HATCHERY AND GENETIC MANAGEMENT PLAN
(HGMP)

Hatchery Program:	South Santiam Spring Chinook Salmon
Species or Hatchery Stock:	Spring Chinook Salmon (stock 024)
Operator/Funding Agency:	Oregon Department of Fish & Wildlife/ U.S. Army Corps of Engineers
Watershed and Region:	Upper Willamette Watershed District
Date Submitted:	September 1, 2016
Date Last Updated:	August 23, 2016

List of Acronyms

°F	Degrees Fahrenheit
AHP	Adult Holding Pond
BKD	Bacterial Kidney Disease
BLM	Bureau of Land Management
BiOp	Biological Opinion
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
CHS	Spring Chinook Salmon
CEDP	Clatsop Economic Development Program
CEDC	Clatsop Economic Development Council
cfs	Cubic feet per second
CWT	Coded Wire Tag
ODEQ	Oregon Department of Environmental Quality
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
ft	feet
FHMP	Fish Hatchery Management Policy
FMEP	Fish Management Evaluation Plan
FR	Federal Register
gpm	Gallons per minute
HGMP	Hatchery Genetic Management Plan
HMIS	Hatchery Management Information System
HMP	Harvest Mitigation Program
HMT	Hatchery Management Team
HOR	Hatchery-origin Recruits
HSRG	Hatchery Scientific Reform Group
INAD	Investigational New Animal Drug Permit
IHNV	Infectious Hematopoietic Necrosis Virus
IHOT	Integrated Hatchery Operations Team
MOA	Memorandum of Agreement
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
ODFW	Oregon Department of Fish and Wildlife
OTC	Oxytetracycline
LFT	Limiting Factor or Threat
PA	Proposed Action
PIT	Passive Integrated Transponder
ppm	Parts Per Million
PVC	Polyvinylchloride
RM&E	Research, Monitoring, and Evaluation

RPA	Reasonable and Prudent Alternative
SBA	Supplemental Biological Assessment
SCAB	Steelhead and Chinook salmon Above Barriers
SMU	Species Management Unit
STEP	Salmon and Trout Enhancement Program
USACE	US Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	US Fish and Wildlife Service
UWR	Upper Willamette River
WATER	Willamette Action Team for Endangered Species Recovery
WBFMP	Willamette Basin Fish Management Plan
WFMP	Wild Fish Management Policy
WHMP	Willamette Hatchery Mitigation Program

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program:

South 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 South Santiam Hatchery (stock 24) originated entirely or in part from wild stock of spring Chinook salmon in the South Santiam River (Johnson and Friesen 2014). The natural origin spawning population and the South Santiam Hatchery population of CHS in the South 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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Hatchery Manager:	Brett Boyd, South Santiam Hatchery
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1.4) Funding source, staffing level, and annual hatchery program operational costs:

Funding:

South Santiam and Willamette Hatchery - Cost responsibilities for the South Santiam hatchery production at both South Santiam and Willamette Hatcheries are split between the US Army Corps of Engineers (USACE) (with partial cost reimbursement by Bonneville Power Administration (BPA) according to its Operation and Maintenance (O&M) power share percentage at Green Peter and Foster Dams) and Oregon Department of Fish and Wildlife (ODFW) based on each party's production level. USACE is authorized to fund up to 71,000 pounds of CHS and/or steelhead for lost production due to the construction and operation of Foster Dam. Federal mitigation responsibilities for the losses associated with Green Peter dam have not been determined (USACE and ODFW 2012). The Oregon Department of Fish and Wildlife (ODFW) production plan calls for a total of 116,044 pounds of spring Chinook juveniles released from the South Santiam hatchery into the South Santiam River. The federal /state funding split is reviewed on an annual basis under the USACE and ODFW Cooperative Agreement (2012) based on total production levels.

Foster Fish Collection Facility - The redesign cost of the Foster Fish Facility (to accommodate both adult salmon collection for outplanting and for release) was solely borne by the federal government (USACE, with partial cost reimbursement to USACE by BPA as noted above).

Staffing Level: This facility has four permanent and one seasonal (four month) position.

Budget: The annual operation and maintenance budget for the CHS program at South Santiam Hatchery for the calendar year 2013-14 was $550,944 (including indirect costs). The annual operations budget for operating the Foster Fish Facility is anticipated to be approximately $250,000. Funding for fish pathology, fish identification (marking), and Research, Monitoring, and Evaluation (RM&E) is separate from the operation and maintenance budget.

Note: with the rebuild of the Foster Fish Collection Facility, total staffing for both facilities is anticipated to remain at 4 FTE's with an approximate budget of $654,857.

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
120,118[1]	South Santiam	South Santiam	South Santiam Spring Chinook program (RPA 6.1.1; 6.2.1-3)	USACE
Egg take as available	South 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.

1.5) Location of hatchery and associated facilities:

- The South Santiam Hatchery is located in Section 27, T 13S, R 1E (44° 24' 58" N, 122° 40' 51" W), approximately two miles east of Sweet Home, Oregon at the base of Foster Dam (RM 37). Site elevation is 500 feet (ft) above sea level.

- The Foster Fish Collection Facility is located across the River from the South Santiam Hatchery.

- Willamette Hatchery is located one mile east of Oakridge, Oregon, adjacent to Salmon Creek, and three miles above its confluence with the Middle Fork of the Willamette River (near River Mile 42). Site elevation is 1,217 ft above sea level.

Adult Collection: Adult CHS are collected at the newly constructed Foster Fish Collection Facility at the base of Foster Dam. The new facility was constructed in compliance with Reasonable and Prudent Alternative (RPA) 4.6 of the National Marine Fisheries Service's (NMFS's) 2008 Willamette Valley Project Biological Opinion (WP BiOp; NMFS 2008) to support ESA listed fish. Specifically, the Foster Fish Collection Facility will improve trap and haul of listed spring Chinook salmon and winter steelhead (i.e., minimize fish stress and injury) and result in improved passage of adults to historical habitat upstream of Foster Dam. The Facility is also used for broodstock holding and spawning, and potentially for trap and haul of listed spring Chinook and winter steelhead for passage above Green Peter Dam (Table 1.16-1). Downstream

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

passage at Green Peter has not been identified as a priority action in the current BiOp.

Holding and spawning: Fish will be held and spawned at the Foster Fish Collection Facility.

Incubation: Incubation of eggs to the eyed stage occurs at South Santiam Hatchery.

Early rearing: Currently 300,000 eggs are kept at South Santiam Hatchery and 900,000 eggs are transferred to Willamette Hatchery for early rearing and marking. The Willamette Salmon Trout Enhancement Program (STEP) receives approximately 15,000 eyed eggs each year. STEP fish are reared in classrooms over the winter until January, and released directly into various streams in the Willamette River basin (see Sections 1.5 and 10 for more information about STEP).

Late rearing (fingerling to smolt): In late May once juveniles are marked at Willamette Hatchery, 300,000 are transferred to South Santiam Hatchery to be reared and released in the spring. The original 300,000 eggs kept at South Santiam Hatchery are reared full term and released in November. After the November release 153,000 juvenile CHS are brought over from Willamette Hatchery to South Santiam Hatchery and released in February. Once the February release is completed, a final group of 268,000 smolts is transferred to South Santiam in the spring for a three-week acclimation period, and then released. The program goal is to rear as many fish as possible on site.

1.6) Type of program:

The South Santiam spring Chinook salmon hatchery program is managed as an integrated program to meet the original purpose of the hatchery mitigation program for fishery harvest and ESA conservation needs, consistent with survival and recovery of the ESU,[2] including supporting implementation of the Willamette Biological Opinion (NMFS 2008). The program also supports recommendations in the Upper Willamette Conservation and Recovery Plan for Chinook Salmon and Steelhead (NMFS and ODFW 2011), as the Recovery Plan informs the best scientific and commercial data available.[3] The program provides mitigation for impacts from the construction and operation of Foster and Green Peter dams that blocked access to about 85% of the historic CHS spawning and rearing areas in the South Santiam basin.

To mitigate effects of the Foster Dam project, the Cooperative Agreement calls for rearing of a maximum of 71,000 lbs of CHS and/or steelhead for release into the South Santiam Subbasin. Currently, 116,044 pounds of Chinook salmon are produced for the South Santiam. The remainder of the production at South Santiam Hatchery is funded by ODFW for the purpose of providing adults to assist with recovery of the ESU and

[2] *See* 65 F.R. 42477 (Jul. 10, 2000), codified at 50 C.F.R. 223.203(b)(5)(i)(C)
[3] *See* 16 U.S.C. § 1536(a)(2); *See also* NMFS "Updated July 2000 4(d) Rule Implementation Binder for Threatened Salmon and Steelhead on the West Coast," (August 2003)("An HGMP must use the best available scientific and commercial information").

enhancing the run for in-river fisheries (ODFW 1998a). ODFW's harvest goal in the South Santiam River is 1,600 hatchery CHS adults (ODFW 1998a) in addition to ocean, lower Columbia River, and lower Willamette River sport and commercial fisheries.

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 Foster and Green Peter Dams, which will provide adult returns to help meet harvest objectives for the South Santiam River, lower basin, and ocean fisheries.

1.8) Justification for the program:

The original purpose of the hatchery mitigation program was to mitigate for lost natural fish production due to habitat and fisheries losses resulting from construction and operation of specific federal Willamette Valley Project (WVP) dams, which Congress authorized to reduce the damage associated with flooding in the Willamette Valley. U.S. Army Corps of Engineers dams and hatchery mitigation was developed prior to ESA-listing of Upper Willamette River (UWR) CHS.

Since this ESA-listing, it has become important to recover natural populations so that the spring Chinook salmon within the ESU can be delisted. Reducing the impacts of hatcheries and associated fisheries and continuing to manage the risks from these activities is a necessary component for recovery, in addition to addressing the other key limiting factors and threats from the construction and operation of the federal dams.

The USACE-funded portion of the hatchery program is implemented in compliance with the July 2008 Willamette BiOp issued by NMFS, which contains several actions as part of its Reasonable and Prudent Alternative (RPA) to avoid jeopardy or destruction or adverse modification of critical habitat for spring Chinook by reducing effects of Corps projects and operations, including federally funded hatchery mitigation programs in the Willamette. Specific hatchery actions in the BiOp include implementing HGMP's, complete hatchery facility improvements, support mass marking of hatchery releases, and support continued outplanting of adult Chinook.

In addition, the 2011 Recovery Plan for UWR CHS and winter steelhead (ODFW and NMFS 2011) identifies objectives and strategies for conservation consistent with survival and recovery of the ESU, including some recommended actions for hatchery reform.

The South Santiam CHS program provides harvest opportunities in the South Santiam River and contributes, along with other upper Willamette hatchery programs, to significant sport, commercial and tribal fisheries in the Pacific Ocean, lower Columbia River, lower Willamette River, and mainstem and tributary fisheries. Hatchery spring Chinook production from the Upper Willamette basin supported harvest of over 27,000 adults in sport and commercial fisheries in the lower Willamette and Columbia Rivers in 2011 (Fish Management Evaluation Plan [FMEP] 2012).

Outplanted CHS into historic habitat above Foster Dam serves conservation and RM&E purposes by informing managers about the effectiveness of ongoing reintroduction efforts of natural-origin recruits, although the current management practice is to only place natural-origin Chinook above Foster. Decisions regarding fish management and outplanting are made by the ODFW, NMFS, and USFWS, collectively referred to as the fishery co-managers in coordination with the region. Further details on the reintroduction efforts using hatchery fish are being discussed and formalized by the co-managers with recommendations from the Hatchery Management and Fish Passage Technical Teams within the advisory WP BiOp Willamette Action Team for Ecosystem Restoration (WATER) forum. The UWR Conservation and Recovery Plan for Chinook Salmon and Steelhead (UWR Plan 2011) provides guidance for the conservation objectives and strategies for the WHMP and delisting criteria. Outplanting protocols are contained in Section 15.

The following is a list of current hatchery practices used in the South Santiam spring Chinook salmon hatchery program.

1. 9 & 1.10) List of program "Performance Standards" and "Performance Indicators":

Category 1: Legal Mandates:

Standard 1.1: Meet production levels for mitigation, fisheries, and ESA conservation objectives consistent with survival and recovery of the ESU.

Indicator 1.1.1: Produce and release up to 1,021,000 spring Chinook salmon smolts including 71,000 lbs of CHS and/or steelhead smolts as identified in the Cooperative Agreement (2012) for release into the South Santiam River Subbasin. ***Benefit***

Standard 1.2: Program goals are aligned with authorized federal, state, regional, and local fisheries conservation and restoration initiatives. Approval of this HGMP indicates compliance of the South Santiam CHS hatchery program with the ESA.

Indicator 1.2.1: Program complies with the Willamette BiOp (NMFS 2008), and is consistent with the objectives and in the Santiam Sub-basin Fish Management Plan, and the UWR Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NMFS 2011), as these documents inform the best scientific and commercial data available. HGMPs will be reviewed and must be approved by NMFS. ***Benefit***

Category 2: Harvest:

Standard 2.1: Provide sufficient hatchery adults to meet harvest management goals including mitigating for impacts from lost production

above Foster and Green Peter dams while minimizing impacts to natural-origin Chinook salmon. Take associated with harvest is covered through the FMEP for upper Willamette CHS (ODFW 2001).

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

Category 3: Conservation:

Standard 3.1: Maintain heterozygosity in hatchery broodstock and avoid genetic drift by integrating natural-origin broodstock at an average rate of 5-10% at times when the wild run is projected to exceed 750 adults to the South Santiam River based on counts at Willamette Falls and Foster Dam.

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

Benefit

Indicator 3.3.2: Flow management to promote efficient downstream migration of hatchery smolts, protect eggs deposited during spawning and provide juvenile rearing habitat.

Standard 3.2: Produce and release sufficient numbers of fish to support successful outplanting upstream from Foster Dam, for RM&E and reintroduction efforts including nutrient enrichment to boost habitat productivity.

Indicator 3.2.1: Abundance and productivity of hatchery returns available for outplanting are adequate to determine: spawning success (including PSM), SAR, recruits per spawner (productivity), adult spawn and migration timing and distribution, number of juveniles emigrated from spawning areas, and genetic diversity. ***Benefit***

Standard 3.3: Reduce potential for negative ecological interactions between hatchery and naturally produced juveniles.

Indicator 3.3.1: 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. ***Risk***

Indicator 3.3.2: Flow management to promote efficient downstream migration of hatchery smolts, protect eggs deposited during spawning and provide juvenile rearing habitat.

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

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

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

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

Standard 3.6: Monitor benchmarks and protocols for broodstock.

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

Standard 3.7: Hatchery adults spawning (pHOS) with natural-origin adults in the South Santiam CHS population area is less than 30%.

Indicator 3.7.1: This HGMP incorporates the pHOS target designated in the Recovery Plan (ODFW and NMFS 2011). The projected pHOS to achieve recovery is <30% for the South Santiam CHS natural population. The desired pHOS above Foster is 0% while the area below Foster has a target pHOS of <80%. Hatchery-related risks will be reduced as natural production continues to be restored above Foster Dam and potentially above Green Peter Dam in the future. The goal is to minimize pHOS above Foster Dam. The hatchery mitigation program for CHS will be reduced commensurate with restoration of natural production above these dams.

Category 4 Life History Characteristics:

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

Indicator 4.1.1: Life history characteristics of the broodstock including: morphometrics (length and weight), sex ratio, average number of eggs per female by age class, age structure, and 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 in time and space that minimizes the interaction with listed fish. ***Risk***

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

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

Category 5: Genetics

Standard 5.1: Manage genetic risks of hatchery CHS spawning with naturally produced CHS in the South Santiam population to promote natural selection and local adaptation. Also see Standard 3.7.

Indicator 5.1.1:

The hatchery program may be used to supplement natural origin CHS passed above Foster Dam if the return of natural origin females remains at less than 500. The need to supplement with hatchery origin fish will be determined on an annual basis by the fisheries co-managers with input from WATER.
Since 2009, only unclipped CHS have been outplanted above the dam, of which on average ~20% of the outplanted unclipped CHS were hatchery fish with an adipose fin. For the past two years natural origin returns to Foster Dam have been low compared to previous years, but this may related to a near-complete year-class failure upstream of the dam in 2010.

Once the number of natural-origin CHS returns to Foster Dam trap averages, over a 5-year period, more than 500 female CHS (assigned by pedigree analysis), hatchery CHS should not be needed for supplementation. ***Risk***

HOR fish may be released into the upper portion of Foster Reservoir and/or the mainstem South Santiam River above Foster Reservoir, and potentially above Green Peter Dam, if needed to support RM&E and natural fish reintroduction strategies, as described in Section 15. Every effort will be made by the Corps to identify juvenile fish needs for RM&E and coordinate with ODFW hatchery managers as early as possible. ODFW RM&E team members will assist with coordination between the RM&E team planning and hatchery managers. There may be instances when the hatchery will not be able to support production needs for RM&E; this includes when requests are made too late in the hatchery production cycle or if production capacity does not exist.

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

Indicator 5.2.1: Genetic composition of natural and hatchery stocks; pHOS; and pNOB, and ensure escapement of >750 adults. ***Risk***

Standard 5.3: Integrate natural-origin broodstock at an average rate of 5-10% when natural-origin returns to the South Santiam River are expected to exceed 750 adults annually.

Indicator 5.3.1: Maintain genetic diversity (heterozygosity) of broodstock similar to natural-origin fish. The impact to the natural population from broodstock integration would be 0% up to a maximum of 12% (10% integration rate of maximum broodstock size (900) at lowest natural population size (750). Integration rates will be tracked annually. ***Benefit***

Category 6: Operation of Artificial Production Facilities:

Standard 6.1: South Santiam Hatchery and Willamette 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 Investigational New Animal Drug Permit (INAD).

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

Standard 6.2: South Santiam Hatchery, Willamette Hatchery, and Foster Fish Collection Facility effluent will not negatively impact natural populations.

Indicator 6.2.1: All facilities are in compliance with permits issued by ODEQ, to maintain Oregon water quality standards for protection of aquatic life. ***Risk***

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

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: South Santiam Hatchery or Foster Fish Facility operations do 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, ***Risk***

and released.

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.

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 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. ***Neutral***

Indicator 7.1.2: Provide adequate CHS to support sport, tribal, and commercial fisheries in the Pacific Ocean, Lower Columbia and Willamette rivers, and 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 South 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 (DEQ) guidelines for disease control and water quality. ***Benefit***

Table 1.9-1. Recommended performance targets for hatchery rearing and release of hatchery fish from all funding sources

Variables	Performance Target (benchmark)
Size-at-release	South Santiam: target size at release is 9.0 fpp (Feb/Mar) and 8.0 fpp (Nov).
Release timing	February 15 - March 15; November 1
Acclimation time	Varies: over-winter, 3 weeks
Migration timing	Similar to naturally produced fish
Level of disease occurrence in hatchery fish	Below IHOT standard
Number of fish released	Up to 1,021,000 smolts[4]
Number of hatchery produced fish required for broodstock and conservation needs	Up to 350,000 smolts
In-hatchery life stage survival	Maximum and unbiased survival
Rearing density	Implement best management practices
Growth rate	Achieve target size at release
Residualism rates	< 10%
Precocial rates	< 10%

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

Variables	Performance Target (benchmark)
Number of hatchery produced fish removed for broodstock	Approximately 717 (269 females); this number can vary based on holding mortality, Bacterial Kidney Disease (BKD) culling, fecundity, and production needs.
Number of hatchery produced fish harvested	1,600 minimum within South Santiam basin; plus ocean/Columbia River/Lower Willamette.
Number of fish passed upstream into target areas above Foster Dam	Determined on annual basis by fish co-managers in

[4] 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 1,021,000 smolts, analyses show broodstock is met 99% of the time. Cumulatively, broodstock and the outplanting goals are met 55% of the time. Harvest goals are met approximately 50% of the time.

Variables	Performance Target (benchmark)
	coordination with the WATER Technical Teams
Age structure	Similar to naturally produced fish
Sex Ratio	Similar to naturally produced fish
Fecundity	Similar to naturally produced fish
pHOS	pHOS levels <30% in the natural population of the South Santiam River (0% above Foster, <80% below Foster).
Genetic diversity	Maintain genetic diversity and avoid genetic drift
Adult migration and spawn timing	Similar to naturally produced fish
SAR	0.45 (See Appendix E for more information)

Table 1.9-3. Recommended performance targets for hatchery broodstock

Variables	Performance Target (benchmark)
Number of naturally produced fish spawned	5-10% of broodstock natural-origin CHS. Integration rates vary annually depending in part on natural escapement level of 750 natural-origin CHS return to South Santiam River (see Section 6.2.3, integration will occur with S. Santiam stock only, not SAFE CHS). The impact to the natural population would range from 0% to up to 12% (10% integration rate at 750 population level).
Number of hatchery fish spawned	400-450 females (800-900 adults)
Morphometrics	Sample 100% of broodstock
Run timing	Similar to naturally produced fish
Spawn timing	Similar to naturally produced fish
Age	Similar to naturally produced fish
Fecundity	Similar to naturally produced fish
pNOB	5-10% target (incorporate natural-origin adults into brood) when natural-origin returns are greater than 750 annually
Genetic diversity	Maintain heterozygosity and avoid genetic drift
Sex ratio	Similar to naturally produced fish
Age structure	Similar to naturally produced fish
Average number of eggs per female by age class	Similar to naturally produced fish
Adult migration and spawn timing	Similar to naturally produced fish
Average size (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 South Santiam Hatchery Spring Chinook Salmon Program collects and spawns approximately 717 adults (269 females) to meet production goals including BKD-culling and mortality.

1.11.2) Proposed annual fish releases:

Approximately 1,021,000 smolts are released into the South Santiam River on an annual basis. An additional 12,000-15,000 eggs are raised in classrooms and 8,000-10,000 fry are released into waters in the Willamette Basin as part of the Salmon-Trout Enhancement Program's (STEP) Eggs to Fry classroom incubation program. See Sections 1.5 and 10 for more information about STEP. Proposed annual fish releases are described in Table 1.11.2-1.

Table 1.11.2-1. Proposed annual releases of South Santiam spring Chinook salmon. (Source: NMFS 2008.) [1/]

Life stage	Release location	Release period	Mean size at release (fish per lb)	Number of fish released	Total lbs released
Unfed Fry[1/]	Santiam Basin	December		8,000 – 10,000	6.5 – 8.5
1+ Yearling	South Santiam River	February/ March	9.0	721,000	80,111
Yearling	South Santiam River	November	8.0[2]	300,000	37,500
Totals				1,031,000	116,044

[1/] Transferred to Mid-Willamette STEP program (*not included in totals*).
[2/]Due to warmer water and higher feeding rates the fish released in November are larger than those released in the spring.

1.12) Current program performance:

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

The number of adults returning to Foster Trap since 1984 is presented in Table 1.12-1. From 1990 to 1992, adult returns to Foster Dam declined and remained low through

1997. Since then, the number of adults returning to Foster Dam has generally increased, with peak counts occurring in 2004; however, in 2007, the returns to Foster Trap declined again and remained low in 2008. Returns during 2010-12 were significantly higher than the long-term average. Based on CWT data collected at the Foster Trap since 1990, fish released in April appear to have higher survival rates than those released at other times of the year (Table 1.12-2).

The ODFW harvest goal for the South Santiam River sport fishery is 1,600 CHS; however, this does not include harvest associated with ocean, lower Columbia River, and lower Willamette River fisheries. According to South Santiam harvest statistics gathered from sports harvest angler tags (i.e. punch cards), harvest is more often below the goal than equal to or exceeding it. In eight out of the past 14 years, the harvest goal on the S. Santiam has not been met. Average annual harvest over this time period has been 1,720 CHS, however this includes two very high catch years. If the two lowest and the two highest catch years are removed from the average then the annual catch in the S. Santiam basin is 1,545, which indicates that smolt releases on the South Santiam are close to what is needed to meet harvest goals.

Table 1.12-1. Numbers of spring Chinook salmon adult and jacks returning to Foster Dam, 1986-2013.

Calendar Year	Total Counted	Number Clipped[1/]	Number Unclipped[1/]	Number of Jacks	
				Jacks	Sub-jacks[2/]
1986	3,682			184	19
1987	6,501			179	222
1988	3,898			125	84
1989	6,066			123	38
1990	7,464			125	19
1991	4,331			51	97
1992	1,721			51	12
1993	2,379			60	69
1994	2,013			13	62
1995	2,136			57	88
1996	2,395			41	26
1997	1,883			52	43
1998	3,891			62	30
1999	5,200			38	47
2000	3,948			84	274
2001	5,522	2,944 (172)	2,273 (6)	178	305
2002	7,136	6,293 (76)	811 (6)	82	32

2003	6,203	5,751 (107)	451 (4)	111	1
2004	10,600	8,746 (55)	1,854 (4)	59	0
2005	3,793	2,826 (112)	967 (0)	112	0
2006	3,674	3,405 (17)	264 (0)	17	5
2007	1,473	1,278 (29)	156 (10)	39	39
2008	2,226	1,116 (43)	468 (5)	48	642
2009	3,167	2,720 (553)	447 (20)	573	447
2010	8,973	8,245 (163)	728 (10)	173	407
2011	8,993	7,769 (300)	1,224 (9)	309	99
2012	8,230	7,172 (79)	1,058 (13)	92	82
2013	3,659	2,732 (129)	927 (23)	152	617

Data taken from ODFW Hatchery Management Information System (HMIS) database.
[1/] Number of clipped or unclipped fish returning to Foster Dam. Number in parentheses is number of clipped or unclipped jacks. Data distinguishing between clipped and unclipped fish were not collected 1984-2000.
[2/] Sub-jacks not included in adipose clipped and unclipped totals.

Table 1.12-2. Smolt-to-adult returns based on coded wire tag recoveries in the Foster Trap, 1990 – 2015 (ODFW unpublished data). Data does not account for harvest.

	Smolt-Adult Return (SAR) Estimates		
Run Year	From Run Reconstruction (Foster Returns, In-River Harvest, Hatchery-origin Escapement, and Prespawn Mortality)	From Columbia Basin Research Coded Wire Tag Recoveries	From Returns to the Foster Trap (Based on smolt releases 4 yr earlier)
1990			0.8%
1991			0.4%
1992			0.2%
1993			0.2%
1994			0.2%
1995			0.2%
1996		0.3%	0.2%
1997		0.1%	0.2%
1998		0.1%	0.4%
1999		0.8%	0.4%
2000			0.4%
2001		0.6%	0.5%
2002	1.3%		0.7%
2003	1.0%		0.6%
2004	1.6%		1.0%

2005	0.5%	0.4%	0.3%
2006	0.6%	0.3%	0.3%
2007	0.3%	0.0%	0.1%
2008	0.2%		0.1%
2009	0.4%	0.3%	0.3%
2010	1.4%	1.0%	0.7%
2011	1.0%		0.7%
2012	1.0%		0.7%
2013	0.4%		0.3%
2014	0.5%	0.2%	0.3%
2015			0.8%
Mean	0.8%	0.4%	0.4%

1.13) Date program started:

The South Santiam River spring Chinook salmon program (stock 024) began in 1968.

1.14) Expected duration of program:

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

1.15) Target watersheds:

Spring Chinook salmon smolts are released into the South Santiam River. Unfed fry are released as part of the STEP program in the South Santiam River subbasin as well as in other rivers and creeks within the Willamette River basin, including the Calapooia, North Santiam, and Willamette rivers, and Mill Creek. STEP is an educational program that poses a low ecological risk; while there is low likelihood that unfed fry releases will return as adults, large benefits are realized from the releases, including the nutrient supplement that fry consumption provides to piscivorous fish, and the educational benefit to kids of connecting fish to their waterways. ODFW conducts annual snorkel surveys in a number of the basins where fry are released, to track the juvenile populations.

1.16) Alternative actions considered:

1.16.1) Key issues and alternatives:

In order to meet the stated goals of the South Santiam Hatchery Program (see Section 1.7), the facilities release approximately 116,044 lbs of CHS annually. Current

production levels associated with mitigation program provides for the release of adequate numbers of juveniles to mitigate for lost production of natural-origin adults from construction and operation of Foster Dam; mitigation, for Green Peter Dam has not been determined. It is anticipated that hatchery production associated with the federal mitigation responsibility will be reduced in the future commensurate with natural production above Foster and Green Peter dams following implementation of the 2008 BiOp and appropriate 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 South 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.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS

2.1) ESA permits or authorizations:

This HGMP and the resulting 4(d) determination will serve as the authorizing document under the ESA for direct take of listed CHS for the South Santiam River hatchery CHS program. The program already has incidental take authorization via the 2008 Willamette Project BiOp (Section 11.1.5) and its subsequent letter of clarification from NMFS, dated February 2013. However, the new authorization from NMFS will grant ESA direct and incidental take coverage for the entire South Santiam Chinook hatchery program.

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

NMFS (National Marine Fisheries Service). 2000a. Biological Opinion on the impacts from the collection, rearing, and release of listed and non-listed salmonids associated with artificial propagation programs in the Upper Willamette spring Chinook salmon 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 (SBA) 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) ESA-listed natural populations in the target area

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

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

Upper Willamette Chinook Salmon

Spring Chinook salmon is the only stock of salmon native to the Santiam River basin. Historically, the basin was highly productive for CHS accounting for approximately 33 percent of the naturally produced CHS in the Willamette Basin above Willamette Falls (unpublished department memo dated Nov. 22, 1977 from W. Saltzman, ODFW Portland, Oregon). Major areas of CHS production in the South Santiam system were the Middle Santiam River, Quartzville Creek, and a 5-mile reach upstream of Cascadia on the South Santiam River. Historically, 85 percent of the CHS production in the South Santiam system occurred above the present location of Foster Dam (Mattson 1948).

The UWR Chinook salmon ESU was listed as threatened under the ESA on March 24, 1999 (64 FR 14308) and reaffirmed on June 28, 2005 (70 FR 37160) and 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, South Santiam, Molalla, Calapooia, McKenzie, the Middle Fork Willamette, and the Clackamas Basins. Wild CHS are commingled with hatchery CHS released from hatcheries located on the Clackamas, North Santiam, South Santiam, McKenzie, and Middle Fork Willamette rivers. The NMFS designated these five hatchery stocks as part of the ESU.

Adult CHS begin entering the Santiam Basin in late April, with the peak of the migration occurring from late-May through early-June. Adults arrive at Foster Dam primarily in June and July, but may arrive as early as late-April and as late as mid-October.

Spawning occurs from early September through early October with peak spawning in late September and early October (Mattson 1962; Kenaston et al. 2009). In the South Santiam drainage, most of the spawning occurs in the mainstem South Santiam River. Some additional spawning and rearing occurs in Thomas Creek from Jordan Creek to Hall Creek, in Crabtree Creek from RM 14 to about one mile below White Rock Creek (Wevers et al. 1992).

The age distribution of natural-origin CHS in the South Santiam River based upon analysis of scales collected from carcasses during spawning surveys is presented in Table 2.2.1-1. Age 4 and age 5 adults predominate in the population. Scales were collected for hatchery-origin CHS returning to Foster Dam from 1995-2000 and 2007-2008. Scales

were randomly selected at the time of spawning and from adult mortalities prior to spawning (Table 2.2.1-2). As with the natural origin fish, hatchery origin fish returning to Foster Dam were predominantly ages 4 and 5.

The abundance of unclipped (adipose fin intact) spring Chinook salmon returning to Foster Dam is shown in Table 1.12-1. Since 2001, all returning hatchery CHS were adipose fin-clipped with the exception of a very low mismark rate (<5% with an average of 2.4% over the past five brood years). The count of unclipped CHS at Foster Dam provides the best information on the status of natural-origin CHS returning to the South Santiam population. There are no other counting stations available in the South Santiam Basin. The abundance of unclipped CHS returns to Foster Dam has ranged from 156 to 1,224 from 2002-2012. It is important to consider, however, that even with a very low mismark rate (i.e. <5% of the hatchery fish released did not receive ad clip) this could result in a number of the unclipped CHS in fact being hatchery origin CHS. This must be taken into account in the status assessment of natural-origin CHS returning to Foster Dam in the South Santiam River.

Table 2.2.1-1. Age composition (percent of sample) by return year of natural origin spring Chinook salmon in the South Santiam River basin, 2002–2013. Based on analysis of scales collected from carcasses recovered on spawning grounds, except in 2002 and 2007, which included scales collected at the hatchery. Origin of fish was determined by absence of fin clips and absence of thermal marks in otoliths. Source: Schroeder et al. 2007; K Schroeder, unpublished data.

	Total adult age				
Return year	Age 3	Age 4	Age 5	Age 6	Sample size
2002[a]	0.5	69.1	30.4	0.0	191
2003	0.7	67.8	30.8	0.7	143
2004	1.2	53.0	45.8	0.0	83
2005	4.0	37.4	54.5	4.0	99
2006	0.0	68.9	28.9	2.2	45
2007[a]	18.2	43.9	37.2	0.7	148
2008	24.2	64.4	11.3	0.0	326
2009	1.1	86.5	11.0	1.4	282
2010	13.7	57.9	28.4	0	95
2011	3.5	84.9	11.3	0.3	345
2012	6.4	51.6	39.7	2.3	219
2013	10.9	79.6	8.8	0.7	147

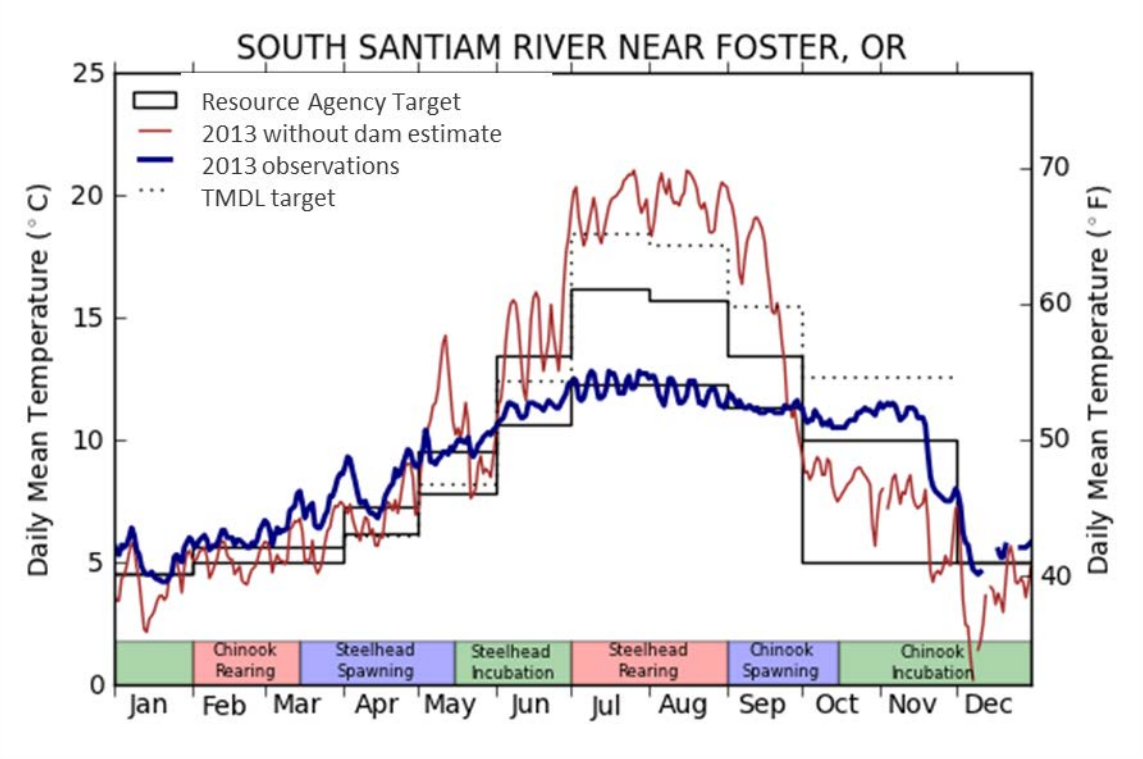
[a] *Includes 15 natural origin fish incorporated into the hatchery broodstock in 2002 (all age 5), and 79 fish in 2007 (25.3% age 3, 41.8% age 4, 31.6% age 5, 1.3% age 6).*

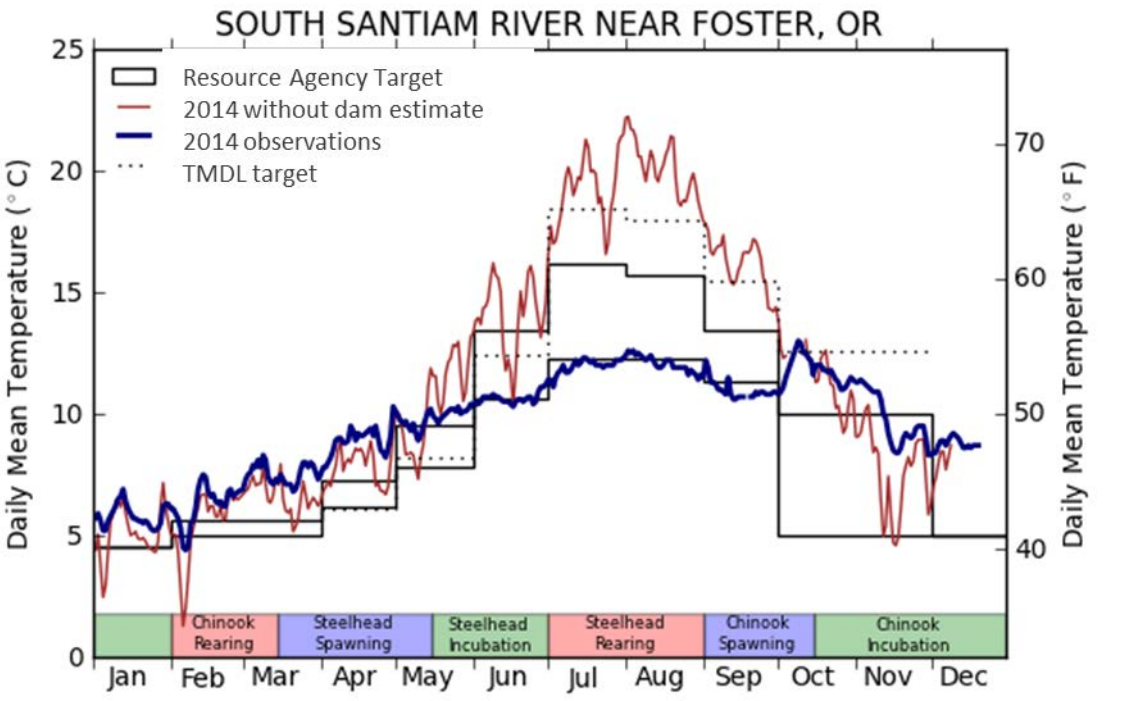
Table 2.2.1-2. Age composition (percent of sample) by return year of hatchery origin spring Chinook salmon in the South Santiam River basin, 1995-2000 and 2007-2013. Based on analysis of scales from randomly selected adults at the time of spawning, hatchery mortalities prior to spawning, and carcass recoveries during spawning surveys. Source: K. Schroeder, personal communication (November 2009); Boatner and Foster 2001; K Schroeder, unpublished data.

	Percent of Sample				
Return year	Age 3	Age 4	Age 5	Age 6	Sample size
1995	2.8	54.2	42.5	0.4	2052
1996	2.0	45.8	51.9	0.3	2387
1997	2.8	36.2	60.1	0.8	1843
1998	1.6	62.0	36.4	0.0	3883
1999	0.8	56.8	42.4	0.0	5351
2000	2.3	56.4	41.3	0.0	3674
2007	1.5	33.8	53.8	10.8	65
2008	1.4	90.4	8.2	0.0	73
2009	0.0	75.0	25.0	0.0	20
2010	2.1	75.0	22.9	0.0	48
2011	0.0	71.2	28.8	0.0	104
2012	0.0	61.4	37.5	1.1	88
2013	11.1	33.3	55.6	0.0	9

Naturally produced fish emerge early in the South Santiam River compared to historic conditions because warm water discharged from Foster Reservoir in the fall shortens the incubation time of CHS eggs.

The following figures illustrate how temperatures downstream of Foster Dam correspond with species conservation targets and the modeled “no dam” thermograph in 2013 and 2014.





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

Upper Willamette River (UWR) Steelhead

The UWR steelhead Distinct Population Segment (DPS) (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. Natural populations of steelhead occur in the North Santiam, the South Santiam, the Molalla, and the Calapooia rivers. Additionally, smaller, but still significant natural populations occur in several West Valley tributaries (Tualatin, Yamhill, Luckiamute, Rickreall). There are no hatchery programs included in this DPS (NMFS 2006). Steelhead numbers in this DPS are depressed from historical levels but to a much lesser extent then CHS in the Willamette Basin (McElhany et al. 2007).

Lower Columbia River Steelhead

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

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. This ESU excludes populations above Willamette Falls. Within this ESU, there are historic runs of three different Chinook salmon populations: spring-run, fall-run (tules), and late-fall (bright) Chinook salmon. Current data for the Lower Columbia River Chinook salmon ESU indicated that populations currently have low abundance. Hatchery management practices have reduced the diversity and productivity of natural populations in the Lower Columbia River Chinook salmon ESU.

Lower Columbia River Chum Salmon

The Lower Columbia River chum salmon 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.

Columbia River Bull Trout

Columbia River bull trout were listed as "threatened" under the federal ESA in June 1998. Bull trout are native to the South Santiam River however populations were last observed in 1953 and no longer believed present. Information on life history and distribution of bull trout in the South Santiam River subbasin is lacking.

Oregon Chub

The reduction of suitable habitat and the restricted distribution of the Oregon chub resulted in a determination of "endangered" status under the federal ESA in 1993. The listing was downgraded to "threatened" in early 2010 and delisted in 2014. The Oregon chub are endemic to the Willamette Valley of western Oregon. Historically, Oregon chub were found throughout the Willamette Basin from Oregon City to Oakridge. The historical records note collections from the Clackamas River, Molalla River, Mill Creek, Luckiamute River, North Santiam River, South Santiam River, Calapooia River, Long Tom River, Muddy Creek, McKenzie River, Coast Fork Willamette River, Middle Fork Willamette River drainages, and the mainstem Willamette River. Oregon chub distribution and abundance have improved dramatically in recent years. However, compared to the historical distribution, the current distribution is limited to populations in the Santiam River, Mary's River, McKenzie, Coast Fork and Middle Fork Willamette River drainages. No populations are known to exist in the Willamette River drainage downstream of the Santiam River confluence.

2.2.2) Status of ESA-listed Salmonid population(s) affected by the program:

(a) Status of listed natural population(s) relative to "critical" and "viable" population thresholds:

The Recovery Plan for the UWR Chinook salmon ESU (ODFW and NMFS 2011) describes the objectives and strategies for recovery and delisting of spring Chinook and winter steelhead in the Upper Willamette Basin. The Recovery Plan contains standards for a "viable salmonid population" (VSP) of South Santiam River spring Chinook salmon in terms of abundance, productivity, distribution, and diversity.

The Recovery Plan states that South Santiam spring Chinook salmon are at a very high risk of extinction with a desired status of moderate risk (>5% and <25% probability of extinction over a 100 year period) and that the gap between current and desired status is approximately 3,100 additional CHS in the South Santiam population (ODFW and NMFS 2011). Since 2009 an average of about 1,076 NOR Chinook have returned to the South Santiam, or about 35% of the Recovery Goal. The South Santiam hatchery program is currently a tool used to minimize risk of extinction over the short-term. The Foster Fish Facility was rebuilt in 2013 and is improving adult outplanting above Foster Dam. Currently, Foster Dam is operated to provide spill over a fish weir; the fish weir is scheduled to be improved by the year 2020 with the goal of further improving downstream fish passage, with consideration given to the goal of maintaining a successful harvest program. Chinook outplanted above Foster dam are surviving at a

level that allows for their replacement.

The availability of areas historically used for spawning by CHS in the South Santiam was severely reduced by construction of Foster and Green Peter dams in 1968 and 1967, respectively. Mattson (1948) estimated that over 85 percent of the CHS spawning in 1947 were located upstream from the site of these dams. Pre-dam spawning habitat in the river below Foster was less optimal than that above the dam, and currently the dams negatively impact water quality, flows, temperature and substrate availability (ODFW/NMFS 2011). Today, spawning and rearing habitat is still available below these dams downstream to Lebanon (which Mattson noted as the extreme downstream location of spawning by CHS). The habitat above and below Foster Dam was designated as critical habitat by NMFS in 2005. [5] The habitat below Foster Dam was categorized in the critical habitat assessment as having high potential for spawning and rearing PCEs, particularly in light of the high redd density beneath Foster Dam (Schroeder 2003). Foster Dam is managed with a flow regime proscribed by NMFS' RPA to ensure adult access to existing spawning habitat below Foster Dam, protect eggs deposited during spawning, and provide juvenile rearing and adult holding habitat for listed salmonids. Presently, the spawning habitat below Foster Dam is used primarily by hatchery CHS because the hatchery facility is located at the base of Foster Dam. The higher stream temperatures and different flow patterns impact incubating eggs and newly emerged fry downstream of Foster dam.

The run of spring Chinook salmon above Foster and Green Peter Dams was extirpated when the dams were built because no successful fish passage occurred. In the 1990's, ODFW began passing adult hatchery spring Chinook salmon upstream of Foster Dam. Over the last decade, this hatchery supplementation has begun to produce returning natural-origin CHS back to Foster Dam, with an average of over 1,076 natural origin Chinook returning since 2009. Ongoing pedigree analyses have demonstrated a high proportion of these returning natural-origin CHS were produced by hatchery supplementation upstream of Foster Dam.

About 35% of the natural origin fish that return to the South Santiam River spawn beneath Foster Dam. It is expected there will be substantial seasonal mixing of natural-origin CHS produced downstream of Foster Dam with CHS produced upstream of Foster Dam because of the life history of CHS and their propensity to over-summer and spawn in the headwaters of the Cascade Mountains upstream of Foster Dam. Even though Foster Dam inhibits natural migration of CHS upstream (natural-origin adults collected at the South Santiam hatchery are outplanted above Foster Dam), this barrier is being used as a management tool to control and manage the number of hatchery CHS allowed upstream of Foster Dam. The current management is to minimize the number of hatchery CHS released upstream of Foster Dam and maximize the number of natural-origin CHS released upstream. This will allow hatchery-related risks to be minimized and to continue to develop a self-sustaining run of natural CHS upstream of Foster Dam.

[5] 70 FR 52630.

In compliance with NMFS WP BiOp, a new adult fish collection facility (Foster Fish Collection Facility) was constructed, and began operation in April 2014. The Foster Fish Collection Facility improved the ability to safely collect, sort and transport Chinook salmon and winter steelhead above Foster Dam to continue adult outplanting.

Currently, most of the natural spawning of CHS below Foster Dam in the South Santiam River occurs in the uppermost reach, immediately below Foster Dam (RM 37; Table 2.2.2-1). Redd densities in the reach between Foster Dam and Lebanon Dam ranged from 8.7 redds per kilometer in 2008 to 37.3 redds per kilometer in 2002, with an annual average of 22.7 redds per mile. Redd densities below Lebanon Dam were low in all years surveyed (averaging 1.4 redds per kilometer) (Table 2.2.2-1).

The status of hatchery and wild population returns is available from CHS counts made at Foster Trap. Data on adult returns to Foster Trap are presented in Table 1.12-1.

The estimates for pHOS (Figure 2.2.2-1) above and below Foster Dam in the South Santiam River are based on numbers of clipped and unclipped fish adjusted following otolith analyses, and have varied over time. The below dam pHOS target of less than 80% from the Recovery Plan (ODFW/NMFS, 2011) is currently being met. Over the past twelve years, pHOS above Foster Dam has ranged from 10% to 96%. Since 2009 however it has been consistently lower with only NOR CHS being passed above the dam (Table 2.2.2-1). Implanting CWTs in all hatchery fish would likely reduce pHOS above Foster Dam to the target range by making it easier to differentiate hatchery fish from wild fish.

Figure 2.2.2-1. Estimates for pHOS for CHS spawning in the South Santiam River, 2007 – 2015 (ODFW, unpublished data). Estimates are derived from counts of clipped and unclipped carcasses recovered during spawning surveys and are adjusted using otolith scores. Basin-wide pHOS is weighted by annual redd counts above and below Foster Dam.

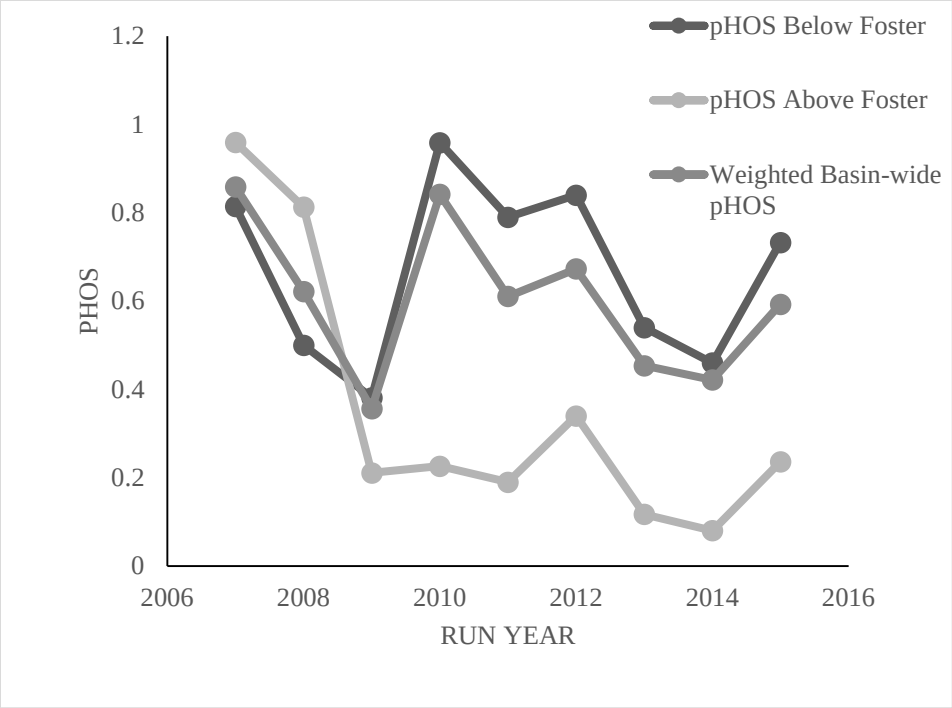


Table 2.2.2-1. Summary of Chinook salmon spawning surveys in the South Santiam basin, 2002–2015 From Kenaston et al. (2009); Schroeder et al. (2005); Firman et al. (2002); Cannon et al. (2012); unpublished ODFW data.

Run Year	Below Foster			Above Foster		
	Total Redds	Spawner Estimate (redds * 2.5)	Redd Density (redds/km)	Total Redds	Spawner Estimate (redds * 2.5)	Redd Density (redds/km)
2002	955	2,388	18.1	--	--	--
2003	630	1,575	11.9	--	--	--
2004	377	943	7.1	--	--	--
2005	530	1,325	10.0	--	--	--
2006	528	1,320	10.0	--	--	--
2007	483	1,208	9.1	157	393	4.8
2008	209	523	4.0	133	333	4.1
2009	483	1,208	9.1	84	210	2.6
2010	799	1,998	15.1	152	380	4.6
2011	545	1,363	10.3	232	580	7.1
2012	443	1,108	8.4	222	555	6.8
2013	368	920	7.0	94	235	2.9

2014	551	1,378	10.4	62	155	1.9
2015	437	1,093	8.3	174	435	5.3

The South Santiam River above Foster Dam is managed for conservation purposes. To achieve this goal, only unmarked adults are passed above the dam. Current estimates indicate that approximately 65% of the NOR spring Chinook salmon in the subbasin are passed above the dam. The remaining 35% of NORs in the basin do not return to the trap, and spawn in areas below Foster Dam. Efforts are underway to improve homing to the trap and reduce the number of mismarked hatchery adults above the dam through improved fidelity to the fish ladder and better identification. The numbers of hatchery adults passed above the project can be limited by better identification such as 100% coded wire tagging or other methods.

(b) Most recent 12-year progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population:

Data were not available for analysis of survival or productivity of natural-origin salmon in the South Santiam River.

(c) Most recent 12-year annual spawning abundance estimates or other abundance information:

Table 2.2.2-1 provides redd densities for survey sections in the South Santiam River basin.

Table 2.2.2-2. Summary of Chinook salmon spawning surveys in the South Santiam basin, and comparison to redd densities in 1998 and 2002–2012 From Kenaston et al. (2009); Schroeder et al. (2005); Firman et al. (2002); Cannon et al. (2012).

	Redds/km										
Section	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002
Lebanon Dam to Foster Dam	18.5	22.6	32.7	20.1	8.7	20.1	21.2	22.1	15.6	25.4	37.3
Below Lebanon Dam	0.0	0.2	5.9	--	--	--	0.7	--	0.1	0.6	2.1
Above Foster Dam	7.7	7.4	4.8	--	--	--	--	--	--	--	--

(d) Most recent 12-year estimates of annual proportions of direct hatchery-origin

and listed natural-origin fish on natural spawning grounds:

Currently, data about these interactions is limited, as 100 percent marking of CHS began at the South Santiam Hatchery in 2002. From 2002 to 2008, the percentage of naturally produced fish spawning between Foster Dam and Waterloo ranged from 9 to 46 percent and averaged 19 percent.

Table 2.2.2-3. Composition of spring Chinook salmon in the South Santiam River basin between Foster Dam and Waterloo based on carcasses recovered. Source: Kenaston et al. 2009; Cannon et al. 2012.

Run year	Number of Carcasses Recovered	Total Number Clipped	Total Number Unclipped	Number Unclipped with Otolith Mark	Number Unclipped without Otolith Mark	Percent Natural-Origin Spawners [a]
2002	1,865	1,604	261	37	224	12
2003	1,152	970	182	31	151	13
2004	953	838	115	30	85	9
2005	607	467	140	12	128	21
2006	302	243	59	9	50	17
2007	378	302	76	6	70	19
2008	105	51	54	1	53	50
2009	471	168	303	9	294	62
2010	1227	1115	112	59	53	4
2011	759	573	186	25	155	21
2012	443	360	83	14	69	16
2013	355	215	150	7	132	5

[a] Percent of total carcasses sampled that were unclipped and not otolith marked.

2.2.3) Potential take of listed fish due to hatchery activities:

(a) 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 occurs at the Foster Fish Facility between mid-May and early October. All CHS captured at the Foster Fish Facility are ESA-listed as part of the Upper Willamette ESU. Thus, direct take of listed CHS is intended as part of normal trap operation through migration delay, capture, handling, and upstream release. Trapping and handling devices may further lead to injury to listed fish through confinement, delayed migration and spawning, or delayed mortality as a result of injury. In addition, direct take is needed for up to 900 adults (450 females) for broodstock needs including an integration rate averaging 5-10% natural-origin adults (45-90 fish) when wild escapement is predicted to exceed 750 adults. Competition, disease, predation, and genetic interactions between hatchery and natural- origin fish in the South Santiam River may result in additional indirect take. However these effects have not been quantified. It is important to note the recent natural-origin CHS returns to Foster Dam were produced originally from hatchery CHS outplanted above Foster Dam, so the hatchery program has also provided recovery benefits from supplementation/reintroduction of CHS back into historic vacant habitats in the South Santiam Basin. 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 provides a framework for future RM&E activities related to the Willamette Hatchery Program in general and the South 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) Past takes associated with the hatchery program, including numbers taken and observed injury or mortality levels for listed fish (if known):

Prior to 2002 (i.e. before all returning hatchery fish were marked by adipose fin clip), natural-origin CHS were not readily distinguishable from hatchery fish. Consequently, there is little specific information on the level of take associated with the adult trapping and holding before that time. Table 2.2.3-1 gives the mortality of adult CHS at South Santiam Hatchery from 1990 to 2012. Assuming the proportion of natural-origin fish in the spawning population between Foster Dam and Waterloo in 2002-2011 (Table 2.2.2-3) is representative of adults captured in Foster Trap prior to 2002, approximately 16 percent of the broodstock prior to 2002 may have been natural origin fish. However, this estimate could be biased upward, because natural origin fish may be less inclined to enter

the trap than hatchery origin fish. Another possibility is natural-origin CHS were observed in greater numbers at Foster Dam trap because these fish were produced above Foster Dam and all CHS have the life history propensity to migrate to the headwaters of the basin for holding and spawning throughout the summer. Spring Chinook salmon naturally migrate to the uppermost extent of the river.

Table 2.2.3-1. Numbers of spring Chinook salmon taken for broodstock and holding mortality at South Santiam Hatchery since 1990.

	Fish Held (No.)			Holding Mortality					
				Males		Females		Total	
Brood Year	Males	Females	Total	(No.)	%	(No.)	%	(No.)	%
1990	844	1,009	1,853	94	11.1	75	7.4	169	9.1
1991	511	887	1,398	11	2.2	40	4.5	51	3.7
1992	514	559	1,073	48	9.3	45	8.1	93	8.7
1993	456	456	912	28	6.1	26	5.7	54	5.9
1994	966	855	1,821	63	6.5	91	10.6	154	8.5
1995	930	649	1,579	27	2.9	36	5.6	63	4.0
1996	742	625	1,367	9	1.2	11	1.8	20	1.5
1997	755	500	1,255	3	0.4	10	2.0	13	1.0
1998	589	513	1,102	11	1.9	18	3.5	29	2.6
1999	742	584	1,326	23	3.1	23	3.9	46	3.5
2000	769	613	1,382	29	3.8	44	7.2	73	5.3
2001	883	578	1,461	123	13.9	99	17.1	222	15.2
2002	897	698	1,595	87	9.7	88	12.6	175	11.0
2003	822	750	1,572	115	14.0	155	20.7	270	17.2
2004	634	656	1,290	113	17.8	102	15.6	215	16.7
2005	480	722	1,202	68	14.2	78	10.8	246	12.2
2006	708	664	1,346	17	2.4	11	1.7	28	2.1
2007	502	586	1,088	17	3.4	21	3.6	38	3.5
2008	663	500	1,163	18	2.7	13	2.6	31	2.7
2009	429	412	841	9	2.1	20	4.9	29	3.5
2010	430	450	880	14	3.3	16	3.6	30	3.4
2011	395	389	784	12	3	13	3.3	25	3.2
2012	404	397	801	14	3.5	21	5.3	35	4.4
2013	348	418	766	7	2.0	21	5.0	28	3.7

2014	553	458	1,011	9	1.6	14	3.1	23	2.3
2015	646	643	1,289	44	6.8	63	9.8	107	8.3
Average	639	598	1,237	39	5.73	44	6.92	83	6.26

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

Projected incidental take levels for CHS are presented in Tables 2.2.3-2 and 2.2.3-3. Take levels were estimated independently for the hatchery and natural-origin components of the ESU. Incidental take attributable to some hatchery operations (e.g., juvenile releases) and related RM&E programs are not quantifiable at this time. As part of the RM&E program, monitoring and evaluation activities will be conducted to provide information on incidental take levels associated with hatchery operations, and will result in task-specific take estimates. Generated take estimates should be reviewed annually as part of baseline 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 Foster Fish Facility and handling of broodstock.

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

Location of hatchery activity: Foster Trap Dates of activity: May - September Hatchery program operator: ODFW

	Annual Take of Listed Fish *(Number of Fish)*	
Type of Take	**Hatchery-Origin**	**Natural Origin**
Capture, handle, and release[1]	3,500	1,000
Removal (e.g., broodstock)[2]	800-900	0-90
Unintentional lethal take[3]	<10 %	<5%

[1] Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream. Estimate only due to Foster Facility upgrades and operational changes.
[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.
[3]Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or for integrated programs, mortalities during incubation and rearing.

(d) 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 plan for natural-origin CHS adults collected at the Foster Facility, except those incorporated into the broodstock, is to outplant them to Foster Reservoir and/or upper mainstem South Santiam River (above Foster Dam) for conservation of the population, consistent with survival and recovery of the ESU. Outplanting of hatchery CHS may also occur above Green Peter Dam in the future. Downstream passage at Green Peter has not

been identified as a priority action in the current BiOp.

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, eggs from both naturally produced and hatchery produced females have been tracked to allow identification and culling of eggs infected with BKD. There is no option but to destroy infected eggs. It is expected that mortality rates for alevins, fry, and presmolts in the hatchery environment will be the same for both hatchery and natural- origin 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) Alignment of the hatchery program with any Evolutionary Significant Unit (ESU)-wide hatchery plan:

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

In August 2011, the Recovery Plan for the UWR Chinook salmon ESU and steelhead DPS, which includes the South Santiam CHS population, was finalized (ODFW and NMFS 2011). The Recovery Plan provides the primary guidance for ESA Section 4 recovery of the UWR CHS ESU, including delisting criteria. It also informs ESA Section 7 analysis of effects and actions to avoid jeopardy and destruction or adverse modification of critical habitat where it informs the best scientific and commercial data available. Chapters 4 and 6 of the plan document the current status of the population across the ESU and report a desired status goal for the population from a recovery perspective, based on interrelations of the populations, limiting factor threats, and recovery potential by subbasin. The population is currently at a very high risk of extinction, and the desired status is to improve it to moderate extinction risk (viable). Chapter 7 of the Recovery Plan identified several management actions to achieve the desired population status, again from a recovery standpoint. For details, see http://www.dfw.state.or.us/fish/CRP/upper_willamette_river_plan.asp

Willamette Valley 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 Willamette Project, including the Hatchery Mitigation Program and operation of USACE's 13 Willamette Project dams (NMFS 2008). NMFS concluded that the proposed action (PA) was likely to jeopardize the continued existence of the listed spring Chinook salmon ESU and winter steelhead DPS, and adversely modifies and/or destroys designated critical habitat for those species. NMFS therefore provided a 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. RPA measures 1.1 to 1.4 of the BiOp describe WATER, the

interagency coordination and adaptive management forum that will be used to implement actions prescribed in the BiOp. Section 2.10 of the BiOp describes the proposed action with regard to fish hatcheries and related programs. 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 Section 1.6.2 of this HGMP.

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 authorized under the ESA. The fisheries are evaluated annually to ensure the effectiveness of the fishery regulations in protecting natural spawning populations. The South Santiam hatchery program is part of this comprehensive plan. The selective fishery was implemented in 2001. The FMEP calls for a comprehensive monitoring and evaluation program assessing the catch of wild 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 wild populations. The measures outlined in the plan are designed to maintain viable populations of CHS in the Willamette Basin.

ODFW Policies

Native Fish Conservation Policy (OAR 635-007-0502 through -0506): The Oregon Fish and Wildlife Commission has approved the NFCP. The NFCP defines ODFW's principle obligation for fish management as the conservation of naturally produced native fish in the geographic areas to which they are indigenous. The policy is based on the concept that locally adapted populations provide the best foundation for maintaining and restoring sustainable naturally produced fish. The NFCP requires a conservation plan for each native stock within each Species Management Unit (SMU). The ODFW has completed an Oregon Native Fish Stock Status Report in 2005. The Recovery Plan finalized in 2011 (ODFW and NMFS 2011) fulfills the requirement of the conservation plan required by the NFCP.

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. This HGMP

incorporates the direction provided for by this policy.

BiOp and Recovery Plan Actions

Table 3.1-1 outlines pertinent BiOp and Recovery Plan goals specific to the South Santiam Hatchery program. Funding for BiOp compliance is derived from USACE annual budgets for the hatchery program. US Army Corps of Engineers' annual funding is subject to congressional approval, and may require obtaining Congressional authority, prior to seeking federal funding, in order to implement. Some actions could also be funded through special budget allocations outside of hatchery program budget, or through other programs such as harvest management, conservation and recovery programs, or research.

Table 3.1-1 BiOp and Recovery Plan actions

Proposed Action (PA)	**Reasonable and Prudent Alternatives (RPA) or Recovery Plan actions**	**Timeframe**
Continue use of the South Santiam (stock 024) spring Chinook salmon.	Recovery Plan 202-SUB-SSA; BiOp RPA 4.1 and 6.2.3 adult Chinook outplanting; 2.8, 4.10-4.12 improved downstream passage, 9.3 RM&E; 6.2.2 genetic diversity: use South Santiam stock to help re-establish production above Foster Dam.	Immediate/ ongoing
Continue collecting all South Santiam spring Chinook salmon broodstock at Foster Fish Collection Facility.	Recovery Plan 189-SUB-SSA; BiOp RPA 4.1, 4.6 facility upgrade, and 6.2.3): use Foster facility upgrade to support outplanting and reintroduction efforts.	Immediate/ ongoing
Continue to collect South Santiam broodstock throughout the run to ensure the hatchery population is similar to the naturally spawning population.	Recovery Plan 202-SUB-SSA; BiOp RPA 4.1 and 6.2.3 adult Chinook outplanting, 6.2.2 genetic diversity, and 9.5.1 Chinook RM&E: It will be important to maintain similarities between the hatchery and wild population in the near term. As the natural segment of the population increases and pHOS reduced, it will become less important to maintain characteristics similar to the wild population as the influence of hatchery CHS on the natural population is minimized.	Immediate/ ongoing

Proposed Action (PA)	Reasonable and Prudent Alternatives (RPA) or Recovery Plan actions	Timeframe
Broodstock integration levels averaging approximately 5-10% will be used to maintain heterozygosity of the hatchery stock, reduce domestication risks, avoid genetic drift, and meet mitigation responsibilities and conservation supplementation goals.	Recovery Plan 202-SUB-SSA; BiOp RPA 6.2.2 and 9.5.1: 1) Integration is only needed to meet conservation and reintroduction goals to support outplanting/ reintroduction above Foster Dam, and potentially above Green Peter Dam. 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 750 fish is met, and - if integration has not happened within a multi-year period (e.g., >5 yrs), allow a 10% integration of natural-origin fish at the 5 year mark if the annual evaluation determines no conservation impacts. 3) Conduct scientific review and continue ongoing monitoring of current UWR hatchery programs maintain conservation (reintroduction) attributes of the hatchery program or suite of strategies that promotes and maintains a locally adapted population in the short term (until other LFT conditions are improved), and how to be consistent with VSP attributes and recovery goals. Fund and implement conservation and outplanting programs that maintain genetic diversity of local broodstock and manage the composition of natural spawners to meet ESA conservation goals, consistent with survival and recovery of the ESU; monitor and evaluate implementation of actions through the end of the ESA take coverage period.	Immediate/ ongoing
Continue to use random spawning protocol with a 1:1 male-to-female ratio for South Santiam spring Chinook salmon.	Protocol as noted	Immediate/ ongoing
Continue to adipose fin-clip and otolith mark (as needed) all South Santiam spring Chinook salmon at South Santiam Hatchery.	Recovery Plan 29-ESU-ADM; BiOp RPA 6.1.3: needed implement harvest management program, assess pHOS trends, and for eventual reintroduction of natural-origin only fish.	Immediate/ ongoing

Proposed Action (PA)	Reasonable and Prudent Alternatives (RPA) or Recovery Plan actions	Timeframe
Insert coded wire tags (CWTs) or other tagging as needed into juvenile hatchery fish from South Santiam Hatchery in addition to the current practice of adipose fin-clipping and otolith marking.	Recovery Plan 30-ESU-ADM, 29-ESU-ADM; RPA 6.1.3: Continue to mark all hatchery fish releases in the Willamette Basin with an adipose fin-clip and otolith mark; ensure CWTs (or blank tags if appropriate) or PIT tags are inserted a proportion of all hatchery spring Chinook salmon released to confirm origin and support RM&E needs.	Immediate/ ongoing
Operate and maintain the South Santiam Hatchery.	Recovery Plan 29-ESU-ADM; BiOp RPA 6.1.2, 6.2.2, and 9.1.5	Immediate/ ongoing
Rebuild, operate and maintain the Foster Fish Collection Facility.	BiOp RPA 4.6: Rebuild and use upgraded Foster facility to support outplanting and reintroduction efforts for natural-origin CHS above Foster Dam (and potentially Green Peter dam).	Immediate/ ongoing; construction completion Dec. 2013; began operation Mar. 2014
Resolve hatchery infrastructure maintenance needs and develop a long-term Hatchery Maintenance Plan for Foster Fish Collection Facility and South Santiam Hatchery.	BiOp RPA 4.6, 6.1.2: 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.	

Proposed Action (PA)	Reasonable and Prudent Alternatives (RPA) or Recovery Plan actions	Timeframe
Continue the spring Chinook salmon Reintroduction/Outplant Program and evaluate long-term feasibility of establishing viable populations in existing habitat in the South Santiam above Foster Dam, and potentially above Green Peter Dam.	Recovery Plan 183-SUB-SSA, 184-SUB-SSA, 190-SUB-SSA, 191-SUB-SSA; BiOp RPA 4.1, 4.2, 4.7, 4.8, 4.10, 4.11, 4.12, 4.13, 6.2.2, 6.2.3, 9.3 and 9.5.1: adapted from Appendix E of Plan 1) To maintain current natural production, natural-origin CHS and winter steelhead captured at Foster Fish Collection Facility will be outplanted above Foster Dam; e.g. Foster Reservoir and/or upper mainstem South Santiam River. In the future, similar adult outplanting may also occur above Green Peter Dam, if and when downstream passage survival is improved. 2) The approach for using HMP fish to re-establish runs above the dams is to continue to outplant primarily adult Chinook salmon into the vacant habitats above the dam(s) to supplement populations as passage is implemented per the Willamette BiOp. Unclipped adults are currently passed at Foster Dam; however additional information is needed to assess downstream passage effectiveness and origin of passed fish. Adequate numbers of hatchery fish that are surplus to broodstock needs are typically available in most years to provide enough fish to "augment" natural production above the dams if needed under proposed production levels. A phased-in reintroduction strategy is in development. In the interim, these outplanted HMP fish can also 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 and natural-origin production increases, natural-origin CHS will be the only Chinook salmon passed above the dams. Ongoing genetic pedigree analysis of CHS returning to Foster Dam will continue to provide information on the production of salmon above Foster Dam (see below). Further details on these reintroduction efforts using the hatchery program are being discussed and formalized by the fish co-managers in coordination with the Corps and BPA, and with input from the WATER Hatchery Management Team.	Immediate/ ongoing

Proposed Action (PA)	Reasonable and Prudent Alternatives (RPA) or Recovery Plan actions	Timeframe
	3) BiOp RPA 9.3, 9.5.1: Genetically assess (e.g. adult pedigree analysis) origin of natural-origin CHS returning to Foster. Transport those originating from above Foster Dam back upstream above Foster Dam.	
Collect, hold, transport, and release outplanted fish in a manner that increases the likelihood for spawning success.	Recovery Plan 189-SUB-SSA; BiOp RPA 4.1, 4.3, 4.4., 4.5, 4.7, 6.1.2: Implement best management practices for optimal handling, sorting, and release to support successful research, monitoring, evaluation, and reintroduction. Protocols will be documented in the annual Willamette Fish Operations Plan.	Immediate/ ongoing
	Work with USFS, Services (NMFS and USFWS), ODFW, and Action Agencies to prioritize, design and construct each release site, which may include infrastructure to minimize stress and injury of adults.	Construction to be completed June 2012
Ensure that outplanted fish represent the life history characteristics of the natural population and promote successful production.		Immediate/ ongoing
Develop and carry out a thorough RM&E program to monitor the progress of the reintroduction/outplant program.		Immediate/ ongoing
Investigate options for acclimating all smolts at the South Santiam Hatchery.		Immediate/ ongoing

Proposed Action (PA)	Reasonable and Prudent Alternatives (RPA) or Recovery Plan actions	Timeframe
Develop a strategy for reducing the incidence of hatchery strays on spawning grounds.	Recovery Plan 202-SUB-SSA; BiOp RPA measures 2.8, 4.1, 4.2, 4.10, 4.11, 9.3: Manage current CHS Harvest Mitigation Hatchery Program (HMP) facilities and broodstock to meet mitigation responsibilities, 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 Foster Dam, and potentially above Green Peter Dam. Reducing pHOS below Foster Dam has not been identified by NMFS as a priority action in the near-term. Decisions regarding changes in the hatchery management program and management of spring Chinook above and below Foster Dam will be made as actions listed below are implemented. The WATER parties will evaluate success using the concepts of viable and critical salmonid population targets, consistent with VSP concepts, such as abundance, productivity, and diversity. In the Recovery Plan, the pHOS target to achieve recovery is <30% for the South Santiam CHS natural population. The target pHOS above Foster is 0% while the area below Foster has a target pHOS of <80%. 1) Work to complete a fish weir below Foster Dam (scheduled to be operational by 2020) with the goal of improving downstream passage. 2) Evaluate additional measures such as 100% CWT to assist with reducing pHOS above Foster Dam through improved identification and selective passage of natural origin adults above Foster Dam into the South Santiam. 3) Continue to implement spill at Foster Dam under RPA measure 2.8 to pass juveniles. Continue adult outplanting above Foster Dam, and potentially above Green Peter Dam, to restore access to lost habitat and increase natural production.	Ongoing

Proposed Action (PA)	Reasonable and Prudent Alternatives (RPA) or Recovery Plan actions	Timeframe
	4) Implement actions and associated RM&E below the Foster facility that will reduce genetic and demographic risk to extant natural-origin population: - improving trap attraction, operation, and sorting at new Foster facility - modifying acclimation, release and/or rearing strategies - encouraging greater harvest of hatchery fish - maintain HOR tagging efforts and CHS spawning surveys to support above efforts - 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. 5) Increase natural-origin production below Foster through WP BiOp RPA water quality/quantity improvements, and other actions addressing LFT's. Further develop a conservation supplementation (reintroduction) program (CSP) or set of strategies to be implemented above Foster and Green dams. 6) Develop a strategy to further reduce pHOS levels below Foster. Actions could include improving homing and attraction to Foster Facility and improved harvest of HOR fish above Lebanon Dam. 7) The 2012 Cooperative Agreement between USACE and ODFW allows for adjustments to the mitigation program to account for improved fish passage at Foster and Green Peter Dams and to meet ESA conservation goals. Assess opportunities to adjust production levels based on crediting for restored sustainable natural production above Foster Dam and to reduce pHOS while maintaining conservation and reintroduction goals.	

3.2) Existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates:

1) 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).

   South Santiam Hatchery is one of several hatcheries funded by the USACE to mitigate for the loss of natural spawning, feeding, and rearing grounds for fish, and fisheries impacts caused by construction of multi-purpose dams and reservoirs in the Willamette Valley. The Cooperative Agreement identifies maximum production levels to ensure consistency with mitigation responsibility and that funding levels are appropriate. The Cooperative Agreement directs ODFW and USACE to meet annually to review and adjust (as appropriate) mitigation production levels. Adjustments will be made in order to: reduce and minimize effects on ESA listed fish; meet mitigation program responsibilities, adjusted to account for fish passage improvements, and comply with ESA; and, support ESA listed fish reintroduction efforts above WVP dams. The Cooperative Agreement also provides for evaluation of the hatchery program through USACE-funded RM&E. Note: incidental take associated with the Willamette spring Chinook salmon hatcheries is covered by the 2008 Opinion and Incidental Take Statement. Approval of this HGMP will provide updated ESA coverage for the program.

3.3) Relationship to harvest objectives:

3.3.1) Fisheries benefiting from the program:

Spring Chinook salmon 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 in the South Santiam in 2001. The fisheries target fin-marked hatchery fish only. Willamette CHS management is based on the Mainstem Willamette Subbasin Plan (Rien et al. 1992) 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 former 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 (1982-1993). In 2012, the South Santiam Hatchery program along with other Willamette Basin hatcheries contributed to a total commercial and sport harvest of over 21,000 CHS below Willamette Falls including over 17,000 in the lower Willamette

River. In 2011, hatchery spring Chinook production from the Upper Willamette basin supported harvest of over 27,000 in the lower Willamette and Columbia Rivers in 2011 (FMEP 2012). Approximately 7,500 adults were harvested in UWR sport fisheries. Current fish management plans target an average annual catch of 3,000 CHS in the Santiam basin, with 1,600 of those produced by the South Santiam Hatchery program. Historic harvest rates of Upper Willamette CHS have ranged from 30 to 50 percent. Under the current fishery management plan, the sport fishery harvest impact on wild South Santiam CHS is expected to be 10.5 percent. This is about one-fifth the average harvest rate from 1981-1997, 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 product is limited in order 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 percent exploitation rate will achieve this goal even under the most pessimistic assumptions.

The South Santiam Spring Chinook is 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 South 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 South Santiam (RPA 6.2; 6.2.1 and 6.2.2), and (2) outplanting of adult Chinook above Foster (RPA 6.2.3).

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 were not included under the umbrella of the Willamette BiOp – the SAFE program is thus part of a separate consultation. The effects of ODFW’s SAFE program activities – including collection of a given number of adults for broodstock at the Foster Adult Collection Facility, will be considered by NMFS in the SAFE HGMP ESA 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 and recovery planning efforts in the basin (e.g. adult outplanting/reintroduction, juvenile releases above Foster Dam and potentially above Green Peter Dam). Downstream passage at Green Peter has not been identified as a priority action in the current BiOp.

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. These include loss of habitat access, decreased habitat quality, streambed coarsening due to reduced peak flows, impaired habitat complexity/diversity including loss of off-channel habitat, decreased water quality, increased predation, and loss of population traits.

3.5) Ecological interactions:

Releases of hatchery CHS could potentially increase competition for food 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 as minimal threats when compared with other limiting factor threats in the South Santiam River subbasin and mainstem Willamette in the Recovery Plan and do not rank as either primary or secondary threats; however, information available to quantify interactions is limited.

One potential negative effect of hatchery fish spawning in the natural environment may be on productivity and long-term fitness of naturally spawning populations (HSRG 2007). The current research related to fitness effects of hatchery CHS on natural-origin CHS is mixed and information specific to the South Santiam is lacking. However, recent research funded by USACE indicates that productivity of hatchery spring Chinook salmon passed above Cougar Dam is similar to natural-origin adults passed above the dam; though higher productivity by hatchery females (relative to natural-origin females) contrasted with lower productivity by hatchery males (relative to natural-origin males) (Banks et al. 2013). It should be noted that this similarity does not address the range of issues associated with hatchery-wild fish interactions or preclude the need to achieve population viability or natural-origin CHS. It does suggest reduced risk of outplanting of hatchery adults (i.e. unclipped thermally-marked fish) to support conservation and reintroduction, and comingling of hatchery and natural-origin adults in the short-term while population limiting factors are addressed.

Ecological interactions above Foster Dam are being minimized through implementation of split basin management. As recommended in the recovery plan, areas above Green Peter and Foster Dams will be managed for natural production in historic habitats. Management of Chinook populations above and below Foster Dam will be re-evaluated pending the improvement of a fish weir meant to improve downstream juvenile passage at Foster Dam. Such re-evaluation and decision-making will utilize the concepts of viable and critical salmonid population targets, consistent with VSP concepts, such as

abundance, productivity, and diversity. The Foster Fish weir is scheduled to be improved and operational in 2020. At this time, approximately 65% of the natural origin spawning population occurs above Foster Dam (C. Sharpe, personal communication), while the remaining ~35% of natural origin Chinook spawn below the dam. Ongoing monitoring of the program and implementation of the Willamette BiOp will be used to monitor the South Santiam 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 is needed to facilitate and expedite outmigration of hatchery and natural origin smolts. There are multiple RPA's related to flow management including RPA 2.4.2, 2.4.3, 2.4.4, and 2.7. Environmental flows or pulse releases outlined in RPA 2.7 should be implemented in combination with periods of outmigration. Flow and ramping rate studies (RPA 2.10) are identified as a high priority however have received little attention when related to reservoir and dam passage, informing instream flow needs, and support outmigration.

SECTION 4. WATER SOURCE

4.1) Water source, water quality profile, and water-driven limitations to production:

South Santiam Hatchery's main water source for incubation, rearing and adult holding is Foster Reservoir. There are two water intake pipes, one located at an elevation of 630 ft and the other at an elevation of 576 ft in the dam structure. The low pool level commonly maintained from November through May is near an elevation of 596 ft. Water temperature from the upper intake can reach 70°F during summer. Water temperature from the lower intake rarely exceeds 50°F. Mixing of these two water intakes is possible and commonly done from late May through October. These intakes do not meet NMFS' screening criteria. A secondary, small water source is a well that is commonly used for summer steelhead egg incubation from December through April.

The main water source (Foster Reservoir) is excellent rearing water for most of the year. However, during fall and winter months, upstream freshets can result in elevated turbidity. Improved forest management practices in the upper basin have reduced turbidity levels. With the water quality improvements, if adequate rearing space was provided, South Santiam Hatchery could incubate and rear their entire production. Rearing water quantity is limited to approximately 19 cubic ft. per second (cfs) due to the size of the pipeline and available head. All reservoir rearing and incubation water passes through an aeration/screening tower that reduces the head from the reservoir intakes. At the facility's current production levels, all available water sources are being used.

There are a variety of disease agents currently present in the water supply of the hatchery and a risk of infecting the hatchery production at any time. Should the need arise to rear fish from egg to smolt at South Santiam Hatchery, it will be necessary to provide more rearing space, additional water volume, and a dependable, pathogen-free water supply for early rearing.

4.2) Measures to minimize take associated with hatchery water withdrawal, screening,

or effluent discharge:

A plan has been developed to bring intake screens into compliance with National Oceanic and Atmospheric Administration standards, but to date, no funding has been available. All effluent from the hatchery is released directly into the South Santiam River at three different locations. Because South Santiam Hatchery does not have an effluent settlement pond, current practices restrict the number of ponds to be cleaned at a given time in order to comply with the National Pollutant Discharge Elimination System (NPDES) permits.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities:

All returning adults are collected at the Foster Fish Collection Facility, located at the base of Foster Dam. The new facility consists of a 10-ft x 80-ft pre-sort pool, fish sorting area, five 10-ft x 80-ft long term holding ponds and four 10-ft x 25-ft short term holding ponds. All returning adults will utilize the existing fish ladder entrances at the base of Foster Dam. Attraction water at the ladder entrances will be provided year round via 4 auxiliary water supply (AWS) pumps. Gates will be available at both entrances to control densities during peak times of the run. Once adults enter the fish ladder they will continue up the existing fish ladder until pool 17 where it intersects with the new transport channel and ladder that will take them into the new pre-sort pool.

The pre-sort pool will have a mechanical sweep to crowd the fish towards the upper end of the trap. Once there, attraction water pumped over a false weir will cause the fish to enter the flume. After entering the flume, an operator may use switch gates to divert them into two of the short-term pools without handling or send them directly to the anesthetic tank. Aqui-S has been approved for use as an anesthetic for fish intended for food when used at a facility like the Foster Trap.

From the anesthetic tank, fish will be manually placed into loading tubes which will transport them to either the long or the short-term ponds. Four of the five long-term ponds will be used for holding brood with the last one set aside for possible long-term holding for outplants. Fish placed into the short-term ponds will be mechanically crowded into a common channel that will connect to the ends of both the long term and short-term ponds. A mechanical crowder will then move the fish to either the fish loading hopper for water to water transfer to a liberation truck, or crowded the opposite direction into a mechanical fish lock which will transfer the fish back into the anesthetic tank in the sorting building. Fish held in the long-term ponds will have the same options once crowded into the crowding channel.

5.2) Fish transportation equipment:

The Foster Facility will have a 1500-gallon tanker truck. An existing 1200-gallon tanker truck will remain at the facility. Fish will be loaded using the loading bell.

5.3) Broodstock holding and spawning facilities:

All spawning will take place at the Foster Fish Collection Facility. The long-term ponds (10-ft x 80-ft; 6' water depth) are designed to hold brood. The ponds are designed for a flow of 1500 gpm. The fish sorting area is 30-ft x 60-ft and provides an overhead cover. Brood fish will be mechanically crowded from the long-term ponds into the transport channel then down to the fish lock located at the base of the fish sorting area. They will then be lifted via mechanical brail into the fish sorting area and onto a stainless steel chute leading to the anesthetic tank. Once anesthetized they will be sorted for ripeness, then fish are either humanely killed or returned to the holding pond. Fish killed for spawning are placed on a rack and bled before spawning takes place.

5.4) Incubation facilities:

The incubation room is approximately 18-ft by 24-ft and contains 30 16-tray vertical incubators and two six-foot fiberglass picking troughs. All incubators and both troughs are plumbed with reservoir and well water. A 58-degree well water is available to mix with reservoir water for accelerating egg growth (but is currently used only for summer steelhead). A chemical treatment system is also plumbed to each incubator. Water from the incubation room is discharged directly into the South Santiam River. All incubators are equipped with low water alarms. Spring Chinook salmon eggs are incubated at the South Santiam Hatchery from the initial egg take through the "eyed" stage. A capacity of 3.8 million CHS eggs is available, but up to 2 million eggs are typically incubated annually. Some eyed eggs are shipped to the Willamette Hatchery to complete incubation. In addition, a small portion of approximately 15,000 eggs are distributed to the STEP program and reared in classrooms until they are released as unfed fry within the Willamette River basin.

5.5) Rearing facilities:

Some South Santiam eggs are incubated at the Willamette Hatchery from the eyed stage through hatching and reared through button-up of the alevin stage; the remainder are incubated and reared at South Santiam Hatchery. The Willamette Hatchery has 40 20-ft x 80-ft x 3-ft raceways, 10 20-ft x 100-ft x 6-ft raceways, 4 20-ft circulars, 13 Canadian style starter troughs, and 2 show ponds.

A portion of the fingerlings are transferred back to the South Santiam Hatchery for completion of the juvenile rearing phase. Rearing facilities at the South Santiam Hatchery consist of ten 17-ft x 75-ft x 4-ft Burrows raceways and four 21-ft x 75-ft x 4-ft Burrows raceways. A middle walkway provides access for feeding and other tasks. Water is supplied at both ends of each raceway via 4-inch valves. All water is discharged directly to the South Santiam River. Rearing stages range from fingerlings at 300 fish per pound through smolt at 8 fish per pound.

5.6) Acclimation/release facilities:

Approximately 600,000 fish are transferred to the South Santiam Hatchery for late rearing. Smolts are volitionally released in November and March to the South Santiam River via a 24-inch diameter pipe from the rearing pond. One final group of 153,000 fish are transferred from Willamette Hatchery to South Santiam Hatchery in February and acclimated for three weeks prior to their release in March.

With the completion of the Foster Fish Facility, an Adult Holding Pond (AHP) at the hatchery was converted into a rearing pond with bird netting, juvenile screens, and a header pipe to replace the up-well.

Unfed fry from the STEP program are directly released.

5.7) Operational difficulties or disasters:

None.

5.8) Back-up systems and risk aversion measures to minimize the take of listed natural fish:

The hatchery is staffed full-time with someone on call 24 hours a day and is equipped with low-water alarm systems on incubators and ponds to help prevent catastrophic fish loss resulting from water system failure.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

6.1) Source:

Broodstock for the South Santiam River spring Chinook salmon program is collected from adult Chinook salmon returning to South Santiam Hatchery, near Foster Dam. Hatchery fish returning to the collection facility are mixed and randomly selected for spawning. Natural-origin fish are also taken into the broodstock when specific incorporation criteria are met.

6.2) Supporting information:

6.2.1) History:

Broodstock for the South Santiam stock 024 was initiated by collecting wild adults that returned to the base of Foster dam. In some years, Willamette stock Chinook salmon have apparently supplemented broodstock collected at the Foster Trap, but review of hatchery records since 1982 did not document any transfers (B. Nyara, ODFW, personal communication, 2007). Since at least 1990, broodstock has been derived entirely from

Chinook salmon collected at the Foster Trap. Refer to Table 6.2.1-1 for details regarding adults collected and spawned.

Table 6.2.1-1. Adult spring Chinook salmon returns to Foster Dam, and fish used for broodstock, 1994-2012. For 2003-2012, 1:1 spawning ratios were achieved via the inclusion of jacks.

Brood Year	Adults Counted at Foster Dam	Adults Spawned			Egg Take (in 1,000s)	Egg Transfers (in 1,000s)	Fry Ponded	Other Stock Transfers (in 1,000s)
		# Males[1]	# Females	Spawning Ratio (M:F)				
1994	2,013	725	725	1.0	3,079	2,917	0	0
1995	2,136	646	646	1.0	2,881	2,420	55	0
1996	2,395	520	634	0.82	3,378	2,184	0	0
1997	1,883	502	523	0.96	2,461	1,444	0	0
1998	3,891	452	465	0.97	2,011	1,379	0	0
1999	5,200	516	521	0.99	2,112	1,280	0	0
2000	3,948	527	543	0.97	2,444	1,275	0	0
2001	5,522	520	572	0.91	2,462	1,838	0	0
2002	6,939	603	603	1.0	2,545	1,277	0	695[2/]
2003	6,203	528	548	0.96	2,348	1,366	0	320[2/]
2004	10,604	483	506	0.95	2,164	1,351	0	632[2/]
2005	3,792	452	547	0.83	2,307	1,353	0	130[2/]
2006	3,650	570	570	1.0	2,443	1,501	0	20[2/]
2007	1,385	436	449	0.97	2,000	1,417	0	249[2/]
2008	1,535	394	400	0.99	1,686	1,396	0	13[2/]
2009	2594	354(13J)	367	1	1507	1306	0	12[2]
2010	8800	340(14J)	354	1	1599	1206	0	314[2]
2011	8684	338(10J)	348	1	1699	1300	0	13[2]
2012	8138	337(5J)	342	1	1610	1320	0	92[2]

[1/] Prior to 1993, the number of males spawned was not recorded.
[2/] 2002 – 695,000 eyed eggs to CEDC; 2003 – 103,800 to STEP, and 217,100 to CEDC; 2004 – 188,000 to STEP, and 444,073 to CEDC; 2005 – 129,700 to STEP; 2006 – 20,000 to STEP; 2007 – 16,650 to STEP and 232,000 to Gnat Creek; 2008 – 12,800 to STEP; 2009 – 12,000 to STEP; 2010 – 13,000 to STEP and 301,000 to Select Area Fisheries Enhancement Areas (SAFE); 2011 – 13,000 to STEP; 2012 – 20,000 to STEP and 72,000 to SAFE.

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 of mark fish. To satisfy the current smolt production goal of 1,021,000 smolts, the total annual broodstock collection goal of 717 adults, of which 269 are females spawned.

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

Until 1996, not all hatchery reared CHS were marked with an adipose fin clip; therefore, an unknown proportion of naturally produced fish may have been incorporated into the brood. Since 1996, all hatchery-reared juveniles have been adipose fin clipped, and approximately 140,000 are coded-wire tagged annually. The proportion of natural-origin fish that been incorporated has ranged from 2.1 to 33.5 percent of brood (Table 6.2.3-1). The current goal is to integrate natural-origin adults at an average rate of 5-10% in years when the wild run is predicted to exceed 750 adults.

The broodstock integration goal is to integrate natural-origin adults at an average rate of 5 to 10% to maintain heterozygosity of the hatchery broodstock, minimize genetic drift, and limit the impact of take on natural-origin spring Chinook each year. The level of integration was determined, through genetic modeling, to adequately maintain heterozygosity and allelic richness in the wild and hatchery spring Chinook populations of the South Santiam River (Johnson and Friesen 2012). ODFW will incorporate wild South Santiam CHS into the broodstock in years that the expected run of wild adult CHS into the South Santiam is greater than 750 fish. Passage counts at Willamette and Foster Dams will be used to project run strength. This practice will serve to reduce potential genetic impacts from unmarked hatchery fish that would otherwise spawn in the wild. In years when less than 750 natural-origin Chinook are expected, all unmarked fish that enter the facility will be released above Foster Dam. During small run years (<750 natural-origin adults), the demographic risks to the wild population from integration would be greater than genetic risks posed by unmarked hatchery fish released to the river.

Table 6.2.3-1. Composition of spring Chinook salmon without fin clips that were spawned at the South Santiam Hatchery, based on the presence or absence of thermal marks in otoliths, 2002–2012. Source: Kenaston et al. 2009; Cannon et al. 2012.

Year	Unclipped[a]		Fin-clipped	Percent wild—	
	Wild	Hatchery	hatchery	in broodstock	of run
2002	26	19	1,174	2.1	2.3
2003	25	23	1,048	2.3	3.6
2004	78	16	905	7.8	3.9
2005[b]	71	19	999	6.5	5.3
2006[c]	137	46	957	12.0	28.9
2007[d]	89	13	783	10.1	22.6

2008[e]	268	16	516	33.5	36.7
2009	2	4	734	0.3	0.2
2010	0	0	708	0	0
2011	0	0	696	0	0
2012	0	0	679	0	0
2013	0	0	688	0	0

[a] Includes fish with partial or questionable fin clips.
[b] Otoliths were analyzed for 63 fish at South Santiam Hatchery (of which 50 were wild).
[c] Otoliths were analyzed for 152 fish at South Santiam Hatchery (of which 114 were wild).
[d] Otoliths were analyzed for 97 fish at South Santiam Hatchery (of which 85 were wild).
[e] Otoliths were analyzed for 294 fish at South Santiam Hatchery (of which 277 were wild.

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 South 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 > 750 fish ; and if
- Integration has not happened within a multi-year period (e.g., >5 yrs), allow a 5-10% of natural-origin run at the 5 year mark if the annual evaluation determines no conservation impacts

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 (2012) found no significant genetic difference between hatchery and wild spring Chinook sampled in 2011 from the South Santiam River (H_0: $\theta < 0.000$; $p > 0.05$), though observed heterozygosity was found to be higher in the hatchery population (81%) than in the wild population (75%). Johnson and Friesen (2012) also found no evidence for positive selection on four immune-relevant loci (Tonteri et al. 2008), as allele frequencies at these markers were very similar for the South Santiam hatchery and wild spring Chinook populations.

Genetic similarity between the South Santiam hatchery and wild spring Chinook 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 regularly integrated into the hatchery brood stock and; 3) a proportion of hatchery-origin fish spawn in the wild.

However, 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 ecological differences between hatchery and wild South Santiam River spring Chinook have been reported. Using data from scale collected in 2002 and 2003, Schroeder & Kenaston (2004) found that most wild adult Chinook in the South Santiam River appeared to have outmigrated to saltwater as age-0 juveniles (80% in 2002; 91% in 2003). This juvenile life history appeared to be much less common in other subbasins and differs from that of South Santiam hatchery Chinook, which are liberated as age-1 smolts. The authors hypothesized that wild spring Chinook in the South Santiam had experienced genetic introgression from introduced fall Chinook, which typically outmigrate as age-0 smolts.

6.2.5) Reasons for choosing:

South Santiam River CHS 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.

6.3) Risk aversion measures to minimize adverse effects to listed natural fish due to broodstock selection practices:

The use of South 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 of broodstock needs may be outplanted in efforts to evaluate the potential for natural production upstream of Foster and Green Peter dams. Natural-origin adults are outplanted above Foster Dam or released back to the river downstream of Foster Dam to provide an opportunity for natural spawning. Natural origin adults are also incorporated into the broodstock as outlined in Section 6.2.3.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life stage to be collected:

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

7.2) Collection or sampling design:

Adults returning to the trap at Foster Dam (and used for broodstock purposes) are collected throughout the run (late April through early October). Once escapement targets have been met, 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 the Foster Facility that are used to support passage research and conservation will be outplanted in accordance with Section 15, the CHS outplanting protocols addendum. NMFS and ODFW will continue to work with input from WATER to complete a reintroduction plan for CHS in the South Santiam.

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 South Santiam River basin.

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

Currently, the goal is for all CHS to be externally marked with an adipose fin clip and thermally marked with an otolith marker. The fish at South Santiam hatchery are adipose fin-clipped using an automated marking trailer, which is highly effective; nevertheless a small percentage (usually less than 5 percent) are mismarked or the adipose fin regenerates. In the past, a portion of each release group was wire tagged in addition to receiving adipose and otolith marks. The internal wire tags and otolith mark allows verification of hatchery-origin broodstock to compensate for error associated with adipose regeneration in some hatchery-origin fish (Table 6.2.3-1). All three marks allow hatchery-origin fish to be distinguished from naturally spawned fish. When unclipped fish are used as brood, otoliths will be removed at the times of spawning and examined to verify natural origin to permit an estimate of pNOB.

7.4) Proposed number to be collected:

7.4.1) Program goal:

The South Santiam Hatchery goal is to have a spawning population of 538 fish, including 269 males and 269 females, with a 1:1 male-to-female spawning ratio depending upon the run size (IHOT 1994). Between 2003 and 2012, the spawning population ranged from 679 to 1,140 fish (mean 866 fish) with a male to female proportion of 0.83 to 1.0 (mean 0.97, including jacks 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 collected, eggs taken, and juveniles released at South Santiam Hatchery, 1990-2012. (*Note: the number of fish actually spawned is presented in table 6.2.1-1* and the survival different life history stages are presented in tables 9.1.1-1 and 9.2.1-1***.)***

	Adults				
Year	**Females**	**Males**	**Jacks**	**Eggs**	**Juveniles[1/]**
1990	1,009	844	0	3,953,000	941,092
1991	887	511	5	3,734,810	1,161,971
1992	559	514	44	2,513,686	1,274,967
1993	456	456	50	1,816,740	1,275,214
1994	855	966	7	3,079,298	970,271
1995	649	930	41	2,480,575	1,155,193
1996	625	742	24	2,855,426	918,914
1997	500	755	41	2,375,257	1,241,418
1998	513	589	18	2,031,065	983,914
1999	584	742	9	2,112,000	1,015,180
2000	613	769	56	2,288,000	1,013,147
2001	578	883	81	2,462,000	1,017,524
2002	698	897	37	2,545,000	1,037,421
2003	750	822	36	2,348,000	1,026,350
2004	656	634	18	2,163,543	1,017,446
2005	722	480	64	2,307,600	902,937
2006	706	664	13	2,442,960	960,128
2007	502	586	39	2,000,750	1,048,026
2008	669	866	48	1,686,300	1,079,576
2009	646	539	110	1,507,230	1,071,233
2010	430	450	32	1,598,700	1,040,432
2011	395	389	20	1,698,708	1,037,472
2012	404	397	9	1,610,400	946,913

[1/] Number of juveniles released in South Santiam through March 21, 2012. Releases in some years are below 1.02 million because fish were directly released transported from Willamette Hatchery into the South Santiam.

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

Surplus fish 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. Additional uses of surplus fish beyond broodstock include:

- outplanting above Foster and potentially Green Peter dams to provide nutrient enrichment, support RM&E for passage studies, and to support NOR populations if needed;
- 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). ODFW and NMFS will work on a fish reintroduction plan for the North Santiam with input from WATER.

7.6) Fish transportation and holding methods:

The rebuild of the Foster Adult Fish Facility included an upgrade to the existing fish ladder entrances and the auxiliary water supply (AWS) system. In addition, other features constructed include a pre-sort pool, a sorting area, holding pools with fish crowders, a false weir, an anesthetic tank, recovery tank, four short-term post-sort pools, five long-term post-sort pools, and a fish hopper to load fish into trucks for transportation.

Refer to sections 5.1 and 5.3 for a description of broodstock handling and holding procedures.

See sections 5.2 and 5.3, and Appendix 2 for a description of the transport tanks and

holding containers that are used.

The new Foster facility has been designed for the use of Aqui-SE or CO2. The new facility will provide pond space to retain fish for the buyer/food bank during the 3 day holding period, the fish will then be mechanically crowded back into the fish handling facility and then anesthetized using CO2 before being donated or sold. Currently, during the collection season Aqui-SE is used as CHS are liberated within a recreational fishery. Unmarked fish at the trap are taken out of the Aqui-SE bath as soon as possible after research staff has collected a genetic sample and misc. data.

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).

Fish transport and holding methods will be documented in the annual Willamette Fish Operations Plan (see 2008 BiOP RPA measures 4.3 and 4.4)

7.7) 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 Department needs are met, grade one and grade two CHS carcasses are used to satisfy tribal agreements. Surplus CHS carcasses have not been sold during the interim of 1994-2009; carcasses were sold in 2010-13. Spawned carcasses, or fish killed for CWT recovery, are currently used for stream enrichment in the South Santiam and Calapooia basins. Holding pond mortalities are buried on-site or rendered, or used for stream enrichment.

7.9) Risk aversion measures to minimize adverse effects to listed natural fish due to broodstock collection:

Spring Chinook salmon broodstock collection at the Foster Fish Collection Facility occurs throughout the entire run, from late April through early October. Collection of broodstock is random, with sex ratio and timing representative of the run during trap operation. The new Foster Fish Collection Facility will have enough space to hold adults for outplanting and broodstock collection. It will support water-to-water transport and allow 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 approved outplant locations.

The risk of adverse ecological or genetic effects to listed fish will be minimized by hatchery management practices described in this document, the NMFS 2008 BiOp, the 2011 Recovery Plan, and the FHMP (see Section 3.1). In addition, hatchery practices identified in Section 1.8.2 will be followed. The HMP may be adapted over time to ensure the hatchery program can meet goals for mitigation and ESA conservation, consistent with the survival and recovery of the ESU, as guided by RM&E.

SECTION 8. MATING

8.1) Selection method:

Fish are selected and paired at random in order 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). Only South Santiam CHS stock 024 are used for broodstock.

8.2) Males:

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 (they can navigate among the bars in the holding alleyways). 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. Eggs from two females are placed in each Heath tray separated by a divider. Fertilized eggs are subjected to a 10-minute iodophor bath for disinfection in the Heath trays. Trays and egg batches are individually marked so eggs can be discarded if BKD tests are positive.

If the hatchery reduces the number of eggs retained below the amount of green eggs taken, a proportional amount of each male/female cross is culled so that the gene pool of the brood is representative of the parental stock. Exceptions may occur if there is a high

degree of disease or epidemics associated with certain parents. If this occurs, offspring of diseased parents may be culled in order to maximize long-term survival of the brood.

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

8.4) Cryopreserved gametes:

No cryopreserved gametes are used for the South Santiam River CHS (stock 024) program.

8.5) Risk aversion measures to minimize adverse effects to listed natural fish due to mating:

The South Santiam 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

RM&E identified in Table 1.9-1 recommends performance targets for hatchery rearing and release of hatchery fish. It is anticipated that these benchmarks will be utilized in 2013 and beyond.

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 South Santiam Hatchery/Foster Facility 2003 - 2015, and survival to ponding 2009-2015.

Brood Year	Egg Take	Eyed Eggs to Willamette Hatchery	Eyed egg to pond (survival)	Eggs	
				Culled [a]	Destroyed [b]
2003	2,348,400	1,366,100		508,200	63,000
2004	2,163,543	1,351,200		95,720	0
2005	2,307,600	1,352,800		46,200	726,600
2006	2,360,910	1,501,000		24,744	772,206
2007	2,000,750	1,417,200		40,329	245,671
2008	1,720,000	1,396,300		12,900	236,500
2009	1,507,230	1,305,900	99%	8,430	132,300

2010	1,598,700	1,205,700	97%	21,500	27,700
2011	1,698,708	1,264,000	94%	9,756	392,952
2012	1,610,400	1,320,000	98%	36,000	121,500
2013	1,610,200	1,208,000	99%	4,500	234,150
2014	1,920,200	848,000	98%	27,000	135,000
2015	2,299,500	1,180,000	99%	418,500	189,000
[a] Eggs culled due to BKD.					
[b] BKD negative eggs destroyed.					

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 gpm.

9.1.4) Incubation conditions:

Water flows are monitored by an alarm system. Temperature is monitored daily and is controlled so that temperatures remain below 52°F. Dissolved oxygen levels remain at or near saturation throughout the eyed stage. Silt is not normally a problem; however, water trays can be drained to remove silt if necessary prior to and during the eyed stage.

9.1.5) Ponding:

An average of 1.2 million eggs each year are transferred to Willamette Hatchery at the eyed stage. Fingerlings are transferred back to South Santiam Hatchery beginning in March. No ponding of fry occurs at South Santiam Hatchery.

9.1.6) Fish health maintenance and monitoring:

Fungus control is accomplished by treating all eggs with formalin at 1:600 for 15 minutes, three days per week. Eggs from BKD-positive females are culled prior to the eyed stage. Eggs targeted for STEP are tested for IHNV and eggs with positive results are sent to the Willamette Hatchery. Unfertilized, damaged, and diseased eggs at the eyed stage are removed by electronic egg picker and by hand.

9.1.7) Risk aversion measures to minimize adverse effects to listed fish during

incubation:

The protocols listed above to maintain survival across all stages of incubation are followed for eggs of hatchery and natural-origin fish. Maximum and unbiased survival is the goal for both hatchery and natural-origin stock. Consequently, all eggs are handled in a manner to reduce any adverse effects, including differential survival (as it pertains to selecting for traits), altered water quality etc. Infectious hematopoietic necrosis virus (IHNV) testing of STEP eggs and culling of eggs with BKD ensures minimum transfer of these diseases.

9.2) Rearing:

9.2.1) Survival rate data:

From 1991 through 1995, fingerlings were raised from 300 fish per pound to 15 fish per pound when they were transferred to Clackamas Hatchery in November. From 1996 to present, fingerlings were raised to smolt size at 8 fish per pound for the fall release and 9 fish per pound for the spring releases and included three release groups in November, February, and March. Survival rate data by life stage are provided in Table 9.2.1-1.

Table 9.2.1-1. South Santiam Hatchery spring Chinook salmon percent survival rates by life stage, 1996-2015.

	Life Stage Percent Survival					
Brood Year	**Egg to Eyed Egg**	**Eyed Egg to Fry Ponding**	**Fry to Fingerlings**	**Fingerlings to Smolt**	**Overall (Egg - Smolt)**	**Overall (Fry - Smolt)**
1996	0.966					
1997	0.970					
1998	0.954					
1999	0.965					
2000	0.955					
2001	0.963					
2002	0.957					
2003	0.949					
2004	0.959					
2005	0.966					
2006	0.981					
2007	0.966					

2008	0.960					
2009	0.955	0.989	0.980	0.983	0.910	0.963
2010	0.981	0.974	0.980	0.984	0.921	0.964
2011	0.985	0.935	0.979	0.992	0.894	0.971
2012	0.977	0.983	0.989	0.993	0.943	0.982
2013		0.990	0.982	0.996		
2014		0.983	0.964	0.984		
2015		0.990				
MEAN	0.965	0.978	0.979	0.989	0.917	0.970

9.2.2) Density and loading criteria:

Rearing density objectives of under 8 lbs of fish/gpm and under 2 lbs of fish/ft^3 rearing volume have been met for the last 10 years.

9.2.3) Fish rearing conditions:

A standard maximum of 600 gpm per rearing pond throughout the rearing period enables density goals to be met. Water temperatures are monitored constantly using a thermograph. Since 2006 water temps have been maintained below 52°F which has eliminated the presence of furunculosis in the yearling fish. Minimum dissolved oxygen objectives are 5 parts per million (ppm) in the pond effluent.

9.2.4) Biweekly or monthly fish growth information:

Fish growth is determined and monitored by sampling approximately 200 fish per pond on a biweekly basis (i.e. once every two weeks) as fish grow from approximately 300 fish per pound through approximately 50 fish per pound. The frequency of sampling is then reduced to a monthly basis as fish grow from approximately 50 fish per pound through the target release size of 8 fish per pound. Lengths and weights of individual fish are rarely measured and consequently condition factor statistics are rarely estimated. The program assumes that fish have an adequate condition factor when they meet the target size at release. Target growth rates are provided in Table 9.2.4-1.

9.2.5) Monthly fish growth rate:

See Table 9.2.4-1. Energy reserve data is not collected.

9.2.6) Feeding protocol:

Fish food formulated for the rearing of salmonids, which is produced by Pacific Northwest fish food manufacturers, is used during the hatchery propagation phases. These feeds consist of semi-moist or dry pellet diets that are designed to meet the

performance requirements for growth, survival and overall health of the fish. Daily feed scheduling depends on size of fish, water temperature, and release size and time. Feeding levels range from 0.4 to 2.0 percent of body weight per day and total food conversion efficiencies range from 1.0 to 1.3. Food conversions are calculated monthly based on the amount of food fed and the gain calculated using that monthly size sample.

Table 9.2.4-1. Targeted size (fish per pound at the end of the month) for the three release groups of South Santiam spring Chinook salmon.

Month	Nov. Release	Feb. Release	Mar. Release
January			
February			
March			
April	300		
May	190		
June	90		
July	50		
August	25		
September	16		
October	10		
November	8	15	
December	Released	13.5	
January		11	
February		Released	10
March			Released

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

Treatments for pathogens at South Santiam Hatchery vary depending on the life stage of the fish and the disease agent being treated. Green eggs are routinely water hardened in diluted buffered iodophor. Later, flush treatments of formalin (1:600) for 15 minutes are given three to five times per week for fungus prevention. Static treatments of juvenile fish with formalin for controlling external parasites or fungus can also occur. Adult steelhead and CHS are presently held in the same pond prior to spawning and there is potential for disease cross-contamination. The new Foster Facility will provide separate holding ponds for adult steelhead and Chinook salmon. Prevention and minimization treatments of both summer steelhead and CHS adults occur for fungus control with drip treatments of hydrogen peroxide at 100 ppm active ingredient. The CHS adults are given antibiotic injections of erythromycin and OTC also under a veterinary prescription to prevent bacterial infections such as furunculosis and BKD. Juvenile fish are treated for

bacterial infections with OTC, florfenicol or Romet medicated feed according to label, under a veterinary prescription or under an INAD.

9.2.8) Smolt development indices:

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

9.2.9) Use of "natural" rearing methods:

Fish are reared under natural water temperatures. Raceway shade covers were installed in 2010. At this time, no other "natural" rearing methods have been implemented at South Santiam Hatchery.

9.2.10) Risk aversion measures to minimize adverse 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:

Proposed South Santiam juvenile CHS releases are described in Table 1.11.2-1. Aside from the unfed fry releases associated with STEP, all fish released into the mainstem South Santiam River (approximately 1,021,000 juveniles) are reared to a target size of 8 or 9 fish/lb; these smolts are released in November, February, and March.

10.2) Specific locations of proposed releases:

Stream, river, or watercourse:	South Santiam River, 0201200000
Release points:	RM 23.2-37.5
Major watershed:	Santiam River
Basin or Region:	Willamette Basin

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

Spring Chinook salmon hatchery releases since the 1990 brood year are reported in Tables 10.3-1 through 10.3-4.

South Santiam River Subbasin

Table 10.3-1 shows the history of CHS releases into the South Santiam River subbasin,

since the 1990 brood year. Typically, the majority of broodstock production has been released into the South Santiam subbasin. For the past ten years, approximately one third of the South Santiam subbasin releases were made in late-October/early November.

The fall release group is of juvenile age (one-year) and is reared in the hatchery environment for 365-395 days. For brood years 1994 to 1998, the size of the juveniles at the time of release has averaged 8.1 fish/lb (ranging from 7.8 fish/lb. to 8.3 fish/lb). The remaining fish (about two-thirds of annual production) have been released in mid-February/early-March, and most recently in early April. With the exception of the 1990 brood year releases, fish released during late winter have averaged 8.5 fish/lb, have reared in a hatchery for 485 to 555 days, and are a typical age for smoltification. In 1994, sub-yearling CHS were released in July and May.

From 1994 to 1997 (brood years 1992-1995), smolts were released into Thomas Creek and Crabtree Creek, tributaries to the South Santiam River (Table 10.3-1); these releases typically amounted to approximately 2-3 percent of annual production. These fish were released in February at an average size of 9.0 fish/lb.

Out-of-Basin Transfers

Currently, there are no out of basin transfers (besides the small STEP fry releases) from the South Santiam except inter-hatchery transfers for incubation or rearing.

Salmon and Trout Enhancement Program (STEP) Releases

Approximately 8,000 - 10,000 unfed South Santiam CHS fry are released into the Willamette River basin each year as part of the STEP program. Historical release numbers and release locations are provided in Table 10.3-4. Release locations are typically within the Santiam River basin, but also include other Willamette subbasins.

Table 10.3-4. Numbers of unfed fry STEP releases by release location for brood years 1997-2011.

Brood Year	Calapooia R	Mill Cr	Quartz-ville Cr	N Santiam R	S Santiam R (below Foster Dam)	S Santiam R (above Foster Dam)	Willamette R (R-2)	Total
1997				1,104	9,620			15,877
1998	955	2,688		4,600	3,600			17,964
1999	2,870	4,610		2,600	3,950			14,030
2000		900		2,533	2,555			5,988
2001		3,730		5,555	3,330			12,615
2002	2,269	5,942		9,104	573	486		18,374
2003	1,846	4,538	83,410	5,542	2,558	392		98,286
2004	1,000	3,400	168,000	6,809	1,598			180,807
2005	1,255	3,707		2,481	9,097			16,540

2006	1,165	4,083		5,133	1,284			11,665
2007	3,015	4,905		3,735	3,321			14,976
2008	2,015	4,162		2,345	2,587		623	11,732
2009	1929	2836		1745	2135		923	9568
2010	1537	3150		1935	2115		955	9692
2011	1472	2865		2785	1857		935	9914
Total	21,328	51,516	251,410	58,006	50,180	878	3436	448,028

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

Actual release dates are described above in Tables 10.3-1 through 10.3-3.

On-station (acclimated) smolt releases (to the South Santiam River) occur in the spring and fall. Spring releases make-up nearly 71 percent of annual smolt production for the South Santiam system. Fry from the STEP program are released into the South Santiam subbasin in May of each year. Out-of-basin fingerling and smolts are generally released in late-spring/early-summer.

All smolts are released volitionally through a smolt release tube. Details regarding the number and size of fish stocked into each designated water body are provided in Tables 10.3-1 through 10.3-4.

10.5) Fish transportation procedures:

All off-station releases of South Santiam stock 24 CHS are with fish reared from the eyed stage to release at Willamette Hatchery. IHOT guidelines for transportation are followed.

10.6) Acclimation procedures:

In late May once juveniles are marked at Willamette Hatchery, 300,000 are transferred to South Santiam Hatchery to be released in the spring. The original 300,000 eggs kept at South Santiam Hatchery are released in November. After the November release 153,000 juvenile CHS are brought over from Willamette Hatchery to South Santiam Hatchery and released in February. Once the February release is completed, a final group of 268,000 smolts is transferred to South Santiam in the spring for a three-week acclimation period, and then released.

10.7) Marking:

Since 1996, all juvenile CHS released for this program have been externally marked with an adipose fin clip to identify hatchery fish among all returning adults. In addition, all hatchery-reared smolts are marked with an otolith mark, which distinguishes them from naturally produced CHS, as a check against poor or missed marks and to allow identification of system strays.

All Chinook salmon smolt and fingerling production will continue to be adipose fin-clipped and otolith-marked. In addition, a total of 110,000 smolts (approximately 11 percent of the total South Santiam River release) will be coded wire-tagged (USACE 2007, NMFS 2008). The November release group will have 50,000 CWT fish, while the February and March release groups will have 30,000 CWT fish each. The remainder of the releases will be wire-tagged.

10.8) Disposition plans for surplus juvenile fish:

Juvenile CHS production for the South Santiam is within amounts listed in 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:

The fish health monitoring plan is identical to that developed for the Columbia Basin anadromous salmonid hatcheries (IHOT 1994):

- All fish health monitoring will be conducted by a qualified fish health specialist.
- Annually examine broodstock for the presence of viral reportable pathogens. Number of individuals examined, usually 60 fish, will be great enough to assure a 95 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.
- 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:

Fish reared at South Santiam Hatchery are from species and basin specific stocks found in the South Santiam River. Out of basin CHS stocks are not reared at South Santiam. In response to a flooding event, no emergency release procedures will be initiated. Flooding of the rearing units will provide water flow sufficient to maintain the biological needs in the hatchery ponds. However some volitional release of fish would take place during a flood event if the rearing units become inundated.

In the event of a water system failure, releases of hatchery production would take place. South Santiam Hatchery is the release site for hatchery production during normal operations. Most initial rearing and marking of South Santiam stock CHS take place at other facilities. If these fish were released prematurely they would be mass marked with an adipose fin clip or adipose CWT. One group of 300,000 fish that is on station from April through July of each year prior to marking could be kept alive thru the use of recirculation pumps until water could be restored or they could be transferred to another facility.

10.11) Risk aversion measures to minimize adverse effects to listed fish due to fish releases:

All hatchery CHS smolts released into the South Santiam are liberated during the natural peak outmigration periods (February-March, and November). An attempt to release fish during periods of higher flow is made to encourage downstream movement and coordinate with the USACE for increased flows if necessary. Releases, for the most part, are volitional 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 encourage emigration and reduce contact 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 South 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 has been developed for the WHMP including the South Santiam CHS 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.

11.2) Risk aversion measures to minimize adverse genetic and ecological effects to listed fish due to monitoring and evaluation activities:

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

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

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
Harvest	Standard 2.1: Provide sufficient hatchery adults to meet harvest management goals including mitigating for impacts from lost production above Foster and Green Peter dams while minimizing impacts to natural-origin Chinook salmon. Take associated with harvest is covered through the Fisheries Management and Evaluation Plan for upper Willamette spring Chinook salmon (ODFW 2001).	Indicator 2.1.1: 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 via the FMEP.
Conservation	Standard 3.1: Maintain heterozygosity in hatchery broodstock and avoid genetic drift by integrating natural-origin broodstock at an average rate of 5-10% at times when the wild run is projected to exceed 750 adults to the South Santiam River based on counts at Willamette Falls and Foster Dam.	Indicator 3.1.1: Maintain characteristics similar to natural-origin recruits with respect to 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 absence of a thermal mark indicating the fish was naturally produced.
	Standard 3.2: The intent is to inform passage studies to aid design of potential passage alternatives and reintroduction protocols and strategies.	Indicator 3.2.1: Abundance and productivity of hatchery returns available for outplanting are adequate to determine: spawning success (including PSM), SAR, recruits per spawner (productivity), adult spawn and migration timing and distribution, number of juveniles emigrated from spawning areas, and genetic diversity. Number of Chinook to be used for outplanting above Green Peter will be determined at a future date by the fisheries managers.	- Reintroduce/outplant fish into historic habitat upstream of dam(s). - Coordinate with CRFM studies to ensure outplant program is adequate to meet RM&E needs, and where possible, to aid in recovery goals.

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
	Standard 3.3: Reduce potential for negative ecological interactions between hatchery and naturally produced juveniles.	Indicator 3.3.1: 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.	- 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. - evaluate and supplement flows as needed to support and expedite outmigration of smolts
	Standard 3.4: Meet or exceed benchmarks for rearing and releasing high quality fish to minimize impacts on naturally produced fish.	Indicator 3.4.1: Performance targets for benchmarks for rearing and release as indicated in Table 1.9-1.	- Document variables in Table 1.9-1and compare to established targets to determine if hatchery operations need to be adjusted.
	Standard 3.6: Monitor benchmarks and protocols for broodstock.	Indicator 3.6.1: Performance targets for benchmarks for hatchery broodstock as indicated in Table 1.9-3.	- Document variables in Table 1.9-3 and compare to established targets to determine if hatchery operations need to be adjusted.
	Standard 3.7: Hatchery adults spawning (pHOS) with natural-origin adults in the South Santiam CHS population area long-term goal is less than 30%.	Indicator 3.7.1: The projected pHOS to achieve recovery is <30% for the South Santiam CHS natural population. The desired pHOS above Foster is 0% while the area below Foster has a maximum allowed pHOS of <80%. .	-Baseline monitoring and specific RM&E targeted to evaluating stray rates and hatchery origin spawning core production areas upstream of Foster and Green Peter dams. - Complete spawning ground surveys to assess redd numbers, location, and number of natural origin and hatchery origin spawners.
Life History Characteristics	Standard 4.1: Maintain life history characteristic of broodstock that are similar to natural-origin spring Chinook salmon.	Indicator 4.1.1: Life history characteristics of the broodstock including: morphometrics (length and weight), sex ratio, average number of eggs per female by age class, age structure, adult migration, and spawn timing. Collect brood stock throughout the adult return period	- Sample both hatchery and natural-origin broodstock 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 differences between hatchery and natural-origin broodstocks through genetic monitoring as part of a basinwide 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).

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.	Indicator 4.2.1: 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.
	Standard 4.3: Release hatchery fish that are ready to migrate	Indicator 4.3.1: Timely migration of all hatchery fish released as indicated by: residualism rates, rates of outmigration, precocial rates, and proportion of fish that migrate per day.	- 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.
	Standard 5.1: Manage genetic risks of hatchery CHS spawning with naturally produced CHS in the South Santiam population to promote natural selection and local adaptation. Also see Standard 3.7.	**Indicator 5.1.1:** The hatchery program may be used to supplement natural origin CHS passed above Foster Dam if the return of natural origin females remains at less than 500. The need to supplement with hatchery origin fish will be determined on an annual basis by the fisheries co-managers with input from WATER. Since 2009, only unclipped CHS have been outplanted above the dam, of which on average ~20% of the outplanted unclipped CHS were hatchery fish with an adipose fin. For the past two years natural origin returns to Foster Dam have been low compared to previous years, but this may related to a near-complete year-class failure upstream of the dam in 2010. Once the number of natural-origin CHS returns to Foster Dam trap averages,	HOR fish may be released into the upper portion of Foster Reservoir and/or the mainstem South Santiam River above Foster Reservoir, and potentially above Green Peter Dam, if needed to support RM&E and natural fish reintroduction strategies, as described in section 15. Every effort will be made by the Corps to identify juvenile fish needs for RM&E and coordinate with ODFW hatchery managers as early as possible. ODFW RM&E team members will assist with coordination between the RM&E team planning and hatchery managers. There may be instances when the hatchery will not be able to support production needs for RM&E; this includes when requests are made too late in the hatchery production cycle or if production capacity does not exist.

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
		over a 5-year period, more than 500 female CHS (assigned by pedigree analysis), hatchery CHS should not be needed for supplementation	
	Standard 5.2: Broodstock collection does not adversely impact the genetic diversity of the naturally-spawning population.	Indicator 5.2.1: Genetic composition of natural and hatchery stocks; pHOS; and pNOB; and ensure escapement of >750 adults.	-Ensure adequate escapement of natural-origin to spawning grounds. Assessments are made based on Willamette Falls passage counts.
	Standard 5.3: Integrate natural-origin \ broodstock at a rate averaging 5-10% when the wild run in expected to exceed 750 adults.	Indicator 5.3.1: Maintain genetic diversity (heterozygosity) of broodstock similar to natural-origin.	-Adhere to established integration protocols recommended in the Recovery Plan.
Operation of Artificial Production Facilities	Standard 6.1: South Santiam Hatchery and Willamette 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.	Indicator 6.1.1: 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.
	Standard 6.2: South Santiam Hatchery, Willamette Hatchery, and Foster Fish Collection Facility effluent will not negatively impact natural populations.	Indicator 6.2.1: All facilities are operated under National Pollutant Discharge Elimination System (NPDES) permits, 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.
	Standard 6.3: Water withdrawals and instream water diversions will not impact natural, ESA-listed populations.	Indicator 6.3.1: Install and maintain fish screens at Foster 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. -Will be completed with Foster reconstruction.

Category	Standard	Indicator	Monitoring and Evaluation Strategies and Methods
	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.	- Routine annual fish health monitoring of fish rearing in the hatchery and broodstock. - Determine if pathogen levels are consistent with expected targets and standards.
		Indicator 6.4.2: An evaluation of pathogen levels in natural populations before and after artificial production releases.	- Develop studies of pathogens in hatchery and naturally reproducing populations. - Monitor pathogens over time. - Determine relationship between pathogen levels in hatchery and naturally reproduced fish before and after releases.
Socio-Economic Effectiveness	Standard 7.1: Estimated harvest will equal or exceed hatchery production costs based on benefit-cost model (ODFW 1999).	Indicator 7.1.1: Annual budget expenditures. Indicator 7.1.2.: Provide adequate 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	- Periodic cost-benefit analysis of the hatchery and conservation program to evaluate cost effectiveness. - Estimate economic benefit of fisheries and conservation of viable salmon populations. - Evaluate effect of hatchery operations (e.g., off-station releases, recycle excess hatchery adults, etc.) changes to reduce the cost-benefit ratio. - Initiate angler creel surveys to monitor fisheries in the South Santiam River.
Ecosystem Function	Standard 8.1: Provide nutrient enrichment and food web benefits in natural spawning streams in the South Santiam River Basin.	Indicator 8.1.1: Pathogen-free hatchery fish may be placed in streams for nutrient enrichment	- Track the number and location(s) of carcasses distributed for nutrient enrichment. - Monitor the ability to consistently respond to planned nutrient enrichment needs as appropriate for Oregon watersheds.
		Indicator 8.1.2: Hatchery carcasses placed for nutrient enrichment will comply with ODFW and Oregon Department of Environmental Quality (DEQ) guidelines for disease control and water quality.	ODFW's Fish Pathology Department screens carcasses for possible diseases and gives final approval for all nutrient enrichment projects prior to project initiation.

SECTION 12. RESEARCH

The baseline RM&E, funded by the USACE through the Cooperative Agreement, follows the most recent science to ensure that methods used 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. Unclipped fish are not currently used in broodstock in the South Santiam Hatchery program but are proposed to be with adoption of this HGMP.
- 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 South Santiam include the river reach between Lebanon Dam and Foster Dam. The key area for surveys above Foster Dam is the upper South Santiam River.

- 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.
    - Estimate potential for interactions based on proportion of NOR’s in conservation areas above Foster Dam vs below the project.
- Release hatchery fish that are ready to migrate

- Smolts are released after final rearing and acclimation at the South Santiam Hatchery 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.

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SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

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

Name and Title of Applicant:

Signature: _____ Date: _____

SECTION 15. OUTPLANTING PROTOCOLS ADDENDUM

15.1 Background and purpose:

The USACE's Green Peter and Foster dams on the South Santiam River were completed in 1967 and 1968, respectively. It is thought that historically the Santiam River basin may have supported approximately one third of the CHS natural production above Willamette Falls (Myers et al. 2006), and it is estimated that 85 percent of the historic production in the South Santiam subbasin occurred upstream of the Foster and Green Peter dams (Mattson 1948). Currently, 65% of the natural origin adults are passed above Foster Dam (C. Sharpe, personal communication). The NMFS 2008 BiOp RPA includes interim and long-term fish passage solutions. The Upper Willamette Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NOAA 2011) identified access to historical spawning habitat as a key factor limiting natural production and recovery of South Santiam spring Chinook salmon. Other limiting factors identified include habitat and flow alterations.

The rebuilt Foster Fish Collection Facility is being managed to reduce impacts of trapping and collection of outplanted CHS and allow sorting to reduce the effects of hatchery fish on the productivity and diversity of wild UWR spring Chinook and winter steelhead above and below USACE projects.

Re-establishing productivity of CHS in areas currently above USACE facilities is a specific requirement in the NMFS 2008 BiOp and a key measure to reduce limiting factor threats in the Recovery Plan (ODFW and NMFS 2011). Volitional downstream passage past Foster Dam is currently being conducted with a combination of surface spill using fish weirs in spill bays in Foster Dam and turbine passage under RPA measure 2.8 of the WP BiOp, while upstream passage is being improved for adults by the rebuilt Foster adult collection facility under RPA measure 4.6 of the BiOp. Using broodstock from the South Santiam HMP to initiate this effort is predicated on the success of outplanting efforts of hatchery fish. Structural/operational feasibility will be determined in part by a series of USACE system configuration studies designed to determine the feasibility of reestablishing naturally self-sustaining populations in river reaches above the USACE Willamette dams (Section 3.0 in USACE 2007). The USACE is evaluating downstream passage actions and alternatives to address this limiting factor per RPA 4.10-4.11, related to RM&E per RPA 9.3 (NMFS 2008). Downstream passage at Green Peter Dam has not been identified as a priority action under the 2008 Willamette BiOp.

The current approach for using HMP fish to re-establish natural production above Foster Dam (and potentially in the future the portion of the basin above Green Peter Dam) is to supplement natural-origin returns released above the dam, but only to the extent deemed necessary to sufficiently seed available habitat. Since the hatchery program stock was derived from local, wild salmon from the South Santiam River, HMP are provisionally the best available fish to supplement reintroduction. This hatchery supplemented reintroduction strategy may have to continue for at least 10 years (two generations) or

more given the problems that have been identified to date with adult trap and haul facilities, prespawning mortality, and uncertainty regarding downstream passage. It is expected that the new Foster Fish Collection Facility will significantly reduce the incidence of prespawning mortality in fish released above the dam. Over time, as natural-origin returns hopefully start to increase from these reintroduction and passage improvements and return to the collection facilities, these NOR fish will represent the majority of fish transferred above the dams, with the HMP component becoming less and less of an above-dam component. The primary indicator of a successful reintroduction program above Foster Dam would be when natural-origin returns demonstrate replacement at numbers sufficient to fully seed the above-barrier habitat without the supplementation of hatchery fish. It is anticipated that HMP fish would, out of necessity, comprise a key component of any potential future reintroduction strategies initiated for that portion of the basin above Green Peter Dam. Downstream passage at Green Peter has not been identified as a priority action in the current BiOp. Further details on these reintroduction efforts using the hatchery programs are being discussed and formalized by the fish co-managers with recommendations from WATER Teams, and will be documented in a Reintroduction Plan for the South Santiam.

Outplanting protocols are currently under development including protocols for handling, and transport procedures that will be used to outplant spring Chinook from the Foster facility. These procedures will be developed consistent with regionally accepted best management practices.

Since the mid-1990s, ODFW has outplanted excess adult hatchery CHS into historic habitat upstream of dams in the Willamette River. Outplanting in the South Santiam River started in 1996. More recent outplants have been wild CHS only. Snorkel observations and head-of-reservoir trapping indicate that natural production is occurring in outplanted areas (Beidler and Knapp 2005; Monzyk et al 2011). Genetic pedigree analysis confirms returning adult spring Chinook from parents transported above Foster Dam (Evans et al. 2014 presentation at the Willamette Fisheries Science Review). Their analysis indicated total lifetime fitness for the 2007 cohort placed above Foster Dam averaged 2.8±5.4 adult offspring returning to the South Santiam. Research has also documented occasional year class failures such as those observed in 2010.

Efforts are currently underway to refine the ongoing reintroduction strategy and describe the protocol for collecting, transporting, and releasing hatchery or natural-origin CHS into historical habitat and outplanting and reintroduction efforts with other hatchery operations. The plan incorporates conservation and reintroduction role of the hatchery program as outlined in the recovery plan Appendix E. Once completed, this reintroduction plan will complement and dovetail with the NMFS 2008 BiOp RPA.

15.2 Hatchery goals and objectives for outplanting and reintroduction:

The program goals and objectives for the South Santiam Spring Chinook Salmon Program as described in Section 1.7 of the HGMP.

Main Goal: Manage the South Santiam Spring Chinook salmon program and returns to fish collection facilities in the South Santiam Basin to meet conservation and recovery 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 South Santiam basin, while continuing to meet the USACE's mitigation responsibility. This includes compliance with the 2008 BiOp, where NMFS 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 listed species from incidental take. Included in the Recovery Plan goal is to reestablish natural production of 3,099 adults in core spawning and rearing habitats in the South Santiam upstream from Foster and Green Peter Dams 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 Foster Dam, and potentially Green Peter Dam. . Downstream passage at Green Peter has not been identified as a priority action in the current BiOp.

- Release natural-origin or a combination of hatchery and natural-origin spring Chinook and winter steelhead into historical habitat upstream of Foster Dam in the South Santiam Basin in compliance with RPA measures 4.1 and 4.2 of the WP BiOp. Continue to pass juveniles with spill under RPA measure 2.8 while continuing to evaluate passage under RPA measures 4.10 and 4.11 as part of the RM&E under RPA 9.3. The Incidental Take Statement allows for juvenile downstream passage mortality up to 10% of the run past Foster Dam.
- Most of the historic habitat is upstream of Green Peter Dam, compared to upstream of Foster reservoir in the South Santiam River, and thus outplanting could reduce risk by increasing abundance, productivity, spatial structure, and diversity of the South Santiam Chinook population. Even if downstream passage through the dams and reservoirs were poor, any additional production from this historic habitat would be a benefit to the population. Restoring use by Chinook salmon to areas above Green Peter dam is also prudent given continual concerns regarding climate change and droughts. The headwater habitat areas will be even more important than they were historically under projected future conditions. Downstream passage at Green Peter has not been identified as a priority action in the current BiOp.
- Release natural-origin or a combination of hatchery and natural-origin fish into inaccessible habitat, with the long-term intention of releasing only naturally produced fish in the South Santiam River CHS population once safe and effective downstream passage results in self-sustaining naturally produced populations of CHS.

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 South Santiam Basin as sustainable natural production increases above Foster Dam, and in the

future potentially above Green Peter Dam.

> ODFW and the Corps in coordination with NOAA propose to develop crediting strategies to adjust mitigation requirements commensurate with fish passage improvements at Foster and/or Green Peter dams. In addition, the Recovery Plan recommends that actions to reduce pHOS be coupled with actions that will improve passage, survival, and production of wild fish above flood control/hydropower barriers, in order to provide management flexibility and avoid elimination of fisheries. The 2012 Cooperative Agreement between USACE and ODFW provides similar direction and allows for program adjustments to meet ESA requirements and adjust the mitigation program.
>
> The NMFS and ODFW with advice from the WATER forum will work together to develop a reintroduction plan on the S. Santiam that will take into consideration RM&E activities and various study results, and support and compliment implementation of NMFS 2008 BiOp RPA for the Willamette Project.

15.3 Outplanting strategies:

Upstream of Foster Dam and Reservoir:

Proposed Releases. Continue to release natural-origin adult Chinook salmon in the areas above Foster Dam while measurable and well-defined progress towards safe downstream passage is being conducted and evaluate the success of preliminary reintroduction efforts. Hatchery supplementation will be used to assess production and passage potential upstream from Green Peter Dam and assist, as needed, with reintroduction above Foster Dam or to expand distribution to include currently unused habitats. The hatchery program will produce and release adequate numbers of smolts (up to 1,021,000) to return 500 females in excess of broodstock needs and after fisheries harvest to support this effort.

Long-term Strategy. The long-term program goal is to release only natural-origin fish when production and survival through Foster Reservoir and Dam are high enough to support a self-sustaining run. Information on the survival of outplanted adults and juvenile passage through the reservoirs and dams is necessary to evaluate the outplant program and determine actions necessary to achieve ESA goals for the South Santiam Subbasin. Similar strategies will be considered for production areas upstream from Green Peter dam.

Since the hatchery program was originally founded from the historic population of CHS in the South Santiam River after the USACE dams were built, this stock of fish represents the best remaining source of fish for reintroduction efforts.

15.4 Protocols for Outplanting Adults:

The protocols for outplanting fish in historical habitat for South Santiam CHS are essentially the same as for North Santiam CHS however site specific adjustments will be made as needed to reflect subbasin specific equipment, operations, and conditions. Specific information for the South Santiam that differs from the North Santiam is provided below.

Beidler and Knapp (2005) identified the following recommendations for outplanting CHS adults in the South Santiam River subbasin.

- Install smolt traps at the head of Foster Reservoir and below Green Peter Dam to monitor juvenile outmigration production.
- Give consideration to mark error rates to better distinguish between hatchery and natural-origin fish when outplanting.

The following information describes the past, proposed, and long-term protocols for the CHS reintroduction and outplanting program. Past operations describe general operation of the outplanting and reintroduction program prior to 2006. These efforts focused on transporting the majority of excess hatchery fish using normal IHOT transportation guidelines and protocols for loading and transport. While transportation of adults could have some effect on PSM, condition of the fish prior to entry into the trap has a significant impact on PSM levels. That said, average pre-spawning mortality was 25% (range 6% - 89%) between 2007 and 2012 above Foster Dam (ODFW unpublished data) when fish were transported at relatively high densities. The rivers and streams above Foster Dam are generally warmer and have lower flows, which also can contribute to PSM.

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 new 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.

1. Target Number of Fish to Release:

Proposed Operation. The current program involves releasing fish according to the annual disposition table. Transport and handling protocols as mentioned above, 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.

Disposition priorities are established in Section 7.5. A fish disposition table is developed by ODFW annually, with input from NMFS and WATER, to guide distribution of anadromous and resident fish as they are encountered in the adult fish traps. Currently all unmarked adults returning to the Foster Adult Trap are outplanted upstream from Foster Dam however numeric goals and disposition are reviewed annually based on predicted run size, results of research, monitoring and evaluation (RM&E) of passage, and the construction of new infrastructure

affecting the ability to collect or release fish in the South Santiam subbasin. Because returns to Foster Fish Facility are expected to fluctuate annually, the plan for outplant releases also incorporates variability in outplanting numbers. Specific release targets and distribution will be outlined in the reintroduction plan that provides an adaptive framework to guide reintroduction efforts based on feedback through RM&E and trigger points for transitions to natural-origin only releases.

The annual plan for releases in each location will be determined by expected returns to the South Santiam River based on returns to Willamette Falls and the Foster Adult Collection Facility. Target outplanting releases are presented in Table 15.4.1. Numerical adult abundance recovery goals have been recommended for the South Santiam population in the 2011 Recovery Plan.

Long-term Strategy.

- Maximize adult survival to spawning by minimizing pre-spawning mortality and implementing actions to improve survival of other life stages).
- Reduce the need to release hatchery-origin adults upstream of projects; eventually release only natural-origin fish in these areas.
- 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 to support a self-sustaining natural Chinook run above Foster Dam.
- Achieve and exceed passage survival standards identified in the Incidental Take Statement (NMFS 2008). Ensure adequate escapement of adults to achieve production goals while passage survival is improved.

2. Outplanted Fish:

Proposed Operation. All unmarked adults except those needed for broodstock integration are passed into habitats upstream of Foster Dam. While unmarked adults are not passed above Green Peter Dam, such outplanting may occur in the future. Downstream passage at Green Peter has not been identified as a priority action in the current BiOp.

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

Proposed Operation. Operation of the Foster Fish Facility year-round so that fish can be collected throughout the entire run. Some fish may be held at the Foster Fish Facility prior to outplanting. The new facility has better holding conditions and will facilitate late season outplanting if needed to improve survival. Outplanting timing guidelines for each location will consider the impacts of water temperature on arrival time and holding capability in the South Santiam River.

Long-term Strategy. Collect fish throughout the run and outplant when collected, ensuring temporal outplants are representative of run strength. However, pre-spawning mortality of fish may be high and thus should be monitored to ensure effectiveness of this strategy. Fish could be

held at the new the Foster Fish Facility. Fish will not be held longer than the agreed to time that will be agreed upon by the fishery co-managers.

4. Handling Protocols for Outplanted Fish:

Proposed Operation. Continue to use the Foster Fish Facility as the collection location for fish to be outplanted. Condition of natural-origin fish entering the collection facilities is variable however most are in good physical conditions (i.e., no lesions, fungus, etc) have a high 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 new facility provides water-to-water transfer. Handling protocols will be updated following testing of the Foster Fish Facility.

In addition, the following protocols will be implemented to minimize handling effects on outplanted adults:

- 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 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.

The annual fish disposition table will be used to guide the management of anadromous and resident fish as they are encountered in the adult fish traps.

To ensure captured fish are not overly stressed or injured, protocols are needed in regard to how long trapped fish are held prior to transport, broodstock collection, or recycling for fisheries. The following protocols will be incorporated into overall protocols for the Foster Adult Collection Facility in 2014.

- Once fish are sorted, they will spend no longer than the allotted time (using 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 week to minimize time in the trap and to assess the overall density of fish within the trap. Timing of trap checking with be adjusted as needed.

- Fish will be removed and placed in holding tanks with density ≤ 25 gallons of water per fish. If NOR outplants increase then ACOE will fund the additional trips, personnel, and equipment that is needed to accomplish this goal.
- Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 ppm (7 mg/L).
- Fish will be loaded onto trucks using the water-to-water transfer system at the new facility.

Long-term Strategy. The Foster Fish Facility will be used for collection of broodstock and for reintroduction efforts above projects. During initial processing/sorting, Aqui S 20E will be used as anesthetic. The facility was designed to minimize stress to fish, thus, all activities should complement this by minimizing any fish handling that may need to occur (e.g. multiple crowds). Handling protocols will be developed specific to the facility as it nears completion and adapted as needed based on testing and modified procedures based on experience operating the facility.[1]

In addition, the following protocols will be followed:

5. Transport Protocols for Outplanted Fish:

Proposed Operation. The proposed operations are intended to reduce stress from handling, high transport density and temperature effects that have likely contributed to high incidence of pre-spawning mortality observed in fish outplanted above Foster reservoir.

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.

Table 15.4-2. Approximate Hauling Times and Distance from Foster Fish Facility to Release Sites

Release Site	Distance (miles)	Transport time (minutes)
Above Foster Reservoir [a]	10-20	20-40

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

Long-term Strategy. Fish will be loaded according to the NMFS recommended loading density of approximately 25 gallons per fish (40 fish/1000 gal; 50 fish/1200 gal), although densities will be reduced if water temperatures are high. All transport tanks will be treated with Nov-Aqua to reduce stress during transport. Tanks will be aerated during transport, if possible. 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. Any upgrades required to ODFW equipment to meet these standards will be paid for by ACOE.

6. Release Protocols for Outplanted Fish

Proposed Operations

- Release sites. Continue to use the existing and new (constructed in 2012) release sites, but identify potential new 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. Work with private landowners or the Forest Service to develop these areas into suitable release sites.
- Release methods. 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 waterspout to flush fish from the truck. Avoid abrupt changes in temperature. Release fish early in the day whenever possible. If receiving waters are known to be too warm at certain times of year, release fish when or where waters are cooler.
- See Section 2.3.1 in the main report for more specific protocols. Investigate the options to improve survival such as holding fish in a hatchery pond and treating with antibiotics until they are ready to spawn, at which time they would be released. Releasing ripe fish may limit numbers outplanted and potentially reduce pre-spawning mortality.
- Monitoring. Fish liberation truck driver and/or trained volunteer will observe released fish and document any mortality and unusual behavior for 30 minutes after release.

Long-term Strategy

- Release sites. Fish would be released at sites selected based on suitable habitat and temperature.
- 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.

Appendix E: Modeling Smolt Releases and Adult Returns in the South 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 South 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 1,250 adults (500 females) are available for outplanting above Foster Dam,
2. approximately 1,600 fish are harvested in the subbasin by sport anglers,
3. sufficient brood are collected to propagate the program (717 adults collected, 269 females spawned).

With the above objectives, we arrived upon a Total Adult Goal back to the Foster FCF of 4,828. 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 Foster trap (Foster). The latter estimates includes returns during some very poor ocean years in the mid-90s.

The Foster SAR estimates were derived by dividing the number of adult Chinook captured in the Foster trap by the number of smolts that were released 4 years earlier (most HOR Chinook in the South Santiam are 4 YO). Run Reconstruction SARs were derived by dividing the sum of adults captured at Foster, 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 and are provided as part of the complete record of work but they were not actually used in the final estimates because we were not able to gain confidence that they accurately reflected returns to the river.

Using the Total Adult Goal back to Foster of 4,828 and two of the three estimates of SAR, we arrived at a range of smolts releases. We selected five different expressions of standard deviation of SAR with their respective smolt releases, each representing a level of assurance that the adult goal would be met, for the range captured by the data set. After thoroughly reviewing the data available, we arrived upon the decision that a smolt release of 1,021,000 would met all program goals with satisfactory assurance.

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

Return Year	Foster SAR	Run Reconstruction	CBR SAR
1990	0.77%	--	--
1991	0.36%	--	--
1992	0.17%	--	--
1993	0.21%	--	--
1994	0.16%	--	--
1995	0.17%	--	--
1996	0.23%	--	0.30%
1997	0.16%	--	0.10%
1998	0.42%	--	0.05%
1999	0.42%	--	0.77%
2000	0.40%	--	--
2001	0.51%	--	0.60%
2002	0.68%	1.33%	--
2003	0.62%	1.05%	--
2004	1.02%	1.62%	--
2005	0.28%	0.55%	0.40%
2006	0.33%	0.56%	0.25%
2007	0.12%	0.26%	0.01%
2008	0.11%	0.15%	--
2009	0.27%	0.45%	0.29%
2010	0.69%	1.38%	1.03%
2011	0.68%	1.02%	--
2012	0.69%	0.98%	--
2013	0.26%	0.38%	--
2014	0.26%	0.53%	0.15%
2015	0.83%	--	--
Scenario Estimates			
mean-1XSD	0.16%	0.32%	0.04%
mean-1/2SD	0.29%	0.56%	0.20%
mean	0.42%	0.79%	0.36%
mean+1/2SD	0.54%	1.02%	0.52%
mean+1XSD	0.67%	1.26%	0.68%

Table 2. Model results for South Santiam smolt releases.

SAR estimated with Variance and Smolt Releases								
		SAR				Smolt release (adult goal/SAR)		
Source	Scenarios	No harvest	Ocean harvest (10%)	Adjusted for additional 34% harvest (South Santiam 18.2%, Willamette 16%)	Adult goal	No harvest	Adjusted for Ocean harvest (10%)	Adjusted for additional 34% harvest (South Santiam 18%, Willamette 16%)
Columbia Basin Research	mean-1XSD	0.04%	0.07%	0.04%	4,828	12,505,077	7,103,586	10,763,010
	mean-1/2SD	0.20%	0.21%	0.14%	4,828	2,427,965	2,275,396	3,447,570
	mean	0.36%	0.36%	0.24%	4,828	1,344,506	1,354,658	2,052,512
	mean+1/2SD	0.52%	0.50%	0.33%	4,828	929,655	964,410	1,461,227
	mean+1XSD	0.68%	0.64%	0.43%	4,828	710,446	748,719	1,134,423
Reconstruction from Actual Returns	mean-1XSD	0.32%	0.31%	0.21%	4,828	1,500,190	1,534,510	2,325,015
	mean-1/2SD	0.56%	0.53%	0.35%	4,828	868,657	919,259	1,392,817
	mean	0.79%	0.74%	0.49%	4,828	611,313	656,172	994,200
	mean+1/2SD	1.02%	0.95%	0.62%	4,828	471,599	510,165	772,977
	mean+1XSD	1.26%	1.16%	0.76%	4,828	383,868	417,309	632,286
Reconstruction from Actual Returns, 1990 - 2015, incl. Poor Ocean yrs	mean-1XSD			0.16%	4,828			2,983,799
	mean-1/2SD			0.29%	4,828			1,671,961
	mean			0.42%	4,828			1,161,363
	mean+1/2SD			0.54%	4,828			889,669
	mean+1XSD			0.67%	4,828			720,996

The SAR provided in Table 1.9-2 is the average of the mean “Reconstruction from Actual Returns” SAR after harvest (0.49%) and the mean “Reconstruction from Actual Returns, 1990 – 2015, incl. Poor Ocean yrs” (0.42%). (0.4856 + 0.4157) / 2 = 0.4507.