RM&E plan was completed for the WHMP. The plan recommends monitoring goals and objectives that support the 2008 BiOp and hatchery reform actions identified in the facility-specific HGMPs. The plan also provides recommendations on how to coordinate strategies and methods that will be applied. The RM&E plan recommends a format for monitoring progress.

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

In May 2008, the NMFS released their BiOp regarding impacts to ESA-listed species that are related to the WP, including the HMP operation of USACE's 13 WP dams and funding of the HMP (NMFS 2008). In this opinion, NMFS concluded that the proposed action was likely to jeopardize the continued existence of the listed Upper Willamette spring Chinook salmon ESU and winter steelhead DPS and to adversely modify or destroy designated critical habitat for those species. NMFS therefore provided a Reasonable and Prudent Alternatives (RPA) to ensure the species' survival with an adequate potential for recovery. NMFS also included the terms and conditions with which actions must comply in order to meet reasonable and prudent measures that were deemed necessary to minimize the impacts to listed species from incidental take. Section 2.6 of the BiOp describes WATER, the interagency coordination and adaptive management forum that will be used to implement actions delineated in the BiOp. Section 2.10 describes the current hatchery program and the related CHS reintroduction/ outplant program. 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 the RPA. Particular RPA measures related to the hatchery program are summarized in Table 3.1-1 of this HGMP.

The RPA measures are significant because UWR Chinook are currently limited to degraded downstream habitat in three important subbasins. The RPA measures both provide access to higher quality habitat and improve downstream habitat conditions, which together will provide significant enough improvements to allow the UWR Chinook ESU to increase in numbers, productivity, spatial structure, and diversity (NMFS, 2008).

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

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 North Santiam hatchery program is part of this comprehensive plan. The selective fishery was implemented in 2001. The Fishery Management and Evaluation Plan (FMEP) 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 (WBFMP)- Spring Chinook salmon Chapters (ODFW 1998a):

This document 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 fisheries on CHS adults in ways consistent with rebuilding of wild populations. The measures outlined in the plan are designed to maintain viable populations of CHS in the Willamette Basin.

Native Fish Conservation Policy (OAR 635-007-0502 through -0506):

The Oregon Fish and Wildlife Commission has approved the Native Fish Conservation Policy (NFCP). 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 SMU. The ODFW has 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. This plan is superseded by the Upper Willamette Conservation and Recovery Plan for Chinook Salmon and Steelhead.

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. Once the conservation plan for North Santiam River CHS is completed and approved by the ODFW, this HGMP shall be revised and resubmitted if necessary.

Table 3.1-1 outlines pertinent BiOp and Recovery Plan goals specific to the North Santiam Hatchery program. USACE's annual funding for the hatchery program is subject to congressional approval. Some Recovery Plan actions could also be funded through special budget allocations outside of the hatchery program budget, or through other programs such as harvest management, conservation and recovery programs, or research.

Table 3.1-1 Proposed Actions, Reasonable and Prudent Alternatives, or 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 the North Santiam (stock 021) CHS.	Recovery Plan (162-SUB-NS) and BiOp (RPA measures 4.1 and 6.2.3 adult Chinook outplanting; 4.10-4.12 improved downstream passage; 6.2.2 genetic diversity): use North Santiam stock to help re-establish production above Detroit Dam.	Immediate/ Ongoing
Continue collecting all North Santiam, CHS	Recovery Plan (162-SUB-NS) and BiOp (RPA measures 4.1 and 6.2.3); use Minto facility upgrade to support outplanting and reintroduction efforts.	Immediate/ ongoing

broodstock at Minto Fish Collection Facility.		
Continue to collect North Santiam broodstock throughout the run to ensure the hatchery population is similar to the naturally spawning population.	Recovery Plan, BiOp (RPA measures 6.2.2 and 9.5.1): It will be important to maintain similarities between the hatchery and wild population in the near term. As pHOS is reduced and the natural segment of the population increases, it may become less important to maintain characteristics similar to the wild population.	Immediate/ ongoing
Integration levels averaging approximately 5-10% will be used to maintain heterozygosity of the hatchery stock, avoid genetic drift, and meet mitigation and conservation supplementation goals.	Recovery Plan (177-SUB-NS); BiOp (RPA 9.5.1): 1) Integration is only needed to meet conservation and reintroduction goals to support reintroduction above Detroit Dam; there may be sufficient mixing already on the spawning grounds to preserve a "gene bank" for future reintroduction; integration without meeting adult escapement goals could reduce wild production. 2) HMP integration goals: Maintain production goals and run characteristics - if determined through analysis that run characteristics cannot be maintained without integration, and - if natural-origin escapement goal of 1,000 fish is met, and - if integration has not happened within a multi-year period (e.g., >5 yrs), allow a 10% natural-origin integration rate at the 5 year mark if the annual evaluation determines no conservation impacts. 3) A scientific review of the current UWR hatchery program was completed with recommendations for achieving a conservation (reintroduction) hatchery program. Other strategies may be considered that promote and maintain a locally adapted population in the short term (until other Limiting Factors and Threats [LFT] conditions are improved), and how to be consistent with VSP attributes and recovery goals. Fund and implement conservation and outplanting programs that maintain genetic diversity of local broodstocks and manage the composition of natural spawners to meet ESA conservation goals, consistent with survival and recovery of the ESU; monitor and evaluate implementation of actions.	Immediate/ ongoing
Continue to use random spawning protocol with a 1:1 male-to-female ratio for North Santiam CHS.	Protocol as noted.	Immediate/ ongoing
Continue to adipose fin-clip and otolith mark (as needed) all North Santiam CHS.	Recovery Plan (29-ESU-ADM); BiOp (RPA 6.1.3): needed to implement harvest management program, assess pHOS trends, and for eventual reintroduction and/or passage of natural-origin only fish.	Immediate/ ongoing
Insert coded wire tags (CWTs) or other tagging as needed into juvenile hatchery fish from Marion Forks Hatchery in addition to current practice of adipose fin-clipping and otolith marking.	Recovery Plan (29-ESU-ADM, 30-ESU-ADM); 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 inserted into a proportion or all hatchery CHS released to confirm origin and support RM&E needs.	Immediate/ ongoing

Operate and maintain the Marion Forks Hatchery.	Recovery Plan 29-ESU-ADM); BiOp (RPA measures 6.1, 6.2.2, 9.5.1)	Immediate/ ongoing
Rebuild, operate and maintain the Minto Fish Collection Facility.	BiOp (RPA 4.6) Rebuild and use upgraded Minto facility to support outplanting and reintroduction efforts.	Immediate/ ongoing;
Resolve hatchery infrastructure maintenance needs and develop a long-term Hatchery Maintenance Plan for Minto Fish Collection Facility and Marion Forks Hatchery.	BiOp (RPA measures 4.6, 6.1.1): Improve fish collection facilities associated with hatchery mitigation program, including salmonid ladders, traps, holding, and acclimation facilities associated with hatchery broodstock collection and the outplanting program.	Immediate/ ongoing
Continue the CHS Reintroduction and Outplant Program to help establish a viable population in historic habitats in the North Santiam above Detroit Dam.	Recovery Plan: (157-SUB-NS and 162-SUB-NS) adapted from Appendix E of Plan; BiOp (RPA measures 4.1 and 6.2.3 adult Chinook outplanting; 4.10-4.12 improved downstream passage; 6.2.2 genetic diversity; 9.3 and 9.5.1 fish passage and hatchery program RM&E) 1) To maintain current natural production, natural-origin CHS captured at Minto Fish Collection Facility will be outplanted into accessible habitats; e.g. below Big Cliff Dam, Little North Fork Santiam, and other appropriate areas where juveniles have free egress for migration. 2) The approach for re-establishing runs above the dams is to continue outplanting primarily adult hatchery Chinook salmon or adults from offspring produced above the project into the vacant habitats above the dams. Hatchery adults will continue to be used to supplement populations until passage results in a self-sustaining, natural population and reproduction goals. Adequate numbers of hatchery fish are available in most years to support outplanting objectives above the dams. Until risk to natural origin adults is minimized, outplanted HMP fish will be used for RM&E purposes to monitor the downstream survival of fish through the reservoirs, turbines, regulating outlets, etc. Over time, as conditions improve to support a self-sustaining natural-origin CHS population, hatchery outplants will be discontinued, and natural-origin fish will be the only fish passed above the dams. Further details on these reintroduction efforts using the hatchery programs are being discussed and formalized by the fish co-managers with input from WATER.	Immediate/ ongoing
	BiOp (9.3 and 9.5.1): Genetically assess (e.g. adult pedigree analysis) origin of natural-origin CHS returning to Minto. Evaluate conservation risk and benefit of selective passage and transport of only those returning adults originating from natural production above Detroit Dam back upstream above Detroit Dam until passage actions have been implemented and approved by NMFS.	Immediate/ ongoing
Collect, hold, transport, and release outplanted fish in a manner that increases the likelihood for spawning success.	Recovery Plan (162-SUB-NS), BiOp (RPA measures 4.3 – 4.5) Implement best management practices for optimal handling, sorting, and release to support successful research, monitoring, evaluation, and reintroduction. Protocols are included in this document.	Immediate/ ongoing
Ensure that outplanted fish represent the life history characteristics of the natural population and	Meet integration goals to maintain population run timing, and size and age at maturity.	Immediate/ ongoing

promote successful production.		
Develop and carry out a thorough RM&E program to monitor the progress of the reintroduction/outplant program.	Hatchery RME (BiOp RPA measure 9.5.1) monitoring includes: Success of the current outplant program is being monitored through. 1. Broodstock Management- Determine collection and spawning timing of broodstock, composition of hatchery and wild fish. 2. Determine the abundance, distribution, and percent hatchery-origin Chinook on the spawning grounds of each population annually. 3. Determine the survival rate of outplanted fish and abundance of spawners above the dams. 4. Determine juvenile production by hatchery and wild spawners above the dams. 5. As hatchery program reforms are implemented to make hatchery fish more similar to wild fish, use hatchery fish as a surrogate for wild fish in the testing and evaluation of migration, behavior, and survival of fish through the reservoirs and dams. Wild fish may be used in the future if risks are deemed acceptable.	Immediate/ ongoing

Develop a strategy for reducing the incidence of hatchery strays on spawning grounds.	Recovery Plan: (Recovery Plan Action ID 183-SUB-NS) Manage current CHS Harvest Mitigation Hatchery Program (HMP) facilities and broodstock to meet production goals, but do so in a manner that the genetic and demographic impacts of program do not pose either unacceptable risk to extant natural-origin fish populations or compromise long term productivity of a reintroduction stock that would preclude success of conservation reintroduction/supplementation program above Detroit Dam. 1) This HGMP incorporates the pHOS criteria designated in the Recovery Plan (ODFW and NMFS 2011). The criteria is <10% pHOS for the North Santiam CHS natural population over the long term following completion of passage actions. Hatchery-related risks will be reduced as natural production is restored above and below Big Cliff/Detroit Dams. The goal is to minimize pHOS above Big Cliff/Detroit once successful natural production is demonstrated. The hatchery mitigation program for CHS will be reduced commensurate with restoration of natural production above these dams. For the production areas below Detroit/Big Cliff Dams, pHOS will be higher due to the location of the hatchery facility and reduced natural production due to the adverse effects from the operation of the dams to downstream areas (including high total dissolved gas levels during spill operations; although incubation and run timing have been improved since 2007 by a temperature control spill operation). This area was not core spring Chinook salmon habitat historically, although it is the only area to which spring Chinook currently have volitional access. 2) Implement passage improvements at Detroit/Big Cliff dams with the goal to restore access to lost habitat and increase natural production. Reassess and reduce the hatchery mitigation program commensurate with sustainable natural production increases resulting from passage provisions at Detroit and Big Cliff dams as identified in the Willamette BiOp. 3) In the short term, implement actions and associated RM&E below Minto facility that will reduce genetic and demographic risk to extant natural-origin population: - improving trap attraction, operation, and sorting at new Minto facility; (open year round) - modifying acclimation, release and/or rearing strategies - encouraging greater harvest of hatchery fish above Stayton Island – - maintain hatchery-origin tagging efforts and CHS spawning surveys - implement 5-10% integration standard of natural-origin broodstock and look for annual opportunities to "outplant" natural-origin fish to other locales in lower subbasin. Adapt based on new RM&E as obtained. 4) Assess hatchery production and opportunities to adjust production levels or adult disposition to reduce pHOS while maintaining adequate production to meet harvest goals, and conservation and reintroduction goals. 5) Increase natural-origin production below Big Cliff through WP BiOp RPA water quality/quantity improvements at Detroit, and	Ongoing

	other actions addressing LFTs. Further develop a conservation supplementation (reintroduction) program (CSP) or set of strategies to be implemented above Detroit Dam. 6) Only wild adults will be passed above Minto Dam. The four mile reach above the dam provides an area where natural origin fish interactions with hatchery fish are minimized. Further develop a strategy to reduce pHOS to acceptable levels below Minto. Actions include but are not limited to improving homing and attraction to Minto Facility and improved harvest of hatchery-origin fish above Bennett dams.	

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which 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 US Army Corps of Engineers, Portland District Hatchery Mitigation Program (Cooperative Agreement; USACE and ODFW 2012).

Marion Forks Hatchery is one of several hatcheries funded by the USACE to mitigate for lost or inaccessible habitat (natural spawning, feeding, and rearing grounds for fish) caused by construction of multi-purpose dams and reservoirs in the Willamette Valley. The 2012 Cooperative Agreement identifies maximum production levels for the USACE's mitigation program to ensure consistency with mitigation requirements and that funding levels are appropriate. The Cooperative Agreement identifies that mitigation or production changes will be considered through a collaborative process between ODFW and USACE on an annual basis to review and adjust (as appropriate) mitigation production levels. Adjustments may be made to: reduce and minimize effects on ESA listed fish; meet mitigation program goals with adjustments to account for fish passage improvements; and support re-introduction efforts above WVP dams. The Cooperative Agreement also provides for evaluation of the hatchery program through USACE-funded RM&E. This HGMP will provide direction for management of the hatchery mitigation and conservation program as it relates to effects of the program on ESA listed fish.

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.

CHS fisheries occur during the spring and summer in the lower mainstem Columbia and mainstem Willamette, as well as in the Santiam subbasin. ODFW implemented selected fisheries on marked hatchery CHS beginning in 2002 (2001 in the N. Santiam). The fisheries target adipose fin-marked hatchery fish only. Willamette CHS management is based on a subbasin plan adopted by the Oregon Fish and Wildlife Commission after a lengthy public process. The plan was revised in 1998, in part to address requirements of the ODFW Wild Fish Policy, which adds increased protection for wild fish. In-season regulation of the fishery is based on pre-season estimates of abundance.

Sport catch in the Santiam Basin (including the North and South Santiam rivers) generally improved from the mid-1970s to early 1990s, with an average sport catch of 2,833 fish (1982-93). Returns and harvest decreased through the mid-1990s, but increased again in the late 1990s. From 1999 through 2012, harvest in the North Santiam has averaged 1,095. Current fish management plans target an average annual catch of 3,000 CHS in the Santiam basin, with 1,400 of those produced by the North Santiam hatchery program.

Historic harvest rates of Upper Willamette CHS have ranged from 30-50%. Under the current fishery management plan, the sport, commercial, and ocean fisheries harvest impact on wild North Santiam CHS is expected to be approximately 10.5%. This is about one-fifth the average harvest rate from 1981-97, and less than one-half the harvest rate from 1998-2001. The fishery management strategy is discussed in detail in the Fisheries Management and Evaluation Plan (ODFW 2001). Exploitation of the hatchery fish is limited to protect wild CHS. The goal is to limit fishery impacts on wild fish to levels that ensure the survival and rebuilding of these populations. The plan estimates that under the current regulation strategy, a 15% exploitation rate will achieve this goal even under the most pessimistic assumptions.

Both the North Santiam Spring Chinook salmon program and ODFW's Molalla River Chinook recovery program were addressed under the umbrella of the Willamette BiOp (NMFS 2008), where NMFS issued a jeopardy/adverse modification conclusion for the effects of the continued operation of the Willamette Project on the UWR spring Chinook ESU and UWR winter steelhead DPS, including the North Santiam populations of UWR Chinook salmon and steelhead, and prescribed various RPA Actions including:

> 1. Ensuring that Willamette Project hatchery programs are not reducing the viability of listed stocks, including implementation of HGMPs "to reduce and minimize adverse effects of hatchery programs on UWR spring Chinook and steelhead" (RPA 6.1; 6.1.1);
>
> 2. Preserving and rebuilding genetic resources through conservation and supplementation objectives to reduce extinction risk and promote recovery, including (1) implementation of HGMPs and use of local broodstock in each population area including the North Santiam (RPA 6.2; 6.2.1 and 6.2.2), and (2) outplanting of adult chinook above Detroit (RPA 6.2.3).

In addition, the Willamette BiOp directed the action agencies, including USACE and BPA, to support ODFW's efforts to eliminate the use of non-local hatchery Chinook stock released into the Molalla River by identifying potential funding and implementation mechanisms to develop a locally-adapted broodstock (RPA 6.2.5).

The SAFE program collects Coho, spring Chinook, and fall Chinook salmon adults, and rears smolts, at various facilities and locations throughout the Lower Columbia River basin (including some of the Willamette River Basin collection and hatchery facilities), and releases smolts in the Lower Columbia River estuary to support a terminal fishery. This is a separate underlying action and purpose (where "action" focuses on activities or programs, 50 C.F.R. § 402.02) from the two programs that are the subject of this consultation, and was not included under the umbrella of the Willamette BiOp – the SAFE program is thus part of a separate consultation.

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) to ensure the maximum available protection to fish habitat is applied. Habitat protection and improvement supports management strategies, resulting in benefit to both hatchery and wild CHS populations. Hatchery fish have an important role in ongoing ESA conservation efforts and recovery planning efforts in the basin (e.g. adult outplanting/reintroduction, juvenile releases above Detroit Dam).

USACE provides habitat protection and restoration relative to the hatchery program through implementation of the following RPA measures prescribed in the WP BiOp (NMFS 2008):

- Adult Chinook Outplanting - RPA measures 4.1 and 6.2.3 provide direction for adult Chinook Salmon outplanting above Detroit Dam via trap and haul measures in order for fish to access historic spawning and rearing habitats above the projects.
- WFOP - RPA measures 4.3 and 4.4 provide for completion, annual review, and implementation of a Willamette Fish Operations Plan (WFOP) that includes protocols for optimal handling, sorting, and release conditions for Minto Fish Collection Facility, and identification of the number, origin, and species of fish to be released upstream of USACE dams, or taken to other destinations. This HGMP will guide operation and management of the hatchery spring Chinook program as it relates to production in support of RPA measures 4.3 and 4.4.
- Fish Passage - RPA 4.8 provides interim operational measures for safe and efficient downstream juvenile fish passage through reservoirs and dams. Implementation of RPA 9.3 (fish passage RM&E) through sub-actions identified in RPA measures 4.10 and 4.11, provide for RM&E assessment of downstream juvenile fish passage options. RPA 4.12 and 4.12.3, provide for implementing additional structural and operational Long-Term Passage Solutions after analysis of alternatives in the COP process (RPA 4.13) and decision making in the WATER process (RPAs 1.3 and 1.4).
- Spring Chinook Hatchery Program RM&E – RPA 9.5.1 provides for RM&E activities for broodstock management, composition of hatchery fish on the spawning grounds, survival of fish outplanted above Federal Dams, reproductive success of hatchery fish outplanted above the dams, and use of hatchery fish to evaluate migration and survival through reservoirs and dams.

Recovery strategies relative to hatchery management were discussed briefly in Section 3.1, and greater detail for other management regimes and threats can be found in the Recovery Plan.

3.5) Ecological interactions.

Releases of hatchery CHS could potentially increase negative ecological interactions with naturally rearing salmonids, including natural-origin CHS and winter steelhead. These potential interactions, discussed previously in Section 1.9 and 1.10, are considered in the Recovery Plan as minimal threats when compared with other limiting factors/threats in the North Santiam River subbasin and mainstem Willamette and do not rank as either primary or secondary threats; however, information available to quantify interactions is limited.
Outplanting of hatchery adults above Detroit is currently occurring per RPA 4.1 and 6.2.3.

According to the Recovery Plan, ecological interactions above the Detroit/Big Cliff complex will be minimized through implementation of split basin management where areas above Detroit Dam will be managed for natural production in historic habitats. Management of the hatchery program and spring Chinook above and below Detroit/Big Cliff dams will be re-evaluated following improvements to Detroit Dam that are designed to aid fish passage and, in so doing, also improve the downstream water temperature regime. Such re-evaluation and decision-making will utilize the concepts of viable and critical salmonid population thresholds, consistent with VSP concepts, such as abundance, productivity, and diversity. Phase One of Detroit Dam downstream juvenile fish passage is scheduled to be completed and operational in 2022. Ongoing monitoring of the program and implementation of the Willamette BiOp will be used to monitor reintroduction and passage efforts, the North Santiam spring Chinook population, and its distribution as outlined in RPA 9.5.1.

Instream flows have a direct effect on outmigration of salmonid smolts. Flow supplementation facilitates and expedites outmigration of hatchery and natural origin smolts. There are multiple RPA's related to flow management in the Willamette BiOp.

SECTION 4. WATER SOURCE

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

Marion Forks Hatchery uses two different surface water supplies: Marion Creek and Horn Creek (Table 4.1-1). Surface water from both streams are gravity fed to the hatchery. Marion Creek is used primarily from April to November due to the volatility of the stream system during the winter months. Its temperature ranges from 32 to 60°F, and the full water right is 34 cfs.

Horn Creek is used during the winter months due to the relative stable flows, low volatility and warmer temperatures that range from 36 to 50°F. The water right for Horn Creek is 32 cfs. During the highest months of production (July through October), the entire hatchery cannot be adequately supplied by Horn Creek alone and water is mixed from both supplies. The water source on each pond can be adjusted individually to provide the appropriate mix of water.

Table 4.1-1. Summary of average water temperature (°F) and water usage (gallons per minute; gpm). H=Horn Creek; M=Marion Cr.

	Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Source	H	H	H	H/M	H/M	M	M	M	M	H/M	H/M	H
Water	5550	3750	450	1400	3200	4100	9200	9200	9350	9350	5550	5550
Temp	36	37	38	40	46	50	55	56	52	44	40	38

The hatchery runs on an individual NPDES permit due to the Three Basin Rule. All conditions of the permit are administered within the ODFW and regulated by ODEQ.

The water intakes at Marion Forks Hatchery are not in compliance with NMFS screening criteria. A small diversion dam on Marion Creek provides water to the Marion Creek intake. In 2006, the diversion dam on Marion Creek was dewatered and inspected for structural integrity. The cement curtain was in place and the cables were adequately securing the logs in place. Areas that were undermined were filled in with rock. Over the past three years, a picket weir designed to exclude adult CHS from migrating above the diversion dam has not functioned properly. A new weir needs to be designed and installed to reduce the risk of BKD in the hatchery. In 2013 the weir was not placed in Marion Creek due to high flows and safety factors. Pathology results found clinical BKD for the first time at the hatchery in the CHS smolts possibly from adults above the intake, a permanent solution should be formulated to prevent adults above the Marion Creek intake. The screens on the Horn Creek intake are not in compliance with NMFS or ODFW screening criteria. No adults spawn above the intake; a weir is located about 30 meters below the intake.

The water supply source for the new Minto Fish Collection Facility is the North Santiam River. The intake structure consists of 5 pumps that feed the complex with water. There is a gravity intake for the Alternative Water Supply (AWS) system for the lower ladder. The intake is screened and meets National Oceanic and Atmospheric Administration (NOAA) criteria. The water right for this intake is 60 cfs. With the use of the AWS system the water right is exceeded. The USACE has ruled that a water right is not required for the AWS. The fish facility water needs are: 20 CFS for the presort pool and ladder, 20 CFS for the post sort pools, and 10 CFS for the sort flumes. Depending on the time of year and fish availability the fish facility water usage varies. The AWS system has 12 gates and each gate uses approximately 18 CFS each, depending on head pressure.

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.

Marion Forks Hatchery is not in compliance with NMFS juvenile fish screening criteria. However, because no listed fish species occur upstream of the hatchery, there are no risk aversion measures needed. A study by Tetra-Tech (2002) indicated the costs to upgrade the screens would be $153,000 for the Horn Creek intake and $225,000 for the Marion Creek intake. Because the estimate was completed in 2002, actual costs to bring the screens into compliance would likely be higher.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

All North Santiam CHS broodstock are collected at the Minto Fish Collection Facility. The facility was redesigned to accommodate adult salmon collection, sorting, outplanting, recycling, research needs, and acclimation of CHS; it also handles adult winter and summer steelhead, as well as any native migratory fish. Migrating adults are blocked by the barrier dam and guided to the fish ladder entrance. Attraction water is provided from a gravity fed line to the Auxiliary Water Supply structure. The pre-sort ladder and post-sort pools are supplied by five pumps.

Fish traverse the fish ladder into a pre-sort holding pool. A finger weir prevents fish from falling back down the ladder. A false weir is activated to guide fish into a flume for visual sorting. From this location they can be directed back to the river, to an anesthetic tank, to the sort channel, or to post-sort pools. Fish removal from the anesthetic tank are done by hand and/or brail and transferred onto a table for processing.

5.2) Fish transportation equipment.

The USACE has equipped the Minto facility with a new truck equipped with a lid that fits with the new water-to-water transfer hopper for loading and transport of adults from the collection facility to outplanting sites above and below the project. Marion Forks has a flatbed truck with a 1,000-gal tank equipped with two aerator pumps. The hatchery also uses regional trucks, which have a 1,600-gal tank equipped with recirculation pump and oxygen pumps, to haul both adults and juveniles. To reduce stress associated with transport and protect the mucous layer of transported fish, all tanks transporting fish destined for outplanting will be treated with Nov-Aqua (per manufacturer's recommended dosage). In typical years, broodstock are not transported, but rather spawned on-site at the Minto Facility.

5.3) Broodstock holding and spawning facilities.

The Minto Fish Collection Facility is equipped with treatment methods for long term holding of adults for spawning and outplanting. Minto has eight 75'x10'x6' raceways for holding adults. Formalin testing has been completed with DEQ approval for the system.

5.4) Incubation facilities.

Eggs from individual fish are brought from the Minto Fish Collection Facility to Marion Forks Hatchery where eggs are trayed-down and disinfected. The hatchery has 34 stacks of Heath stack incubators. After 500 Temperature Units (TU) have accumulated, the eggs are shocked, picked, and counted back into the trays at 8,000 eggs per tray. The hatchery is equipped with a water heating system that enables staff to accelerate incubation on individual groups of eggs. Otolith marking begins soon after hatching, and consists of 8-10 cycles of heated water followed by cold water (8-10 ˚F difference) are applied at 48-hour intervals.

5.5) Rearing facilities.

Fish rearing facilities at Marion Forks Hatchery include 12 Canadian style troughs (21' x 2.6' x 1.75'), 8 raceways (20' x 80' x 3') and 48 circular ponds (24' diameter x 2.5'depth). Upgrades and expansion to the hatch house rearing vessels is currently underway.

5.6) Acclimation/release facilities.

The ponds at the Minto Fish Collection Facility allow for acclimation of all Chinook salmon juveniles prior to release and have adequate capacity for collecting adult fish during periods of juvenile acclimation. Chinook salmon smolts are trucked from the Marion Forks Hatchery to Minto Fish Collection Facility and acclimated in the post-sort pools.

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

There has been no significant fish mortality at either Marion Forks Hatchery or at the Minto Fish Collection Facility. The few losses that have occurred were a result of warmer than usual water temperatures in 2001 and 2015 when Detroit Lake was not fully recharged. Other minor losses have resulted from human error. Marion Forks Hatchery is a relatively safe environment with its high elevation location, clean gravity-fed water supply, alarm system in place, on-site housing for staff, and low densities of fish. The Minto Fish Collection Facility lacks on-site housing and relies on pumps equipped with alarm systems and back-up generators.

5.8) Indicate available back-up systems and risk aversion measures that will be applied, that minimizes 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.

Unmarked fish encountered at the Minto Fish Collection Facility are processed quickly (put upstream, transported to other locations, or sequestered as broodstock). The upgraded facility has pumped water with alarm systems. Personnel living nearby are equipped with an auto-dialer for quick response. The Marion Forks Hatchery was equipped with low-water alarms in 2008. Fish densities are kept at moderate levels to prevent overcrowding.

Fish Health Monitoring and Disease Prevention standards and protocols are strictly followed at both facilities that are consistent with ODFW Fish Health Management Policy and IHOT.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

6.1) Source.

Broodstock for the North Santiam River CHS program are collected from adult Chinook salmon returning to the Minto Fish Collection Facility on the North Santiam River. Hatchery fish returning to the collection facility are mixed and randomly selected for spawning. Natural-origin fish will be incorporated into the broodstock when specific incorporation criteria are met.

6.2) Supporting information

6.2.1) History.

Broodstock for the North Santiam stock 021 was initiated by collecting wild adults that returned to the base of Big Cliff after construction was completed, and there have been few out of basin stock transfers to maintain the hatchery program. Broodstock has been comprised almost entirely of adults returning to Minto Pond (Table 6.2.1-1). During the 1992 brood year, 1,668,000 viable eggs were transferred to the Clackamas, McKenzie and Willamette hatcheries, to compensate for egg-take shortages in their CHS programs. In the late 1970s, Carson (Washington State) stock Chinook salmon were introduced for one generation. An arbitrary date of September 10 was used as the distinction between the Carson stock, returning earlier, and the North Santiam stock that returned later. Adults spawned prior to September 10 were considered Carson and those eggs were shipped out of the basin. Any fish spawned after September 10 were considered North Santiam stock and were incorporated into the hatchery broodstock. It is also likely that strays (wild or hatchery-origin) have been captured at the Minto trap and incorporated into the brood stock on occasion.

Table 6.2.1-1. Adult spring Chinook salmon returns to Minto pond, and fish used for broodstock, 1990 – 2015

Brood Year	Adults Counted at Minto Pond	Adults Spawned [1/]			Egg Take (in 1,000s)	Egg Transfers (in 1,000s)	Fry Ponded (in 1,000s)	Other Stock Transfers
		Males [1/] (No.)	Females (No.)	Spawning Ratio (M:F)				
1990	1,084	243	243	1.00	1,090	0	710	0
1991	2,152	297	265	1.12	1,216	0	773	0
1992	2,894	515	515	1.00	2,414	1,668	622	0
1993	2,595	234	234	1.00	1,165	0	957	0
1994	683	201	201	1.00	862	0	735	0
1995	798	298	276	1.08	1,190	0	1,013	0
1996	634	255	230	1.11	1,078	0	769	0
1997	875	240	233	1.03	984	0	725	0
1998	1,925	287	287	1.00	1,192	0	846	0
1999	1,943	228	238	0.96	959	0	746	0
2000	3,004	255	255	1.00	1,081	0	764	0
2001	3,410	252	254	0.99	1,109	0	721	0
2002	4,948	341	341	1.00	1,557	0	832	0
2003	4,441	309	309	1.00	1,524	0	821	0
2004	4,052	283	283	1.00	1,284	0	862	0
2005	1,812	252	252	1.00	1,073	0	860	0
2006	3,636	272	272	1.00	1,224	0	873	0
2007	1,989	278	277	1.00	1,233	0	840	0
2008	1,126	251	251	1.00	1,130	0	812	0
2009	2,068	289	289	1.00	1,409	0	875	0
2010[2]	4,948	236	256	.92	1,229	0	792	0
2011[3]	NA	275	275	1.00	1,246	0	955	0
2012	NA	268	268	1.00	1,206	0	1,062	0
2013[4]	2,875	456	456	1.00	2,052	0	NA	0
2014	3,815	546	546	1.00	2,457	0	NA	0
2015	4536	484	484	1.00	2178	0	NA	0

[1/] Males spawned include jacks.

[2] In 2010, 20 non-marked males were split between 40 females.

[3] No collection at Minto in 2011and 2012 due to facility reconstruction; spawning occurred at McKenzie hatchery.

[4] 2013 first year of spawning at the new Minto facility.

6.2.2) Annual size.

Adult collection goals are based upon annual production goals for the subbasin, anticipated egg transfer needs, and anticipated losses due to diseases and handling to mark fish. To satisfy the current annual smolt and subyearling production goals of 704,000 smolts to support broodstock needs for the hatchery mitigation program, conservation needs, and the Molalla River spring Chinook salmon program, the annual egg take objective is approximately 900,000 eggs (to account for BKD losses). This equates to an annual broodstock goal of 541 adults collected. Collection of approximately 540 adults for broodstock is necessary to account for females representing 40% of returns and adult holding PSM.

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

Until 1996, not all hatchery reared juvenile CHS were marked with an adipose fin clip; therefore, an unknown proportion of naturally produced fish may have been incorporated into subsequent broods. Subsequently, all hatchery-reared juveniles were adipose fin clipped, and approximately 30,000 are coded-wire tagged annually. The proportion of natural-origin fish incorporated has ranged from 0.3 to 36.2% of the brood (Table 6.2.3-1). The current goal is to integrate natural-origin adults at an average rate of 5.0%.

Table 6.2.3-1. Composition of natural origin spring Chinook salmon without fin clips that were spawned at Marion Forks hatchery, based on the presence or absence of thermal marks in otoliths, 2002–2013. Source: Kenaston et al. 2009; Sharpe et al. 2011; unpublished ODFW data.

Year	Unclipped[a]		Fin-clipped	Percent Natural-Origin Brood
	NOR	HOR	hatchery	
2002	4	7	671	0.6
2003	2	17	599	0.3
2004	12	13	541	2.1
2005[b]	18	16	470	3.6
2006[c]	197	12	335	36.2
2007[c]	158	17	375	28.7
2008[c]	154	6	342	30.7
2009	5	4	569	0.8
2010	27	17	446	5.5
2011	94	5	452	17.1
2012	19	5	526	4.4
2013	0	0	912	0

[a] Includes fish with questionable fin-clips.
[b] Otoliths were analyzed for 21 fish (of which 11 were wild).
[c] Bennett Dam trap was not operated in 2006 through 2008.

The Recovery Plan sets guidance regarding take of unmarked fish for use in the broodstock with the intent to ensure adequate escapement and full seeding of currently accessible spawning areas. For the North Santiam, the guideline is as follows:

Protect/maintain local adaptation by maximizing natural spawning opportunities and new targets for integration:

- First, determine whether integration is needed to maintain HMP run characteristics
- If needed, allow integration if natural-origin return is > 1,000 fish (consistent with below dam portion of low viability target and USACE mitigation numbers based on historic production estimates); and if
- If integration has not happened within a multi-year period (e.g., >5 yrs), allow a 10% of natural-origin run at the 5-year mark if the annual evaluation determines no conservation impacts
- The proposed integration rate is approximately 5-10% annually. The HSRG guidelines were considered; however, site specific analysis has shown that the proposed integration rate meets program and conservation needs.

Integration targets may be adapted over time to ensure the hatchery program can meet goals for mitigation and conservation/reintroduction needs, as guided by RM&E.

6.2.4) Genetic or ecological differences.

Using genotypic data for 13 microsatellite markers, Johnson and Friesen (2013) found a small but statistically significant genetic difference between hatchery and wild CHS sampled in 2011 from the North Santiam River (H_0: $\theta = 0.002$; $p < 0.05$). Mean heterozygosity for these markers was higher in the hatchery population (82%) than in the wild population (78%), though allelic richness was slightly higher in the wild population. Narum et al. (2010) similarly found mean heterozygosity in the North Santiam to be 82%, averaged across multiple sampling years. Johnson and Friesen (2013) found that hatchery and wild populations from the North Santiam River were more similar to each other than to any other (hatchery or wild) upper Willamette River population examined. They also found no evidence for positive selection at four immune-relevant loci (Tonteri et al. 2008), as allele frequencies at these markers were very similar between the North Santiam hatchery and wild spring Chinook salmon populations.

Genetic similarity between the North Santiam hatchery and wild spring Chinook salmon populations is not surprising in view of the facts that 1) the hatchery brood stock was founded by local, wild spawners; 2) wild fish have been integrated into the hatchery brood stock and; 3) a proportion of hatchery-origin fish spawn in the wild. The minor differences observed between these populations are likely the result of remnant founder effects and low-intensity genetic drift.

Genetic similarity achieved through wild brood stock integration may not fully mitigate negative effects of hatchery fish on wild populations. 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 wild populations.

Few phenotypic or ecological comparisons have been made between wild and hatchery spring Chinook salmon from the North Santiam River. Cannon et al. (2010) reported no significant difference between the median fork length of marked (hatchery origin) and unmarked upper Willamette River spring Chinook salmon, though marked fish from the North Santiam tended to be larger than hatchery fish from other subbasins. Adult run timing of North Santiam River hatchery Chinook did not appear to differ from that of wild Chinook in 2009 or 2010, as evidenced by observations at the Upper Bennett Dam (Cannon et al. 2010; Cannon 2011). Studies have not been completed in the North Santiam to assess productivity difference between hatchery and natural-origin CHS.

6.2.5) Reasons for choosing.

North Santiam River spring Chinook salmon were chosen as the optimal brood source for this program, because they were indigenous to the basin, and therefore believed to be the best locally adapted stock available for hatchery production. Proactive actions have been taken to avoid hatchery transfers between subbasins.

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 North Santiam stock (random selection, egg takes throughout run) will reduce adverse genetic or ecological effects, avoid genetic drift, and maintain the genetic diversity of the hatchery stock. Hatchery-origin adults in excess to broodstock and tribal needs are outplanted in efforts to evaluate the potential for natural production upstream of Detroit Dam or as described in Section 7.5. Natural-origin spring Chinook salmon not incorporated into the broodstock are released back to accessible reaches of the river, released above Minto Dam, or outplanted downstream of Minto Dam to provide an opportunity for natural spawning.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life 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 returning to the Minto Fish Collection Facility (and used for broodstock purposes) are collected throughout the run (May through early October). Natural-origin fish may be incorporated into the broodstock at levels outlined in Section 6.2.3. Fish returning to the collection facility are mixed and randomly selected for spawning, which occurs on several different days from early September through the first week in October. Hatchery adults arriving at Minto Fish Collection Facility that are used to support passage research and conservation will be outplanted in accordance with Section 15, the spring Chinook salmon outplanting protocols addendum. Updated protocols for adult handling, transport, and release are in development. The National Marine Fisheries Service and ODFW will work on a reintroduction plan for spring Chinook salmon in the North Santiam with advice from the WATER forum.

In the case of increased water temperatures released from Detroit Dam due to emergency outages, returning adults could be temporarily moved to Foster Fish Collection Facility or McKenzie Hatchery where they would be held until spawning in September.

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 North Santiam River basin.

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

Currently, the goal is for all hatchery-origin spring Chinook salmon to be externally marked with an adipose fin clip and a thermal otolith mark. The fish at Marion Forks Hatchery are adipose fin-clipped using an automated 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 (approximately 8.9 %) of each release group were coded-wire tagged in addition to receiving adipose and otolith marks. The CWTs 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 CWT. All three marks allow hatchery-origin fish to be distinguished from naturally spawned fish. The use of "real-time" genetic identification or 100% CWT tagging may be considered in the future as a means of distinguishing inadvertently unmarked hatchery adults from natural-origin adults.

7.4) Proposed number to be collected.

7.4.1) Program goal.

The Marion Forks Hatchery goal for the N. Santiam smolt release is to have a spawning population of 396 fish (including Molalla fish), comprised of 198 males and 198 females, with a 1:1 male-to-female spawning ratio depending upon the run size (IHOT 1994). Between 1990 and 2008, the spawning population ranged from 402 to 1,030 fish (mean 553 fish) with a male to female proportion of 0.96 to 1.12 (mean 1.01, including jacks that were used in spawning; see Table 6.2.1-1).

7.4.2) Broodstock collection levels in recent years.

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 spawned at Minto, 1990-2015 and at McKenzie Hatchery, 2011-2012.

Year	Females	Males	Jacks
1990	243	243	
1991	265	295	2
1992	515	515	
1993	234	234	
1994	201	201	
1995	276	298	
1996	230	255	
1997	233	240	
1998	287	287	
1999	238	228	10
2000	255	255	
2001	254	252	
2002	341	341	
2003	309	309	
2004	283	283	
2005	252	252	
2006	272	272	
2007	277	277	1
2008	245	251	6

2009[1]	180	180	
2010[2]	234	256	2
2011	270	275	5
2012	268	268	
2013	456	452	4
2014	546	546	
2015	484	484	

[1]109 pair were shipped to McKenzie Hatchery and spawned there.
[2]20 non-marked males were split between 40 females.

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

Fish surplus to broodstock and reintroduction needs are disposed of in accordance with ODFW's FHMP (OAR 635-007-0542 through 0548) as modified to meet specific recovery plan goals and actions identified in the Willamette BiOp. Options for use of surplus broodstock include:

- outplanting above Detroit Dam to provide nutrient enrichment, and support RM&E for passage studies;
- provide fish for tribal ceremonial and subsistence use;
- provide for experimental, scientific or educational uses identified in conservation plans, management plans or other Department agreements;
- provide for carcass sales to buyers to support fish hauling;
- 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;
- provide fish to charitable food share programs benefiting needy Oregonians;
- provide fish for animal feed to animal rehabilitation shelters, zoos, or other such operations; and
- 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, support other ODFW programs including Select Area Fisheries Enhancement, or respond to unforeseen circumstances. Disposition priorities for outplanting to support passage studies, research, and meet ESA conservation goals, consistent with survival and recovery of the ESU, and consistent with recovery goals, are established by the fish co-managers with input from WATER to and are documented in the annual Willamette Fish Operations Plan (see 2008 BiOp).

7.6) Fish transportation and holding methods.

In typical years, broodstock are not transported, but rather spawned on-site at the Minto Fish Collection Facility. Refer to sections 5.1 and 5.3 for a description of broodstock handling and holding procedures.

See sections 5.2 and 5.3for a description of the transport tanks and holding containers that are used. During initial processing/sorting Aqui-S is used as anesthetic because under the current INAD, passage facilities are allowed to immediately released adults into a fishery that have been treated with Aqui-S. CO_2 or Aqui-S (with a 72 hour holding time) may be used when spring Chinook salmon are to be used for sales, food share, or tribal needs. Tricaine Methanesulphonate is used when fish are killed for broodstock or outplanted into a closed fishery. Both are used as an anesthetic before hauling for ease of handling and reducing stress to fish (each depending on disposition of those fish). To reduce stress associated with transport and protect the mucous layer of transported fish, all tanks transporting fish destined for outplanting will be treated with Nov-Aqua (per manufacturer's recommended dosage). The Minto Fish Collection Facility allows the use of MS-222, CO_2 or Aqui-SE.

7.7) Describe fish health maintenance and sanitation procedures.

Upon collection, broodstock are anesthetized with Aqui-SE and injected with antibiotics (oxytetracycline [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.

After ODFW needs are met, grade one and grade two spring Chinook salmon carcasses are used to satisfy tribal agreements. Spawned carcasses, or fish killed for CWT recovery, are currently used for stream enrichment in the Upper North Santiam basin. Mortalities in holding ponds are buried in a local landfill, or used for stream enrichment.

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

The broodstock collection at the Minto Fish Collection Facility for the spring Chinook salmon starts in April and lasts until the first part of October. Collection of broodstock is random, with sex ratio and timing representative of the run during trap operation. The

new Minto Fish Collection Facility has enough space to hold adults for outplanting and broodstock collection. It supports water to water transport and allows for treatment of adults.

As outlined in Section 6.2.3, the integration of natural-origin salmon into the hatchery broodstock will be managed to minimize impacts to natural fish. Unmarked fish not retained for brood will be handled carefully and immediately transported to an approved outplant locations.

The risk of adverse ecological or genetic effects to listed fish will be minimized by hatchery management practices described throughout this document and the FHMP (see Section 3.1).

SECTION 8. MATING

8.1) Selection method.

Fish are selected and paired at random to minimize selective pressures from hatchery practices. Once collected for broodstock, 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 North Santiam spring Chinook salmon stock 021 is used for broodstock.

8.2) Males.

The typical sex ratio of returning adults is almost 60% male to 40% female; although in 2007, an unusually high percentage of females returned. Based on the observed sex ratio, a minimum of 540 returning adults is needed to achieve the N. Santiam broodstock goal. The typical spawning sex ratio for this program is a 1:1 male-to-female. Jacks are occasionally used, depending on availability at the time of spawning. Males are not re-used unless needed for research or other purposes.

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 (unless ripe males are not available). Eggs from one or two females are placed in each Heath tray separated from other female(s) by a divider. Fertilized eggs are subjected to a 10-minute iodophor bath for disinfection at Minto prior to water hardening and in the Heath trays at Marion Forks.

Trays and egg batches are individually marked so eggs can be discarded if BKD tests are positive. Eggs are transferred from Minto to Marion Forks in mesh bags (they are spawned into these bags) that are in coolers with wet burlap and ice.

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 or if a late egg take cannot be caught up with TU's in an effective manner. If this occurs, offspring of diseased parents may be culled to maximize long-term survival of the brood.

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

8.4) Cryopreserved gametes.

No cryopreserved gametes are used for the North Santiam River spring Chinook salmon (stock 021) program.

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood of for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

Broodstock are collected throughout the entire run time to maintain genetic diversity within the hatchery-produced population. The Marion Forks Hatchery uses a random spawning selection and a 1:1 male-to-female spawning ratio to avoid intentional selection of demographic characteristics such as run timing or size.

SECTION 9. INCUBATION AND REARING

9.1) Incubation.

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

Egg take and survival rates are provided in Table 9.1.1-1.

Table 9.1.1-1. Egg take at Minto Pond and Incubation at Marion Forks Hatchery and survival to ponding, 2002-2015.

Brood Year	Egg take	Eyed eggs	Egg to eye (survival)	Ponded fry	Egg to pond (survival)	Eggs	
						Culled [a]	Destroyed [b]
2002	1,556,577	937,577	91%	832,000	81%	180,000	342,000
2003[c]	1,524,328	1,202600	91%	821,600	90%	198,000	370,000(shipped)
2004	1,284,480	1,005,480	97%	862,400	86%	243,000	36,000
2005	1,072,977	1,005,000	99%	865,000	86%	63,000	4,977
2006	1,224,000	994,000	91%	879,296	88%	135,000	77,000
2007	1,274,800	1,080,900	88%	840,200	86%	45,000	216,000
2008	1,115,800	983,500	91%	812,000	89%	31,500	158,000
2009	1,463,610	1,351,500	96%	875,226	91%	57,900	406,000
2010	1,253,800	1,058,800	90%	793,700	88%	76,500	245,000
2011[d]	1,282,660	1,213,886	95%	955,000	93%	9000	226,000
2012[e]	1,253,872	1,168,448	93%	1,062,932	88%	18,000	0
2013	2,117,800	1,819,400	93.1%	1,761,400	96.8%	123,000	23,000 (shipped)
2014	2,353,575	2,018,900	90.5%	1,792,000	88.8%	99,000	116,000+(8000 shipped)
2015	2,090,370	1,446,070	72.6%	NA		94,500	3,000 (shipped)

[a] Eggs culled due to BKD.

[b] Eggs destroyed in excess of production needs. After eye-up.

[c] eggs shipped not destroyed.

[d] Spawned at McKenzie and transferred to Marion Forks as eyed eggs; 24k were shipped.

[e] Spawned at McKenzie and transferred to Marion Forks as eyed eggs; 27k were shipped.

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.

9.1.3) Loading densities applied during incubation.

Standard loading per Heath tray starts at about 4,500 eggs or average female fecundity. All females are kept separate until pathology can confirm the presence, or absence, of BKD. After shocking and picking, 8,000 eggs are machine-counted into each incubator tray with a flow of 5 gallons per minute (gpm).

9.1.4) Incubation conditions.

Water to the incubator is monitored for temperature with a 7-day thermograph. Trays are monitored for silt buildup and cleaned as necessary. Dissolved oxygen readings are not regularly taken because the cold water used for incubation always holds adequate dissolved oxygen level. Temperature Units are recorded daily to determine embryo developmental stages and that are required for otolith marking programs.

9.1.5) Ponding.

Fish are ponded at 1,650-1,850 TUs, when ~99% button-up is attained. At Marion Forks Hatchery ponding of button-ups occurs between mid-February and mid-March.

9.1.6) Fish health maintenance and monitoring.

The eggs are treated with formalin three times a week until shocking and picking of eyed eggs. Mortalities are picked by machine after shocking and hand-picked after hatching and ponding. There have been no significant problems in terms of yolk-sac malformation.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed natural fish during incubation.

The protocols listed above to maintain survival across all stages of incubation are followed for eggs of both 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.

9.2) Rearing.

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years, or for years dependable data are available.

Survival data by life stage is provided in Table 9.2.1-1.

Table 9.2.1-1. Marion Forks Hatchery spring Chinook salmon survival rates (%) by life stage, 2002-2012.

Brood year	Lifestage Percent Survival		
	Egg to Fry	Fry to smolt	Egg to smolt
2002	81	93	82
2003	90	98	85
2004	86	95	82
2005	86	89	75
2006	88	101	84
2007	86	98	79
2008	89	98	92
2009	91	96	88
2010	88	98	89
2011	93	96	93
2012	88	NA	NA

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

Density targets from fry to fingerling are not to exceed 4 lbs fish/gal of inflow when the fingerlings go from inside to outside ponds. Density is usually below 3 lbs fish/gal. Once outside, fingerlings are split so levels do not exceed 10 lbs fish/gal. Highest densities (just before release) can reach about 11 lbs fish/gal.

9.2.3) Fish rearing conditions.

Section 4.1 describes the temperature profile of the Marion and Horn creeks' water sources. Water quality is monitored through the individual ODEQ permit. Pond monitoring is done daily at feeding time, while personnel are observing for signs of stress, disease, water quality, and general fish behavior. Pond mortality is picked as needed.

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 of fish at Marion Forks Hatchery vary annually depending on water temperature. Monthly targets are set but may or may not be achieved. Table 9.2.4-1 reports target and actual growth rates for spring Chinook salmon at Marion Forks Hatchery.

Table 9.2.4-1. Target and actual (mean) growth rates of North Santiam spring Chinook salmon (fish/pound) at Marion Forks Hatchery, BY 1993-2001.

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Target	1400	700	400	200	75	30	18	13	12	12	12	12	11	11
Actual	1450	942	651	309	135	55	33	21	16	15	14.5	14.1	13.3	12.9

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.

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

Table 9.2.6-1. Food type, daily application schedule and food conversion efficiency for spring Chinook fry at Marion Forks Hatchery.

Rearing Period	Feed Type	Daily Application Schedule	Food Conversion
Feb - Apr	BioVita Starter #0	demand	0.84
Apr - May	BioVita Starter #1	demand	0.66
Jun	BioVita Starter #2	demand	0.59
Jul - Aug	BioClark's Fry 1.2,1.5,2.0	demand	0.91
Sep - Apr	BioClark's Fry 2.5	demand	1.35

The North Santiam spring Chinook stock has been fed Skretting-Bio-Oregon diets. Due to low water temperatures in rearing ponds at Marion Forks Hatchery, the recommended daily feeding schedules do not work here to achieving the optimum growth. Therefore, the daily feed application schedule is a feed "demand" type program. All feeding is done by hand. Food conversion rates over the past three years average 1.25:1. A new transfer diet (i.e. designed to promote migration) was started in 2008 and used for only that year after no noticeable difference.

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

Treatments for pathogens at Marion Forks Hatchery are rare and 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 times per week for fungus prevention. Static bath treatments of juvenile fish with formalin are applied for controlling external parasites and/or fungus control. With the development of BKD in hatchery juveniles due to adults moving above the hatchery intake on Marion Creek, the hatchery will initiate a medicated feed treatment as needed. The Minto facility has the ability to treat spring Chinook salmon adults for fungus. Spring Chinook salmon adults are given antibiotic injections of erythromycin and oxytetracycline, under a veterinary prescription, to prevent bacterial infections such as furunculosis and BKD. Juvenile fish are treated for bacterial infections with oxytetracycline, florfenicol or Romet medicated feed according to manufacturer's label, under a veterinary prescription or under an INAD.

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 to determine smolt development stage, 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. At this time, no other "natural" rearing methods have been implemented at Marion Forks 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.

Fish are reared to smolt size and released at a time and manner resulting in prompt outmigration to minimize interaction with natural-origin populations.

SECTION 10. RELEASE

10.1) Proposed fish release levels.

Spring Chinook salmon smolts are released into the North Santiam River, as age-1 smolts in March-April period at a target size of 12 fish/lb, after approximately 395-470 days of rearing in a hatchery environment. The proposed production is up to 704,000 spring Chinook salmon smolts.

Prior to 2001, fish surplus to smolt production needs were released into Detroit Reservoir to augment the resident trout fishery. Since 2001, annual releases of adipose fin-clipped and/or Ad-CWT fingerlings reached approximately 100,000 fish for ongoing RM&E purposes. The release was discontinued in 2014 and incorporated into the mitigation release.

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

Stream, river, or watercourse: N. Santiam River, 0201000000

Release points: Minto Dam, RM 42
Major watershed: Santiam River
Basin or Region: Willamette River Basin

All North Santiam spring Chinook salmon (mitigation) are scheduled for release into the North Santiam River at the base of Minto Dam following acclimation in the fish holding pond at Minto Fish Collection Facility. On rare occasions, direct release of fish may occur at the Minto Facility because of emergency conditions such as flooding or loss of water supply. See below Table 10.3-1 under Section 10.3 for additional details regarding historical release information.

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

Spring Chinook salmon juvenile releases for brood years 1990-2011 are reported in Table 10.3-1.

Table 10.3-1. Number of spring Chinook salmon juveniles released for brood years 1990 to 2011 (includes fish released for research purposes). All data taken from ODFW Hatchery Management Information System (HMIS) database.

Brood Year	Release Dates	Location	Number Released	Lbs. Released	#/Lb.
1990	07/17/91	Detroit Reservoir	90,366 (10%)	955	94.62
	02/18/92	Minto Pond	257,151 (29%)	19,194	13.40
	03/06/92	North Santiam River	553,829 (61%)	46,432	11.9
1991	05/29/92	Detroit Reservoir	101,436 (12%)	607	167.11
	03/17-03/18/93	Minto Pond	287,364 (34%)	20,990	13.69
	03/05/93	North Santiam River	444,912 (54%)	36,968	12.03
1992	06/07/93	Detroit Reservoir	49,725 (9%)	255	195.00
	03/03/94	Minto Pond	240,979 (45%)	21,516	11.20
	02/08/94	North Santiam River	248,596 (46%)	19,789	12.56
1993	06/13/94	Detroit Reservoir	106,920 (12%)	540	198.00
	03/06-03/07/95	North Santiam River	664,050 (75%)	58,450	11.36
	03/08/95	Middle Fork Willamette R	112,216 (13%)	8,860	12.67
1994	06/15/95	Detroit Reservoir	45,472 (6%)	232	196.00
	02/28-03/01/96	North Santiam River	699,402 (94%)	54,084	12.93
1995	07/30/96	Detroit Reservoir	114,398 (14%)	2,183	52.40
	03/03-03/05/97	North Santiam River	696,365 (86%)	51,268	13.58
1996	03/02-03/09/98	North Santiam River	725,438 (100%)	50,465	14.38

Brood Year	Release Dates	Location	Number Released	Lbs. Released	#/Lb.
1997	03/11-03/12/99	North Santiam River	488,706 (74%)	40,221	12.15
	02/11-02/12/99	Minto Pond	168,600 (26%)	11,265	14.97
1998	04/15-08/30/99	Detroit Reservoir	218,634 (25%)	1,063	205.68
	03/08-04/11/00	North Santiam River	666,240 (75%)	52,574	12.67
1999	07/21/00	Detroit Reservoir	120,135 (15%)	1,692	71.00
	03/12/01	North Santiam River	664,200 (85%)	52,600	12.63
2000	06/30-07/06/01	Detroit Reservoir	60,075 (8%)	750	80.00
	02/04-03/04/02	North Santiam River	663,604 (92%)	51,046	13.0
2001	7/31/02	Detroit Reservoir	99,955 ad	2,221	45.0
	2/27/03	Minto Pond	669,616	50,347	13.3
2002	7/23/03	Detroit Reservoir	101,026 ad	1899	53
	2/26/04	Minto Pond	668,315	49,986	13.4
2003	8/01/04	Detroit Reservoir	147,000 ad	3,675	40
	2/28/05	Minto Pond	666,875	56,044	11.9
2004	8/17/05	Detroit Reservoir	45,255 ad	4,417	35
	8/17/05	Detroit Reservoir	107,169 cwt		
	3/06/06	Minto Pond (direct release)	666,803	59,500	11.2
2005	8/14/06	Detroit Reservoir	108,561 cwt	2,808	38.6
	2/27/07	Minto Pond	674,675	53,974	12.5
2006	7/24/07	Detroit Reservoir	89,560 cwt	1,606	56
	7/24/07	Detroit Reservoir	99,397 ad	1,702	58
	8/3/07	Minto Pond	670,458	51,180	13.1
2007	8/7/08	Detroit Reservoir	109,247 cwt	1,821	60
	8/7/08	Detroit Reservoir	38,748 ad	646	60
	2/29/09	Minto Pond	667,454	47,708	14.2
2008	7/23/09	Detroit Reservoir	111,161 cwt	2,200	68.5
	7/23/09	Detroit Reservoir	38,492 ad	50,149	13.4
	3/8/10	Minto Pond	641,797 AD	47,895	13.4
	3/8/10	Minto Pond	30,203 CWT	30,203	13.4

Brood Year	Release Dates	Location	Number Released	Lbs. Released	#/Lb.
2009	8/4/10	Detroit Reservoir	46,659 ad	1,653	66.5
	8/5/10	Detroit Reservoir	109,948 cwt	52,068	66.5
	3/23/11	Minto Pond	196,620 AD	15,605	12.6
	3/23/11	Minto Pond	54,126 CWT	4,296	12.6
	3/2/11	Packsaddle	154,908 AD	15,091	13.9
	3/2/11	Packsaddle	54,852 CWT	3,946	13.9
	4/12/11	Packsaddle	171,703 AD	13,208	13
	4/12/11	Packsaddle	55,092 CWT	4,238	13
2010	7/25/11	Detroit Reservoir	100,255 CWT	1432	70
		Detroit Reservoir	38,602 AD	551	70
	4/18/12	Packsaddle	223,749 CWT	20,038	11.2
	3/14/12	Packsaddle	237,652 AD	18,921	12.56
	3/14/12	Packsaddle	55,279 CWT	4,401	12.56
	3/15/12	Packsaddle	107,929 AD	9,024	11.96
	3/15/12	Packsaddle	54,855 AD	4,587	11.96
2011	8/10/12	Detroit Reservoir	100,046CWT	2,084	48
	8/10/12	Packsaddle	100,962CWT	2,103	48
	4/15/13	Packsaddle	228,996 CWT	20,446	11.2
	3/18/13	Packsaddle	134,082 AD	10,314	13
	3/18/13	Packsaddle	99,918 CWT	7,686	13
	3/19/13	Packsaddle	234,000 AD	18,000	13
2012	00/00/14	Detroit Reservoir	0	0	0
	02/19/14	Minto	179,887	16,812	10.7
	03/18-27/14	Minto	505,137	46,567	11.09
2013	00/00/15	Detroit Reservoir	0	0	0
	02/10/15	Minto	447,912	45,548	9.8
	03/16/15	Minto	277,537	25,986	10.7

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

Actual release dates are provided in Table 10.3-1 above. Release dates are variable to take advantage of freshets as well as considerations of fish size and pathology

recommendations. The Minto Fish Collection Facility is the primary release location for all spring Chinook in this program. Releases are volitional.

10.5) Fish transportation procedures, if applicable.

Marion Forks Hatchery has a flatbed truck with a 1,000-gal tank equipped with two aerator pumps. The hatchery also uses regional fish transport trucks, which are equipped with 1,600-gal tanks that include recirculation and oxygen pumps. The Marion Forks truck is used for adults only and the region trucks haul both adults and juveniles. The travel time is about one hour from Marion Forks Hatchery to the Minto Fish Collection Facility acclimation site. Starting 2013, Minto has had a new fish liberation truck (1,500 gal) to accommodate water to water transfer of fish.

10.6) Acclimation procedures.

All spring Chinook salmon will be acclimated and volitionally released. Half of the North Santiam production is moved to the Minto Facility from Marion Forks Hatchery in October or November. The remaining production is moved in January (unless research need, fish size, water flow or water temperature alter this schedule).

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

All juvenile spring Chinook salmon 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 also marked with an otolith mark, which distinguishes them from naturally-produced spring Chinook salmon, as a check against poor or missed marks and to allow identification of Willamette basin strays.

In the future, all Chinook salmon smolt production will continue to be adipose fin-clipped and otolith-marked. In addition, a minimum of 30,000 smolts (approximately 4% of the North Santiam River releases) will be coded wire-tagged (USACE 2007, NMFS 2008). Coded wire tagging continues to be considered for all smolts but has not been implemented at this time.

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

Juvenile spring Chinook salmon production level for the North Santiam program is within the 2012 Cooperative Agreement. In general, OAR 635-007-0545 directs disposition of surplus hatchery juveniles:

> 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 shall be reported on in the Fish Propagation Annual Report.

10.9) Fish health certification procedures applied pre-release.

The fish health monitoring plan and certification procedures follow ODFW's Fish Health Management Policy and protocols 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 percent chance of detection of a pathogen present in the population at the 5 percent level. American Fisheries Society "Fish Health Blue Book" procedures will be followed. With the summer steelhead stock all fish are sampled for viruses at spawning.
- 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.

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

The hatchery is located very high in the watershed and equipped with two different gravity-fed water sources (Marion Creek and Horn Creek) and different pipelines for each. In case of a failure, the hatchery can easily switch between the two water sources. When Marion Creek becomes very volatile, the water supply can be switched to Horn Creek, which is spring fed and only approximately 2 miles long. With such a short system, flooding is rare.

The Minto facility relies on pumping and an emergency release program will be developed. During flood conditions, such as in 1996, fish are direct released either by trucking from the hatchery or by pulling the screens and releasing the fish being acclimated at Minto. The Minto Fish Collection Facility is above the 100 year flood plain.

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

All of the North Santiam stock spring Chinook salmon are released as smolts in March or April coinciding with the releases from other hatcheries in the Willamette River system (though this may be altered due to fish condition or environmental factors). When possible, all smolts are acclimated and volitionally released to eliminate the inundation of the natural population with hundreds of thousands of hatchery smolts all at once. Smolts are released at an appropriate size to expedite emigration and reduce interaction time with naturally produced juvenile Chinook salmon.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Plans, methods, and supporting logistics for monitoring and evaluation of "Performance Indicators"

Monitoring and evaluation activities listed for North Santiam Hatchery facilities are developed, reviewed, and partially funded through the Cooperative Agreement between the Corps and ODFW for the hatchery mitigation program. Section 12 contains information on the 2014 draft Monitoring and Evaluation Plan.

A detailed RM&E plan was developed for the WHMP including the North Santiam River spring Chinook salmon component (Peven and Keefe 2010). The process, objectives,

standardized protocols, and an analytical framework provides a reference guide to the range of RM&E monitoring and evaluation strategies. Baseline monitoring is coordinated and funded through the Cooperative Agreement for the mitigation program. Other RM&E proposals are prioritized regionally across the upper Willamette within available funding allocations. See Table 11.1-1 below for monitoring and evaluation of performance indicators, activities, methods, and strategies.

Table 11.1-1. Strategies and methods for monitoring and evaluation of performance indicators.

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
1. Legal Mandates	1.1: Meet production levels for mitigation, fisheries, and ESA conservation objectives consistent with survival and recovery of spring Chinook salmon, consistent with the Cooperative Agreement (2012). The Cooperative Agreement provides for federal funding of up to 84,000 pounds of Chinook and/or *O. mykiss* for release into the North Santiam Subbasin to meet federal mitigation requirements for habitat losses and fishery impacts from construction and operation Detroit and Big Cliff dams.	Produce and release up to 704,000 of spring Chinook salmon smolts (58,667 pounds) into the North Santiam River basin.	Annual review of broodstock collection, egg take, poundage gain, and number of smolts released.
	1.2: Ensure program goals are aligned with authorized federal, state, regional, and local fisheries conservation and restoration initiatives.	Program complies with the Willamette BiOp (NMFS 2008), and considers the recommendations in the Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NMFS 2011).	Not applicable.

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
2. Harvest	2.1: Provide sufficient hatchery production adults for broodstock to maintain run size as mitigation to offset for habitat lost for spawning and rearing areas, and population impacts from production or made inaccessible by the construction and operation of above Detroit and Big Cliff dams to meet harvest goals while minimizing impacts to natural-origin Chinook salmon. Take of listed fish associated with harvest is covered through the Fisheries Management and Evaluation Plan (FMEP) for upper Willamette CHS (ODFW 2001).The program provides adult returns to help meet harvest objectives for the North Santiam River, and help lower basin, and ocean fisheries. Take of listed fish associated with harvest is covered through the Fisheries Management and Evaluation Plan (FMEP) for upper Willamette CHS (ODFW 2001).	Number of hatchery spring Chinook salmon available for harvest in ocean, Columbia River, Willamette River, and Santiam River sport and commercial fisheries.	- Harvest monitoring will be conducted through catch analysis for commercial and sport fisheries and reported in the FMEP.
3. Conservation	3.1: Maintain genetic diversity in hatchery broodstock that is similar to natural-origin fish by integrating natural-origin broodstock at an average rate of 5-10% at times when the wild run is greater than 1,000 adults based on projections from counts of fish	Compare genetic diversity between hatchery- and natural-origin fish. Potential phenotypic characteristics that are representative of genetic diversity are: age at maturity, run timing, sex ratio, size, fecundity, etc.	- Identify, monitor, and report integration levels (pNOB). - Complete census of spring Chinook salmon broodstock to determine origin and compare pNOB to program goals at recurring intervals. Examine otoliths from all unclipped broodstock for

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
	over Willamette Falls and the Bennett dams.		absence of a thermal mark indicating the fish was naturally produced.
	3.2: Reduce opportunity for negative ecological interactions between hatchery and naturally produced adults.	Number of hatchery-origin fish holding and spawning with natural-origin fish.	Monitor and report the percentage of hatchery origin spawners (pHOS).
	3.3: Produce and release sufficient numbers of hatchery fish to support successful outplanting of adult spring Chinook salmon upstream from Detroit Dam for RM&E and reintroduction efforts. The intent is to inform passage studies to aid design of passage alternatives and reintroduction protocols and strategies. Except in low run years, this goal is expected to be routinely met under the current program.	3.3.1: Abundance and productivity of hatchery returns available for outplanting (target 1500 adults/750 females).	- Monitoring and reporting of total adults outplanted. - Coordinate with CRFM studies to ensure outplant program is adequate to meet RM&E and reintroduction needs.
		3.3.2: Abundance and productivity of fish returning from outplants are adequate to support passage research to determine: spawning success (including pre-spawning mortality (PSM)), Smolt-to-Adult Return Ratio (SAR),	- Annual monitoring and reporting of PSM, SAR, spawner productivity, adult run size estimates and timing, juvenile emigration estimates and timing, and genetic diversity.

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
		recruits per spawner (productivity), adult spawn and migration timing and distribution, number of juveniles emigrating from spawning areas, and genetic diversity.	
	3.4: Reduce potential for negative ecological interactions between hatchery and naturally produced juveniles.	3.4.1: Specific interactions to look for are: residualism or delayed migration that could result in competition for food and space; and disease prevalence in hatchery fish that could be transferred to naturally produced fish, and risk of hatchery smolt predation on natural-origin Chinook fry	- Monitor hatchery fish for size and behavior comparison to naturally produced yearling migrants. - Use mark-recapture and trapping technologies to determine growth rates and migration patterns. - Conduct observational studies (e.g. seining) to determine migration patterns and evaluate number of residuals. -Implement and monitor flow supplementation to enhance outmigration of natural-origin and hatchery spring Chinook salmon, winter steelhead, and summer steelhead.
		3.4.2: Flow management to support and expedite smolt outmigration. Specific targets to be developed through the Flow Management Team and supported by RM&E.	Same as above cell.
	3.5: Use best management practices to meet or exceed benchmarks for rearing and releasing high quality fish to minimize impacts on naturally produced fish.	Performance targets for benchmarks for rearing and release as indicated in Table 1.9-1.	- Document variables in Table 1.9-1 and compare to established targets to determine if hatchery operations need to be adjusted.

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
	3.6: 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.	Performance targets for benchmarks for returning hatchery fish as indicated in Table 1.9-2.	- Document variables in Table 1.9-2 and compare to established targets to determine if hatchery operations need to be adjusted. -Evaluate and implement passage solutions with the intent to ensure full seeding of spawning and rearing habitats upstream from Detroit Dam.
	3.7: Meet benchmarks and protocols for broodstock.	Performance targets for benchmarks for hatchery broodstock as indicated in Table 1.9-3.	- Document variables in Table 1.9-3 and compare to established targets to determine if hatchery operations need to be adjusted.
	3.8: : The long-term target for the percentage of spring Chinook hatchery-origin spawners (pHOS) on all spawning grounds within the North Santiam subbasin is less than 10%. However, the long-term projected pHOS below the dams to meet desired viability is 21%, which means the pHOS target upstream of Detroit Dam will ultimately need to be much less than 10% (ODFW and NMFS, 2011). Overall, the goal is to manage hatchery activities (production, release, adult collection, and outplanting) and habitat above and below the Detroit/Big Cliff complex for ESA conservation, consistent with the survival and recovery of the	Indicator 3.8.1: This HGMP incorporates the pHOS criteria designated in the Recovery Plan (ODFW and NMFS 2011). The criteria is <10% pHOS for the entire North Santiam CHS natural population over the long term. Hatchery-related risks will be reduced as natural production is restored above and below Big Cliff/Detroit Dams. The goal is to minimize pHOS to less than 10% above Big Cliff/Detroit once successful natural production is demonstrated. The hatchery mitigation program for CHS will be reduced commensurate with	Complete spawning ground surveys to assess redd numbers, location, and number of natural origin and hatchery origin spawners.

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
	Upper Willamette River spring Chinook ESU. In the short term, pHOS will be intentionally high because of intense hatchery supplementation necessary for reintroduction of salmon; pHOS will be high for an extended period until survival improvements are made that allow higher survival (see Section 15).	restoration of natural production above these dams and to help meet pHOS objectives. For the production areas below Detroit/Big Cliff Dams, pHOS will be higher due to the location of the hatchery facility and reduced natural production due to the adverse effects from the operation of the dams to downstream areas, and other habitat effects not related to the dams.	
4. Life History Characteristics	4.1: Maintain life history characteristics of broodstock that are as similar as possible to natural-origin CHS (e.g. within 10%).	Compare life history characteristics of the broodstock to natural-origin adults. Indicators include: morphometrics (length and weight), sex ratio, average number of eggs per female by age class, age structure, adult migration, and spawn timing (Table 1.9-3).	- Sample both hatchery and natural-origin broodstocks for indicator variables. - Assess the relationship between fecundity and female size in hatchery and natural-origin broodstocks. - Compare variables between hatchery and natural-origin broodstocks and assess patterns over time to evaluate divergence. - Evaluate genetic drift between hatchery and natural-origin broodstocks through genetic monitoring as part of a basin-wide monitoring program (e.g. analyze hatchery and natural origin samples from each hatchery including the North Santiam every 4 years as part of a rotating sample design). Adjust integration guidelines as needed to accomplish management goals.

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
	Standard 4.2: Rear and release hatchery spring Chinook salmon to minimize impacts to naturally produced juvenile spring Chinook.	Hatchery fish will be released in time and space that minimizes the interaction with listed fish.	- Manage growth rates, release size, and release timing to rear hatchery fish similar to naturally produced fish. - Monitor phenotypic characteristics of hatchery fish during rearing and release. - Use mark-recapture techniques to evaluate behavior of migrants and compare run timing and migration patterns between hatchery and naturally produced smolts. -Implement flow supplementation to support outmigration
	4.3: Release hatchery fish that are ready to migrate.	Indicators are: residualism rates, rates of outmigration, precocial rates, and proportion of fish that migrate per day.	- Use volitional release to encourage fish to move with the outmigration window for naturally produced fish. - Use mark-recapture and trapping/in-water observation techniques to determine migration timing of hatchery fish. - Evaluate smoltification and sexual maturity through, for example, direct observation or monitoring of hormone levels in hatchery fish.
5. Genetics	5.1 Manage genetic risks of hatchery CHS spawning with naturally produced CHS in the North Santiam population to promote natural selection and local adaptation. Also see Standard 3.8.	This hatchery program will be used to reintroduce CHS above Detroit Dam. As natural production increases, the proportion of hatchery CHS outplanted above Detroit Dam will decrease in order to reduce and minimize genetic effects. Once natural-origin CHS returns to Minto	- The pedigree analysis will continue to inform the above or below dam parentage of natural-origin CHS returns to Minto. - Monitor and report natural-origin CHS adult returns to Minto.

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
		trap average more than 500 female adult spring Chinook salmon with a R/S ratio >1 over two life cycles (assigned to production areas above Detroit Dam by pedigree analysis), then no hatchery CHS are anticipated to be needed for supplementation above the dams. The natural population above Detroit Dam will be entirely natural-origin CHS with no hatchery-related genetic effects. A current pedigree analysis will be used to assign what proportion of these natural-origin CHS were produced upstream of Big Cliff/Detroit Dams.	
	5.2: Ensure broodstock collection maintains the genetic diversity of the naturally spawning population (e.g. diversity shows no more than a 10% divergence).	Genetic diversity of natural and hatchery stocks; and Proportion of Natural-Origin Brood (pNOB).	- Sample both hatchery and natural-origin broodstocks for indicator variables. - - Compare variables between hatchery and natural-origin broodstocks and assess patterns over time to evaluate divergence. - Evaluate genetic drift between hatchery and natural-origin broodstocks through genetic monitoring as part of a basin-wide monitoring program (e.g. analyze hatchery and natural origin samples from each hatchery including the North Santiam every 4 years as part

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
			of a rotating sample design). Adjust integration guidelines as needed to accomplish management goals.
	5.3: Integrate natural-origin broodstock at a rate averaging 5-10% when wild returns to the North Santiam River are expected to exceed 1,000 adults.	Proportion of natural-origin fish in the broodstock.	- Identify, monitor, and report integration levels (pNOB). - Complete census of spring Chinook salmon broodstock to determine origin and compare pNOB to program goals at recurring intervals. Examine otoliths from all unclipped broodstock for absence of a thermal mark.
6. Operation of Artificial Production Facilities	6.1: Marion Forks Hatchery facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols such as those described by IHOT, Pacific Northwest Fish Health Protection Committee (PHFHPC), and INAD.	Annual reports indicating compliance.	- Routine annual fish health monitoring of fish rearing in the hatchery and broodstock. - Determine if pathogen levels are consistent with expected targets and standards.
	6.2: Marion Forks Hatchery and Minto Fish Collection Facility effluent will not negatively impact natural populations.	Determine if facilities are operated under a National Pollutant Discharge Elimination System (NPDES) permit, and monitored to comply with the permit, to maintain Oregon Water Quality Standards for protection of aquatic life.	- Conduct routine monitoring of discharge water and stream water downstream of discharge. - Compare water quality parameters to Oregon water quality standards.

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
	6.3: Water withdrawals and instream water diversions will minimize the impact on natural, ESA-listed populations, and comply with NMFS criteria when appropriate.	Install and maintain fish screens at Minto Fish Facility water intakes consistent with ODFW and NMFS criteria.	- Conduct routine visual monitoring of screens to evaluate fish attraction to screens and potential for injury.

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 (TBD) 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 natural-origin spring Chinook salmon population. Take of listed species by the hatchery program is discussed in section 2.2.3.

SECTION 12. RESEARCH

The baseline M&E, funded by the USACE through the Cooperative Agreement, follows the most recent science to ensure that methods used to achieve the objectives are consistent with current state of science on hatchery reform in the Pacific Northwest. Three overarching objectives were developed that encompass all program elements of the WHMP:

- 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 Hatchery and Genetic Management Plans (HGMPs);
- rear and release high quality hatchery fish to minimize impacts on naturally-produced fish and to promote conservation and recovery of listed species; and
- manage adult returns to minimize impacts on naturally produced populations and to aid in recovery goals while achieving harvest goals

Proposed RM&E

- Identify, monitor, and report integration levels of natural-origin broodstock (pNOB)
    - Every year HRME staff recover otoliths from every unclipped fish used in broodstock. The otoliths are examined for thermal marks to account for unmarked hatchery fish. The number of unclipped non-thermally marked broodstock is used to calculate pNOB.
- Describe biological metrics and spawning success for returning CHS (e.g., number, geographic and temporal distribution, size, age, sex, stray rates, prespawn mortality rate, redd counts)

- Every year HRME staff conduct comprehensive spawning ground surveys to count redds and sample carcasses. Surveys begin well before spawning commences and are conducted essentially weekly until spawning ceases. The redd distribution and counts are used to infer spawner spatial and temporal distribution and spawner abundance. Carcass sampling permits estimates of the following: spawner origin (hatchery or wild) based on fin clips and otolith marks; spawner size; spawner age (from scale samples and CWT recovery); sex; stray rates (by recovery of CWTs from hatchery fish); and prespawn mortality rate (by inspection of female carcasses). Key areas for spawning ground surveys below project dams in the North Santiam include the river reach between the Bennett Dams and Minto Dam, the Little North Santiam River, and the "wild fish sanctuary" between Minto Dam and Big Cliff Dam. The latter reach is problematic because river conditions are dangerous to surveyors and weekly surveys are not advisable. Instead, we propose to conduct one or two surveys as close to peak spawning as possible and accept the uncertainty in estimates for spawner abundance in that reach. In addition, beginning in 2015 we are developing protocols to conduct aerial drone-based surveys in that reach where data from the drone will be compared to data from the float surveys. The intent is to develop a robust method for determining spawner abundance in that reach. However, a significant data gap exists for the reach between Minto and Big Cliff dams: because we cannot perform routine surveys in that reach, carcasses cannot be collected except during the proposed peak counts and useful estimates of prespawning mortality are not possible. Key areas for surveys above Detroit Dam are the upper North Santiam River, especially the reaches near Marion Forks Hatchery, and the Breitenbush River.

    - Every year video monitoring stations are operated in the North Santiam River at Upper and Lower Bennett dams to estimate abundance, run-timing, and species composition of upstream migrating fish. Monitoring at Upper Bennett Dam is continuous. Monitoring at Lower Bennett Dam occurs from April through November.

- Monitor broodstock to ensure naturally-produced life history characteristics are maintained for CHS

    - Every year HRME staff sample broodstock to estimate size distribution and age structure and compare those metrics to those of natural-origin spawners. In addition, the collection of fish for broodstock is tracked so that the timing that broodstock are actually collected can be compared to the timing that fish, especially wild fish, enter the trap. The intent is to ensure that broodstock collection reflects run timing of wild (unclipped) fish. Similarly, the timing that

broodstock are actually spawned is compared to spawn timing of naturally-spawning fish to ensure that the program maintains spawn timing similar to that in the river.

- Monitor broodstock to meet hatchery production requirements
    - A well-established estimate of fecundity is used to project the number of females needed, based on the expected program size established by ODFW the previous year. Only that number of females plus an estimated number needed to account for estimated prespawn mortality and culling of eggs from diseased spawners are collected as brood.
    - Hatchery staff coordinate with ODFW Fish pathology to monitor disease issues and incorporate antibiotic and prophylactic formalin treatment as necessary.
    - Hatchery and HRME staff collaborate during broodstock collection and spawning to coordinate sampling for coded wire tags, otoliths scales, genetics, and biological data.
- Monitor distribution and abundance of hatchery fish spawning with naturally produced fish (pHOS)
    - Estimates of reach-specific pHOS are made every year using data obtained during spawner surveys (described above).
    - Estimates of reach-specific pHOS are aggregated for larger river reaches and the subbasin as a whole by weighting the reach-specific pHOS estimates using spawner distribution (peak redds/survey reach) as the weighting factor.
- Release hatchery fish that are ready to migrate
    - Smolts are released after final rearing and acclimation at the Minto Fish Collection Facility at a time and size known to be associated with active smolt migration. A “prelibation” sample is taken just prior to release to establish size distribution, mark/tag retention, and condition factor.
- Results of the annual RM&E are summarized in a comprehensive annual report. The level of task execution will be dependent upon available funds.

SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

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

Name and Title of Applicant:

Signature: _____ Date: _____

SECTION 15. OUTPLANTING PROTOCOLS ADDENDUM

15.1 Hatchery goals and objectives for outplanting and reintroduction

The program goals and objectives for the North Santiam Spring Chinook Salmon Program goals are described in Section 1.7 of the HGMP. Minimum returns of 3,256 hatchery adults are needed to meet broodstock and outplanting goals for the program.

Main Goal: Manage the North Santiam Spring Chinook salmon program and returns to fish collection facilities in the North Santiam Basin to meet ESA conservation needs, consistent with survival and recovery of the ESU, including assisting in restoration of a self-sustaining viable population of naturally reproducing CHS in the North Santiam basin, while continuing to meet the USACE's mitigation responsibility. This includes compliance with the 2008 WP BiOp, where NFMS developed an RPA to ensure the species' survival with an adequate potential for recovery. NMFS also included the terms and conditions with which actions must comply in order to meet reasonable and prudent measures that were deemed necessary to minimize the impacts to of listed species from incidental take. Included in the Recovery Plan goal is the goal to reestablish natural production of 5,428 adults in the North Santiam to support recovery and delisting.

Objective 1: Evaluate the actions and alternatives to establish a self-sustaining naturally reproducing population of CHS in historic habitat upstream of Detroit dam in the North Santiam basin to increase natural production, avoid jeopardy and destruction or adverse modification of critical habitat, and aid in the recovery of UWR CHS.

- Release natural-origin or a combination of hatchery and natural-origin fish into historical habitat upstream of USACE dams in the North Santiam Basin to evaluate and design passage facilities, and to provide safe passage for native fish in compliance with the WP BiOp, and where appropriate, consistent with the recommendations of the Recovery Plan. As noted, outplanting of hatchery-origin fish will dominate the procedure in the near term. However, natural origin fish have already been outplanted into river reaches above Detroit Dam for experimental purposes (2010) or in response to severe environmental challenges in the lower river (2015). Some combination of natural- and hatchery-origin fish may be used until a self-sustaining population is established above Detroit Dam.
- Long-term: in the long term intention is to reestablish a self-sustaining CHS population in the North Santiam River.

Objective 2: Meet legal and policy standards, including implementing the approved HGMP.

Objective 3: Ensure that outplanted fish represent the life history characteristics of the natural population and promote successful production.

Objective 4: In the long-term, reassess and reduce mitigation production of hatchery fish in the North Santiam Basin through crediting for sustainable natural production increased above the projects. Ultimately, provide a sustainable harvest on naturally produced CHS.

The NMFS and ODFW with advice from the WATER forum will work together to develop a reintroduction plan on the N. Santiam that will take into consideration RM&E activities and various study results.

15.2 Outplanting Plan

A. Prior to Long Term Fish Passage Solution

From now until the long-term juvenile fish passage solution past Detroit is implemented and approved by NMFS, up to 750 HOR females and 750 HOR males may be outplanted above Detroit Dam according to the disposition table (Table 15.3-1). NOR fish may also be outplanted during this period under the following conditions:

1. Genetic Pedigree criteria: Based upon the results of genetic pedigree analyses, if there is greater than a 1:1 ratio of recruits to spawners in the pedigree data for adults released above the dams for five complete years of data (2014-2018), then in 2019 the fisheries managers will initiate outplanting NORs above or into Detroit Reservoir. The intent is to gain confidence that NORs are at least replacing themselves above Big Cliff/Detroit Dams under existing conditions. If data shows less than 1:1 replacement over multiple years, then NORs do not have a good chance of increasing in abundance under existing conditions. These data greatly inform decisions regarding the disposition of NORs collected at Minto trap.

2. Special Circumstances criteria: There may be special circumstances that could affect the decision to outplant NORs above Big Cliff/Detroit dams on an annual basis.

    a. Adverse conditions between Minto trap and Big Cliff Dam: Currently, NORs collected at Minto trap are released in this reach. If available information suggests adult NORs and their progeny may not survive well due to adverse conditions, then the fisheries managers will discuss potential options with WATER technical committees on the best alternative for maximizing NOR survival. As an example, in 2015 extreme drought conditions existed in the North Santiam basin that affected river flows and water temperatures below Big Cliff/Detroit Dams for adult and juvenile spring Chinook salmon. Based upon the risks and benefits of all options, the co-managers agreed to outplant some NORs above Detroit Dam. Similar circumstances may occur in 2016 and beyond, where it may make sense from a benefit/risk standpoint to outplant NORs above Detroit Dam, even though multiple years of pedigree analyses may not be available.

b. Availability of genetic pedigree data: Updated genetic pedigree study information is expected to be available on an annual basis from 2014-2018 unless data indicate adult returns are well below replacement due to reservoir and dam effects. However, there may be situations where the pedigree information is not available prior to the annual Chinook migration back to the North Santiam River, due to funding and/or research study schedules. The fisheries managers, with input from the WATER technical committees, will use all of the available pedigree information to inform options for possible outplanting of NORs above Detroit Dam. Because conditions and circumstances change year to year, the fisheries managers must weigh risks and benefits, as well as information learned, to arrive at their best professional judgment of where NORs have the optimal chance of survival and reproduction.

Four years prior to development of successful juvenile downstream passage at Detroit, the number of CHS annual outplants may be increased up to 2,000 females with an equal number of males. These will be HOR fish. NORs outplanted during this time will be determined on an annual basis by fisheries managers based on criteria outlined above. This increase in outplanted fish will help seed the habitat for the successful recovery of CHS above the dams just prior to passage improvements. Data on habitat capacity will be considered when determining the total number to be outplanted.

A formal reintroduction plan will be developed for the North Santiam basin above Big Cliff/Detroit Dams for spring Chinook salmon and winter steelhead by the fisheries co-managers. This plan will describe all aspects of reintroducing salmon and steelhead above the federal dams (not just the hatchery management aspect). The HOR and NOR outplanting plans may be revised as a part of this process, but any future changes would be subject to NMFS' approval before implementation.

B. After Long Term Fish Passage Solution

It is anticipated after implementation of the juvenile fish passage improvements at Detroit Dam, NORs will significantly increase in the North Santiam River. Existing returns of NORs that were produced from above Detroit Dam prior to the downstream passage fix will be the foundation of outplanted fish. This builds upon the NORs that have successfully survived existing conditions above Detroit Dam and returned as adults. For the first generation of Chinook returns after the passage fix (up to 5 years), HORs may supplement NORs outplanted above Detroit Dam only if necessary to ensure at least a minimum escapement of 750 females (Table 15.3-1). It is expected there will be adaptive management of the downstream passage facility after completion and this ensures a minimum seeding level of female Chinook above Detroit Dam (>750 females) for this time period. After this period, it is assumed survival conditions will be sufficient for NORs and hatchery supplementation above Detroit Dam will be terminated.

Table 15.2-1: Outplanting Plan and Thresholds

Time Period	Number of HOR Females[1]	Number of NOR Females[2]
Prior to approved passage	Up to 750	Per pedigree analysis or special circumstance criteria
After approved passage	As needed to ensure at least 750 females outplanted above Detroit for one generation (5 yrs) after passage improvement. Then all hatchery supplementation is terminated.	All

[1]And an equal number of HOR males
[2]And an equal or greater number of NOR males

After implementation of the juvenile passage fix for Detroit Dam, the Action Agencies and Oregon will review existing hatchery mitigation requirements in the North Santiam basin. Federal hatchery mitigation obligations will be reduced based upon a crediting system for the restoration of NORs in the North Santiam basin.

15.3 Protocols for Outplanting Adults

The following are recommendations for outplanting CHS adults in the North Santiam River subbasin (1 – 4 are from Beidler and Knapp 2005).

1. Implement better record keeping of environmental and transporting conditions of transported fish.
2. Investigate causes of high pre-spawn mortality rates in the Little North Santiam River.
3. Install a smolt trap downstream of Detroit and Big Cliff Dams to monitor juvenile outmigration, production, and survival.
4. Collect fresh carcass samples for disease analysis.
5. Give consideration to mark error rates to better distinguish between hatchery and natural-origin fish when outplanting.
6. Outplant only healthy adults that show no visible signs of trauma, including parasites.

In 2006, representatives from ODFW, NMFS, and the USACE agreed to change collection, transport, and release protocols in efforts to improve survival. A May 18, 2006, letter from NMFS to ODFW and the USACE recommended specific changes in broodstock collection, anesthetic use, loading density, transport and release protocol, and monitoring that should increase survival of outplanted fish. These protocols were implemented beginning in the 2006 brood year.

The "proposed operations" section below describes operations that will be implemented in accordance with the new protocols to the extent possible. In some cases, not all

aspects of the new protocol can be implemented (primarily due to limited resources or infrastructure).

The "long-term strategy" identifies the protocol that would likely result in maximum survival of supplemented fish over the long term, but are likely not achievable in the short-term without significant structural modifications. The transition from "proposed operations" will be informed by results of monitoring and evaluation; and described in annual updates to the Fish Passage and Management Plans.

1. Current Program

Disposition priorities are established in Section 7.5. A fish disposition table is developed annually to guide distribution of anadromous and resident fish as they are encountered in the adult fish traps. Currently most unmarked adults returning to the Minto Fish Collection Facility Trap are outplanted upstream from Minto Dam.

Proposed Operation. The current program involves releasing fish according to the annual disposition table. Transport and handling protocols were developed based on the number of truckloads transported under the past operations sections. Thus, outplant targets are determined by completing the same number of hauls, but with the lower loading densities. The annual plan for releases in each location will be determined by expected returns to the North Santiam River based on returns to Willamette Falls and the Minto Adult Collection Facility. Numerical adult abundance recovery goals have been established for the North Santiam spring Chinook salmon population through the recovery planning process.

Long-term Strategy.

- Maximize adult survival to spawning by minimizing pre-spawning mortality and implementing actions to improve survival of other life stages.
- Eliminate the need to outplant hatchery-origin adults in areas upstream of dams. In the long term, collect and release only natural-origin adults collected into habitat upstream of each dam. Elimination of hatchery adults is contingent on productivity of spawning adults and adequate downstream juvenile passage through the hydroelectric projects.
- Achieve and exceed passage survival standards identified in the Incidental Take Statement (NMFS 2011). Ensure adequate escapement of adults to achieve production goals while passage survival is improved.

A. Outplanted Fish

Proposed Operation. All unmarked adults except those needed for broodstock integration are passed into habitats upstream of Minto Dam. To the extent possible, adjust the sex ratio of releases based on known differences in PSM between males and females to maximize reproductive success. Ensure an adequate number of females and males are outplanted to seed available habitat.

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

Proposed Operation. Continue operation of the Minto Fish Facility year-round such that fish can be collected throughout the entire run. Due to interim temperature control operations,

fish are arriving earlier at the adult collection facilities. Continue to outplant adults according to the fish disposition table. Outplanting guidelines for each location will consider the impacts of water temperature on arrival time and holding capability in the North Santiam River.

Long-term Strategy. If Detroit/Big Cliff dams are operated with water temperature control, then collect fish on a regular basis throughout the run and outplant when collected, ensuring temporal outplants are representative of run strength. However, PSM of fish may be high and thus should be monitored to ensure effectiveness of this strategy. Fish could be held at the new collection/holding facility at Minto and released close to spawn timing when river temperatures are lower during early fall, if found beneficial to reduce PSM. Fish will not be held longer than will be agreed upon by the fishery co-managers.

C. Handling Protocols for Outplanted Fish

Proposed Operation. The Minto Fish Facility will be used for collection of broodstock, passage above Minto Dam, and for reintroduction efforts above the Detroit and Big Cliff projects. Condition of natural-origin fish entering the collection facilities is variable however most are in good physical condition (i.e., no lesions, fungus, etc) and have a high likelihood of surviving to spawn. Most outplanted hatchery fish should be in good physical condition (i.e., no lesions, fungus, etc) to increase the likelihood of surviving to spawn. During initial processing/sorting Aqui-S 20E will be used as anesthetic because under the current INAD, passage facilities are allowed to immediately released adults into a fishery that have been treated with Aqui-S 20 E. MS-222 may be used instead of Aqui S 20E if fish are released into areas without allowable harvest. Fish will receive minimal handling during processing and loading into the truck since the Minto facility provides water to water transfer. Handling protocols will be updated as the Minto Fish Facility is tested.

In addition, the following protocols will be followed:

- Sorting of adult spring Chinook for brood production and outplanting shall be completed in manner that minimizes stress and injury.
- All efforts should be made to sort adult fish a single time.
- Natural origin outplants are transported/released in the condition they arrive at the collection facility. If it is determined that late outplanting is desirable, then likely only adults in good to excellent condition will be held to maximize survival until transport and post outplanting. Select for fish in good or excellent condition for both broodstock collection and hatchery outplanting efforts.
- Sorting shall be completed to separate by species or origin (hatchery or wild) and to ensure an adequate sex ratio for brood production. Sex ratio of hatchery outplants will be considered in the reintroduction plan.
- Once fish are sorted, they will spend no longer than the allotted time according to best management practices within holding tanks prior to being transported to their destination, which is determined by the fish disposition table.
- The fish trap will be checked at least twice a day, first in the morning, and then in the late afternoon to minimize time in the trap and to assess the overall density of fish within the trap.

- Fish will be removed and placed in holding tanks with density ≤ 25 gallons of water per fish.
- Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 parts per million (7 mg/L).

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.

D. Transport Protocols for Outplanted Fish

Proposed Operation. Currently no NOR fish are outplanted above Big Cliff Dam. If fish are outplanted in other locations then 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. All truck drivers will complete an 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.

Long-term Strategy. Same as proposed operation.

E. <u>Release Protocols for Outplanted Fish</u>

Proposed Operations

- <u>Release sites.</u> Use release sites that have adequate temperatures, are located near suitable holding areas, and are not located near areas with heavy human use to reduce harassment potential.
- <u>Release methods.</u> Have a minimum of a 12-inch opening on all release trucks. Use 16- to 20-inch smooth walled Polyvinylchloride (PVC) pipe to convey fish from the truck to the stream. 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.
- 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.
- <u>Monitoring.</u> 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. Fish would be released at those sites that have been improved based on the BiOp RPA 4.7. Sites include locations that have been improved on the Breitenbush and North Santiam River upstream of Detroit Dam.
- Release methods. All fish would be released using smooth-walled pipe as described above.

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

Table 15.3-3 Historical Distribution of Spring Chinook Released from 2000-2014

Year	Disposition				
	Downstream of Big Cliff		Upstream of Big Cliff		Total
	Upstream of Minto Dam	Little North Fork	North Santiam River	Breitenbush River	
2000	967	0	707	226	1,900
2001	292	0	540	528	1,360
2002	729	399	1,812	865	3,805
2003	203	268	1,867	1,047	3,385
2004	144	377	1,446	1,065	3,032
2005	30	329	528	86	973
2006	143	130	1,123	720	2,116
2007	0	195	574	420	1,189
2008	114	157	127	92	490
2009	10	232	447	453	1,142
2010[1]	596	132	1,682	823	3,233
2011[2]	No Minto	0	153		153
2012[3]	No Minto	0	189	68	257
2013[4]	624	0	568	327	1519
2014	786	0	402	470	1658
Average					2,088

[1]Ad clipped CHS outplanted to Coopers and Mongold Boat Ramp
[2]Ad clipped CHS outplanted to Mongold Boat Ramp
[3]Ad clipped CHS outplanted to Hoover Boat Ramp and Kanes Marina
[4]Ad clipped CHS outplanted to Hoover, Kanes, and Mongold.

Appendix E: Modeling Smolt Releases and Adult Returns in the North Santiam Subbasin

We used historical estimates of Smolt to Adult Return (SAR) rates, hatchery broodstock mortality and culling rates, survival rates for juveniles under culture, and harvest data to create a spreadsheet-based model for the hatchery program in the North Santiam River. The intent of the model was to predict how changes in program size (number of smolts released) would alter the probability of meeting or not meeting a variety of program goals. The program goals included assurance that:

1. enough adults returned each year such that 1,500 adults are available for outplanting above Detroit Dam,
2. approximately 1,000 fish are harvested in the subbasin by sport anglers,
3. sufficient brood are collected to propagate the program. (541 adults collected, 198 females spawned).

With the above objectives, we arrived upon a Total Adult Goal back to Minto of 3,000. This number provides enough adults captured at the facility to meet all needs and accounts for in-hatchery PSM and females representing 40% of adult returns.

Because SAR estimates are variable (Table 1) and of uncertain accuracy we did not simply rely on a single rate estimate to predict performance of a particular release number. We used published SARs from the Columbia Basin Research group ("CBR": available at http://www.cbr.washington.edu/trends/index.php), our own estimates of SARs from run reconstruction from run years 2002 through 2010 (Run Reconstruction), and SAR estimates from 1990 through 2015 based on numbers of smolts released and the number of adult Chinook entering the Minto trap (Minto). The latter estimates includes returns during some very poor ocean years in the mid-90s.

The Minto SAR estimates were derived by dividing the number of adult Chinook captured in the Minto trap by the number of smolts that were released 4 years earlier (most HOR Chinook in the North Santiam are 4 YO). Run Reconstruction SARs were derived by dividing the sum of adults captured at Minto, fish reported to ODFW as harvested, hatchery-origin spawners in the river, and prespawn mortalities in the river by the number of smolts released 4 years earlier. CBR SARs were downloaded directly from the CBR website.

Using the Total Adult Goal back to Minto of 3,000 and the three estimates of SAR, we arrived at a range of smolts releases. We selected five different percentiles of SAR with their respective smolt releases, each representing a percentage of the time the adult goal was met, for the range captured by data set. For example, using the 25th percentile, the adult goal is met or exceeded 75% of the time for the associated release. After thoroughly reviewing the data available, we arrived upon the decision that a smolt release of 704,000 would met all program goals with satisfactory assurance.

Table 1. Estimates of Smolt to Adult Return (SAR) rates.

Return Year	Minto SAR	Run Reconstruction	CBR SAR
1990	0.21%	--	--
1991	0.45%	--	--
1992	0.64%	--	--
1993	0.49%	--	--
1994	0.12%	--	--
1995	0.10%	--	--

1996	0.12%	--	--
1997	0.10%	--	--
1998	0.26%	--	--
1999	0.24%	--	--
2000	0.41%	--	--
2001	0.52%	--	--
2002	0.56%	1.53%	1.84%
2003	0.57%	2.32%	0.74%
2004	0.56%	1.42%	0.34%
2005	0.24%	0.59%	0.16%
2006	0.47%	0.79%	0.67%
2007	0.24%	0.73%	0.06%
2008	0.14%	0.22%	0.29%
2009	0.30%	0.57%	0.68%
2010	0.58%	1.20%	0.86%
2011	--	--	--
2012	--	--	--
2013	0.34%	--	--
2014	0.47%	--	--
2015	0.51%	--	--
Percentile Estimates			
1	0.10%	0.25%	0.07%
25	0.23%	0.59%	0.29%
50	0.38%	0.79%	0.67%
75	0.51%	1.42%	0.74%
100	0.63%	2.26%	1.76%

Table 2. Model results for North Santiam smolt releases.

SAR percentiles and Smolt Releases: Near-term Proposed								
		SAR				Smolt release (adult goal/SAR)		
SAR Estimate Source	**Percentile of SAR**	**No harvest**	**Ocean harvest (10%)**	**Adjusted for additional 29% harvest (North Santiam 13%, Willamette 16%)**	**Adult goal to Minto**	**No harvest**	**Adjusted for Ocean harvest (10%)**	**Adjusted for additional 29% harvest (North Santiam 13%, Willamette 16%)**
Columbia Basin Research	1	0.07%	0.06%	0.04%	3,000	4,411,765	4,901,961	6,904,170
	25	0.29%	0.26%	0.19%	3,000	1,034,483	1,149,425	1,618,909
	50	0.67%	0.60%	0.43%	3,000	447,761	497,512	700,722
	75	0.74%	0.67%	0.47%	3,000	405,405	450,450	634,437
	100	1.76%	1.59%	1.13%	3,000	170,300	189,222	266,510
Reconstruction from Actual Returns, 2002-2010	1	0.25%	0.23%	0.16%	3,000	1,194,697	1,327,441	1,869,636
	25	0.59%	0.53%	0.38%	3,000	507,373	563,748	794,011
	50	0.79%	0.71%	0.50%	3,000	380,616	422,907	595,643
	75	1.42%	1.28%	0.91%	3,000	211,473	234,970	330,944
	100	2.26%	2.03%	1.44%	3,000	132,965	147,739	208,084
Reconstruction from Minto Returns, 1990 - 2015	1			0.10%	3,000			3,106,662
	25			0.23%	3,000			1,313,997
	50			0.38%	3,000			794,941
	75			0.51%	3,000			589,832
	100			0.63%	3,000			478,294