HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	**Bonneville Hatchery Tule Fall Chinook Salmon Program**
Species or Hatchery Stock:	**Tule Fall Chinook Salmon Stock 14**
Agency/Operator:	**Oregon Department of Fish & Wildlife**
Watershed and Region:	**Lower Columbia River**
Date Submitted: **First Update Submitted:**	**May 10, 2016** **October 18, 2017**
Date Last Updated:	**October 17, 2017**

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Bonneville Hatchery, tule fall Chinook Salmon program.

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

Tule fall Chinook Salmon *Oncorhynchus tshawytscha* (stock 14) is under this propagation program. Several races and populations of Chinook Salmon produced within the sub-basins of the lower Columbia River are part of the Lower Columbia River Chinook Salmon Evolutionarily Significant Unit (ESU)), which is listed as "Threatened" under the federal Endangered Species Act (ESA). The early-run tule race of fall Chinook Salmon produced at Bonneville Hatchery is not considered as part of the ESU, and therefore, not listed under the ESA.

1.3) Responsible organization and individuals.

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

National Marine Fisheries Service (NMFS) provides funding for Bonneville Hatchery tule fall Chinook program.

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

Funding for the tule fall Chinook Salmon program at Bonneville Hatchery is provided by the National Marine Fisheries Service (NMFS) which is ~$296,000/year. At full staffing the hatchery has 15.5 full time employees, and operates on an annual combined NMFS and

United States Army Corp of Engineers (USACE) budget of approximately $2,117,117 (FY 2016) and the tule program accounts for about 14.0% of the budget.

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

Bonneville Hatchery:
Bonneville Hatchery is located at RM 0.25 on Tanner Creek, near its confluence with the lower Columbia River, Multnomah County, Oregon. The site elevation is approximately 60 ft above sea level, at latitude 45º 38' 00" N (45.6334) and longitude -121º 57' 20" W (-121.9568).

Activities at Bonneville Hatchery include brood collection, spawning, egg incubation, fry/juvenile rearing, marking, and release of sub-yearling and yearling smolts into Tanner Creek.

Washougal Fish Hatchery:
Washougal Fish Hatchery is located on the Washougal River (WRIA 28.0159) at RKm 32.2 (RM 20) - a tributary to the Columbia River via Camas Slough (WRIA 28.0154) at RKm 190.1 (RM 118.1), Lower Columbia River, Washington. Activities at Washougal Hatchery include incubation of eyed eggs received from Bonneville Hatchery and continue rearing up to fingering stage (the size of 180 fish per pound (fpp)), marking (ad-clip and coded-wire tagging (CWT)), and then return to Bonneville Hatchery for acclimation and release into Tanner Creek.

***Backup hatchery facility for broodstock*:**

Spring Creek National Fish Hatchery (SCNFH):
SCNFH is located in Skamania County, near the communities of Underwood and White Salmon, WA. The hatchery is located by the Columbia River at RM 167.18, at latitude 45° 43' 41" N and longitude -121° 32' 38" W.

Tule adults returning to SCNFH from the previous releases may be used as backup broodstock for the Bonneville Hatchery tule program, if needed. And if requires, these additional broodstock may be spawned at SCNFH and fertilized green or eyed eggs may be shipped to Bonneville Hatchery for incubation, rearing and release.

1.6) Type of program.

This is a harvest mitigation program.

1.7) Purpose (Goal) of program.

The purpose of tule fall Chinook Salmon program at Bonneville Hatchery is to mitigate for the lost harvest opportunities due to freshwater habitat degradation and production losses that occurred due to construction and operations of federal Hydroelectric Dams on the Columbia River Basin. The aim of Bonneville Hatchery tule program is to increase the

harvests of tule fall Chinook by sport, commercial, and tribal fisheries in the Pacific Ocean and the lower Columbia River. In 2016, the release goal was 2,200,000 ± 5% sub-yearling and yearling smolts into Tanner Creek. In 2017, the actual release of 121,606 yearling and 3,086,916 sub-yearlings smolts occurred from during May/June and early September (see Table 1.7-1). The NMFS' recommended release goal for Bonneville tule program from release year 2018 to 2021 are shown below in Table 1.7-1. Assuming smolt-to-adult survival rate 0.5%, the ultimate goal of Bonneville Hatchery tule fall Chinook program is to produce approximately 25,000 adults for recreational and commercial harvests as well as for broodstock use.

Table 1.7-1. NMFS' recommended release goals for Bonneville Hatchery Mitchell Act funded tule fall Chinook Salmon program, release years 2017-2021.

Program	**Proposed Program Size**	**Release Years**				
Tule Fall Chinook Salmon		2017	2018	2019	2020	2021
		Actual	Planned	Planned	Planned	Planned
	5,000,000 or equivalent	Mar: 121,606 yearlings May & Jun: 2,462,145 sub-yearlings Sept: 624,771 sub-yearlings*	1.6M sub-yearling and 400,000 fall fingerlings (1.6M equivalent). Additional 1.5M (Bonneville stock) sub-yearling will be released from WA production No yearling smolts release due to emergency releases in September 2017*	1.6M sub-yearling and 400,000 fall fingerlings (1.6M equivalent). Additional 1.8M (Bonneville stock) sub-yearling will be released from WA production	1.6M sub-yearling and 400,000 fall fingerlings (1.6M equivalent). Additional 1.8M (Bonneville stock) sub-yearling will be released from WA production	1.6M sub-yearling and 400,000 fall fingerlings (1.6M equivalent). Additional 1.8M (Bonneville stock) sub-yearling will be released from WA production

*Due to catastrophic wild forest fire in the Eagle Creek areas all tule fall Chinook on hand at Bonneville Hatchery (624,771 sub-yearlings) were released early on 9/5/2017 due to fear of "fish kill" which were scheduled for release in October 2017 (400,000 sub-yearlings) and March 2018 (200,000 yearlings). And consequently, there would be no yearling smolts release in March 2018. All these early released fish had ad-clipped and 80,006 fish had Ad+CWT marking.

1.8) Justification for the program.

The Bonneville Hatchery tule fall Chinook Salmon program is managed to mitigate the harvest loss due to construction and operation of hydroelectric dams on the Columbia River Basin. The Oregon commercial and recreational fisheries are managed in a way that the harvest impacts to ESA-listed natural fish stay within the limits authorized by NMFS and state agencies while harvesting the hatchery-produced tule fall Chinook Salmon.

In the past, the Bonneville Hatchery tule program suffered a setback due to lack of funding and consequently the program was discontinued in 1996. In early 2003, the *U.S. v Oregon* parties recommended transferring the upper Columbia River production/release of tule fall

Chinook to areas below Bonneville Dam (in part to address concerns about tule Chinook straying above Bonneville Dam). In a 2008 MOA between federal co-managers and ODFW regarding SCNFH production reprograming resulted in the shifting of some of the tule hatchery production from SCNFH (above Bonneville Dam) to Bonneville Hatchery (below Bonneville Dam) and increasing the upriver bright fall Chinook production above Bonneville Dam (source: SCNFH tule HGMP).

The MOA (2008) required that ODFW to undertake reprogramming of Bonneville Hatchery fall Chinook programs (both tule and URB). Under the previous Chinook program, approximately eight million late-spawning upriver bright (URB) stock juvenile fall Chinook salmon had been reared at Bonneville Hatchery as State of Oregon's contribution to mitigate for the loss of spawners abundance due to construction and operation of John Day Dam. Per production reprograming, the URB fall Chinook Salmon that had been previously released into Tanner Creek, became part of the releases on the Washington side of the Columbia River above the Bonneville Dam. Consequently, the last release of URB fall Chinook juveniles from Bonneville Hatchery into Tanner Creek took place on 7/31/2013 although Bonneville Hatchery still continues rearing of URB fall Chinook (as part of the John Day mitigation program) for release into upriver from Ringold Springs Hatchery operated by the Washington Department of Fish and Wildlife.

To compensate for the lost URB fall Chinook Salmon production at Bonneville Hatchery, Spring Creek National Fish Hatchery began transferring about three million "tule fall Chinook" eyed eggs annually to Bonneville Hatchery in brood year 2008 and continued through brood year 2013 (actual egg transfer numbers presented in Section 9.1.1). Accordingly, Bonneville Hatchery released SCNFH-origin tule juveniles into Tanner Creek from the Spring of 2009 through 2014 release years. And, beginning with the brood year 2014, Bonneville Hatchery was able to launch its own tule broodstock program using the adults returning to Tanner Creek, and the first release of Tanner Creek-origin tule stock sub-yearlings (1.2 million) into Tanner Creek occurred in April 2015.

Tanner Creek is not a designated habitat for natural spawning or rearing use by any ESA-listed fish. Observations suggest that Bonneville-released sub-yearling and yearling smolts quickly enter the Columbia River, and it is presumed that they make consistent and rapid downstream movement towards the Pacific Ocean. This outmigration pattern of tule fall Chinook suggests minimal competitive interactions with the ESA-listed fish in the lower main-stem Columbia River migration corridor. All smolts (100%) are adipose-clipped (hereafter "ad-clipped") for easy identification and selective harvests; and with full production potential (5,000,000 smolts release), certain number of the smolts shall have Coded Wire Tag (CWT) to evaluate program performance relative to fishery contribution, harvest locations, smolt-to-adult survival, stray rates etc. During rearing at Bonneville Hatchery, the ODFW Fish Health Management Policy (ODFW 2003) is followed to minimize transmission of disease agents to the watershed.

The returning adults will be harvested by commercial and recreational fisheries in the Pacific Ocean and the lower Columbia River, and most of the unharvested fish are expected to return to the hatchery trap at Tanner Creek. Hatchery-origin tule fall Chinook returning to Bonneville Hatchery are used mostly for broodstock purpose and the surplus adults are

sold through competitive bid process, or donated to the Oregon Food Bank, or disposed of in a landfill if not suitable for human consumption. Captured hatchery-origin fall Chinook shall not be released back to the watershed. It is expected that stray rates from the Bonneville tule program will be low and thus may have minimal genetic and ecological impacts to the lower Columbia River salmonid ESU's.

1.9) List of program "Performance Standards".

See Section 1.10

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

1.10.1) "Performance Indicators" addressing benefits.

Performance Standard	Performance Indicator	Monitoring and Evaluation
Provides mitigation for lost fish production due to development of hydro dams within the Columbia River Basin.	Number of adult fish returning to the Columbia River as specified by program goals or mitigation requirements.	Annually estimate survival and ocean and freshwater fishery contribution for each brood year released.
Maintain a broodstock of Bonneville Hatchery tule fall Chinook with adequate genetic diversity.	Broodstock collection represents entire run, and fish are spawned at 1:1 female to male sex ratio.	Annually record number of females, males and jacks retained as broodstock and spawned. Timing of run, broodstock survival rate, and results of fish health checks.
Program fish are sufficiently marked for selective harvest in a manner consistent with information needs to enable determination of impacts to natural and hatchery origin stocks in fisheries.	All smolts (100%) are marked with adipose fin-clip and certain numbers of smolts shall be coded wire tagged.	Monitor for tag/mark retention rate prior to release, to confirm fin-clip quality and CWT retention rate is between 95% and 100%.
Program provides an increased and sustainable harvest opportunity.	Harvest of program fish in the Ocean and the Lower Columbia River.	Collect data of CWT recoveries from commercial buyers, sport fishery sampling, dock side creel sampling, and punch cards.
Program fish are released at numbers and sizes to maximize survival of juveniles and maintain sustainable harvest.	Number and size of fish released by program fall within ± 5% of established program goals.	Monitor juvenile hatchery fish size, number, mass-mark quality, and date and location of release in HMS database. Estimate survivals and fishery contributions to ensure compliance with management directives
Program goals are aligned with federal, state, regional, and local fish conservation and restoration initiatives.	Program complies with Native Fish Conservation Policy and the Lower Columbia Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead.	Conduct periodical review of program goals, achievement, practices, and modify as recommended/needed.

1.10.2) "Performance Indicators" addressing risks.

Performance Standard	Performance Indicator	Monitoring and Evaluation
Hatchery is operated in compliance with Oregon Fish Health Management Policy and IHOT protocols to minimize impacts to listed species from disease transmission.	Fish disease and type of pathogens observed in rearing juveniles are within accepted guidelines.	ODFW pathologists will examine fish at least once in a month and prior to fish transfer and releases.
Program addresses ESA responsibilities.	Program complies with Federal ESA-listed fish take authorizations for harvest and hatchery actions.	This HGMP is updated to reflect any major program changes and resubmitted to NOAA fisheries, if needed. Program risks are addressed through actions resulting from ongoing monitoring and evaluation of juvenile production performance standards and the contribution of hatchery adult fish to fisheries and escapement.
Minimize impacts to ESA listed and other native species due to broodstock collection activities.	Listed natural fish captured in adult traps shall be hauled above Bonneville Dam with minimum handling stress.	Monitor and record trap collections and mortalities of listed natural fish.
Hatchery operations comply with the NPDES permit's water quality standards and requirements.	Effluents are managed to comply with the water quality standards and limits outlined in the NPDES permit.	Effluent water quality is monitored per requirements of the permit and data are reported to the implementing agency (DEQ).
Juveniles are reared and released on-station imprinted on Tanner Creek water to maximize homing to Bonneville hatchery trap operated in Tanner Creek.	Location of and type of release and level of smoltification at release. Proportion of adult returns to Bonneville Hatchery originating from program releases.	Monitor size and condition of fish prior and at release. Record and report release information both in the agency hatchery management database HMS and in the regional database RMIS. Monitor stock and age composition of returns to the hatchery using coded-wire recovery information and scale analysis.
Minimize impacts to ESA listed and other native species from program related harvest activities.	Impacts to listed fish taken or caught and released during tule harvest in the Ocean and the Lower Columbia River are within established maximums.	State agencies monitor and manage lower Columbia River basin harvest in-season to ensure that take of listed fish does not exceed limits.

1.11) Expected size of program.

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

Only hatchery-origin adult tule fall Chinook shall be used for broodstock. It is expected that a maximum of 3,200 adults would be collected (including mortalities), to produce 3,100,000 sub-yearling and 400,000 fall fingerling smolts. All broodstock for this tule program will be collected at Bonneville Hatchery. Tule fall Chinook Salmon returning to SCNFH may be used as a backup broodstock source for Bonneville program, if needed. Brood fish are collected from the full temporal spectrum of the adult migration period and spawned accordingly to maintain genetic diversity within the hatchery produced population.

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

See Table 1.7-1

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

The current tule fall Chinook program at Bonneville Hatchery began in May 2009 with the first release of 2,492,752 sub-yearling smolts into Tanner Creek. Adult returns to Bonneville Hatchery from these smolts releases started in September 2011. Based on CWT recovery data, overall survivals for tule sub-yearlings released from Bonneville in 2009-2011 averaged 0.29%. Estimated number of CWT recoveries from the commercial and recreational harvests for return years 2011-2016 are available from the Regional Mark Information System (RMIS) database and are included in section 3.3.1. Data on smolt-to-adult survival rates, fishery contributions, and adult production levels for this program is limited and recovery data from the 2015-2016 return years are incomplete.

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

Releases of Chinook Salmon from Bonneville Hatchery have occurred intermittently since the hatchery was established in 1909. Early evaluation studies on fall Chinook occurred in the mid-1940's and mid-1950's and again sporadically in the 1970's and 80's. Electronic records in the Hatchery Management System (HMS) database indicate that tule fall Chinook were released from Bonneville Hatchery during the years 1978-1996, and then the program was discontinued due to lack of funding. Spring Creek NFH released approximately 15 million tules for the next 13 years. Beginning with the first release in the spring of 2009 a reprograming of production occurred, i.e., ~1.7 million of the SCNFH tule production was shifted to Little White Salmon NFH and ~2.8 million shifted to Bonneville Hatchery. The current program began with the release of tule smolts in 2009 and is expected to continue.

1.14) Expected duration of program.

The mitigation program may continue indefinitely, to augment fisheries of tule fall Chinook in Pacific Ocean and the lower Columbia River below Bonneville Dam.

1.15) Watersheds targeted by program.

Smolts are released only into Tanner Creek, a tributary of the Columbia River about one mile downstream of Bonneville Dam. Post-release migration, natural rearing, and harvest occurs in the lower Columbia River main-stem, Columbia River estuary, and the Pacific Ocean.

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

1.16.1) Brief Overview of Key Issues

Discontinuation of URB fall Chinook program at Bonneville Hatchery:

The upriver bright fall Chinook salmon program at Bonneville Hatchery was very popular to

both commercial and recreational anglers while meeting the harvest mitigation goal. Also, the URB program at Bonneville Hatchery wasn't a serious conservation concern to the listed salmonid ESU of the lower Columbia River. The replacement of the URB program at Bonneville Hatchery with tule fall Chinook is likely to meet the harvest mitigation goal, but with less angler anglers' demand or satisfaction because of the inferior quality of flesh in tule fall Chinook.

Discontinuation of yearling tule juvenile release:

Past releases of both sub-yearling and yearling tule juveniles demonstrated that smolt to adult survival rates were lower for the sub-yearling groups than the yearlings, possibly due to easy predation on the sub-yearlings by various predators along the Columbia River and the estuary. The release of only sub-yearlings from 2018 and onwards may reduce adult for harvest and may cause some public dissatisfaction. However, rearing to yearling stage also problematic due to IHN and BKD infections in the past.

Funding concerns: The program is funded by the NMFS (Mitchell Act). Any future funding reduction for the proposed tule program will impact the programs ability to meet the harvest mitigation goal. It is expected that NMFS will continue providing adequate funding for this harvest mitigation program.

1.16.2) Potential Alternatives to the Current Program.

Alternative 1. *Use of Local Brood.*

Pros: Use of only local brood (Tanner Creek stock 14) may benefit survival and adult return to Tanner Creek and/or hatchery trap and reduce stray rates. This alternative of using local broodstock is now being implemented through development of locally adapted broodstock since 2014 brood year.

Unless there is a shortage in broodstock requirement, the current program will continue using only Tanner Creek stock which may minimize strays of program fish.

1.16.3) Potential Reforms and Investments.

The current tule fall Chinook Salmon program at Bonneville Hatchery began with the first release of smolts into Tanner Creek in 2009 and the development and use of locally adapted broodstock began with brood year 2014. Therefore, sufficient data necessary for a comprehensive evaluation of the program are not available yet. Further, the NMFS recommended to increase the program size to 5,000,000 or equivalent sub-yearling release annually (Table 1.7-1).

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS. (USFWS ESA-Listed Salmonid Species and Non-Salmonid Species are addressed in ADDENDUM A)

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

- Biological Assessment for Mitchell Act Hatchery Operations, Hatcheries and Inland Fisheries Branch, Portland, Oregon (NMFS 1999a).

- Biological Opinion on Artificial Propagation in the Columbia River Basin (NMFS 1999b).

- HGMP for Bonneville Hatchery tule fall Chinook program was submitted to NMFS on 5/10/2016 for approval and ESA coverage. This is an updated version of the previously submitted HGMP with NMFS' recommended production adjustments.

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

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

All the Columbia River anadromous salmonids that successfully return to spawn must migrate through the lower Columbia River and estuary twice during their life cycle. Thus, the hatchery programs in the lower Columbia River basin have the potential to affect the listed ESU's in the Columbia basin. It is likely that the program fish may affect those ESA-listed natural salmonid populations that prevail near the sub-basin where the program fish are collected for broodstock, and smolts are released, including:

The lower Columbia River Chinook Salmon (*Oncorhynchus tshawytscha*) ESU which is federally listed as threatened under the Endangered Species Act, effective May 24, 1999.

The Columbia River Chum Salmon (*Oncorhynchus keta*) ESU is federally listed as threatened, effective May 24, 1999. The ESU includes all naturally spawning populations of Chum Salmon in the Columbia River and its tributaries in Washington and Oregon.

The lower Columbia River Steelhead Trout (*Oncorhynchus mykiss*) ESU is federally listed as threatened under the ESA.

The lower Columbia River Coho Salmon (*Oncorhynchus kisutch*) ESU is federally listed as threatened under the ESA, effective June 16, 2005. This ESU is listed as endangered by the State of Oregon.

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

The program will use only hatchery-origin tule salmon broodstock collected at Bonneville Hatchery and no listed natural fish will be taken as brood for spawning. Therefore, no direct

take of any ESA-listed natural fish will occur due to this program.

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

ESA-listed populations that may be incidentally affected during brood collection include:

Snake River fall-run Chinook Salmon ESU (Threatened)
Snake River spring/summer-run Chinook Salmon ESU (Threatened)
Snake River Sockeye Salmon ESU (Endangered)
Snake River Basin Steelhead Trout DPS (Threatened)
Upper Columbia River spring-run Chinook Salmon ESU (Endangered)
Upper Columbia River Steelhead Trout DPS (Endangered)
Middle Columbia River Steelhead Trout DPS (Threatened)
Lower Columbia River Steelhead Trout DPS (Threatened)
Lower Columbia River Chinook Salmon ESU (Threatened)
Lower Columbia River Coho Salmon ESU (Threatened)
Columbia River Chum Salmon ESU (Threatened)

It is expected that during the return of program fish to Bonneville Hatchery some ESA-listed Chinook, Coho and steelhead may enter the Bonneville Hatchery trap, and consequently, a few incidental mortalities of these listed natural fish may occur due to capture, handling, and hauling above Bonneville Dam for release (Table 2.2.3-1). Additionally, all listed species occupying natural habitats in the lower Columbia River migration corridor may be impacted by the presence of program fish. Bonneville Hatchery tules could be straying into the spawning grounds of listed natural salmonids.

Due to operation of the program at Bonneville Hatchery, the following ESA-listed populations may be indirectly affected through competitive interactions during migration through the main-stem of the lower Columbia River and estuary. The fall component of the lower Columbia River Chinook Salmon ESU is comprised of two groups: wild 'tules' and 'brights'. Native fall Chinook in Oregon tributaries of the lower Columbia River are almost all tule fall Chinook, with the exception of bright fall Chinook in the Sandy River. Small, scattered, naturally spawning populations are still observed in small Oregon tributaries (primarily Big, Plympton, and Gnat creeks and the Clatskanie River). Tule fall Chinook Salmon generally arrive at the mouth of the Columbia River beginning in August, with peak migration generally in September. Bright fall Chinook Salmon return timing generally is later than tules. Tule fall Chinook are sexually mature upon river entry and spawn soon after arrival to the spawning grounds, while bright fall Chinook are sexually immature and may hold in freshwater for months prior to spawning. Populations in the lower Columbia River have short migrations, which are more characteristic of coastal populations than upper Columbia River populations. Depending on spawn timing and water temperature, tule fall Chinook juveniles in the lower Columbia River generally emerge beginning in March-April. After emergence, they follow an ocean-type life history, emigrating in late spring/early summer as sub-yearlings. Bright fall Chinook juveniles in the lower Columbia River generally emerge from March-June and emigrate in early/late summer of their first year.

Ocean distribution of lower Columbia fall Chinook extends from the coast of Washington to Southeast Alaska, with bright fall Chinook Salmon generally more northerly distributed.

The lower Columbia River Chum are occasionally observed in the Klaskanine River and Big Creek, but are not known to be present in other Oregon tributaries to the lower Columbia. Chum salmon arrive at the mouth of the Columbia River beginning in mid-late October, with peak migration generally in November. Chum Salmon are sexually mature upon river entry and spawn soon after arrival to the spawning grounds. Depending on spawn timing and water temperature, Chum fry begin emerging in early spring (March) and emigrate shortly after emergence; peak emigration is usually late April.

Steelhead are Rainbow Trout with an anadromous life history. Lower Columbia River steelhead include summer and winter runs. Summer steelhead return from the ocean between May and November and generally spawn between January and June. Winter steelhead return to freshwater between November and April and generally spawn sometime during the months from March to June. Some adult steelhead return to the ocean after spawning and may survive a second freshwater migration to spawn twice during the life cycle. Juvenile steelhead typically rear two to three years in freshwater before emigrating to the ocean during spring and summer. The factors that cause some fish to remain in freshwater to adulthood (i.e. resident Rainbow Trout) or that motivate others to migrate to the ocean (i.e. steelhead) are not completely understood.

The lower Columbia River Coho Salmon are present in numerous Oregon tributaries to the lower Columbia. Spawning survey results indicate that both hatchery and wild Coho spawn in these tributaries, with hatchery-wild ratios varying from tributary to tributary (Brown et al. 2003). Lower Columbia River Coho are categorized as either Type S or Type N, based on their general ocean distribution either south or north of the Columbia River. Managers also refer to Type S as early stock Coho and Type N as late stock. Early stock Coho Salmon in the lower Columbia enter the Columbia River beginning in August, with peak spawn timing generally in late October. Late stock of Coho Salmon in the lower Columbia enter the Columbia River beginning in September, with peak spawn timing generally in late November and December. Depending on spawn timing and water temperature, Coho fry begin emerging in the spring and rear for a year in freshwater. Emigration begins the following spring when the fish are yearlings.

Listed populations that may be incidentally affected by the Bonneville tule Fall Chinook program include species utilizing habitat in Columbia River tributaries near Bonneville Dam (both upstream and downstream), as well as the Columbia River and estuary downstream of Bonneville Dam. The NMFS' ESA-listed salmonids use the lower Columbia River as a migratory route, and the effects of Bonneville tule fall Chinook program are expected to be minimal. Potential for impacts associated with the Bonneville tule fall Chinook program are most likely to occur in populations of threatened Chinook, Coho, steelhead, and Chum Salmon that spawn in the vicinity of Bonneville Dam.

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

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

The following discussion is limited to status of populations in the Columbia River Gorge.

The Willamette/Lower Columbia Technical Recovery Team (WLC-TRT) determined minimum abundance thresholds (MATs) for the Lower Columbia fall/spring Chinook, chum, and coho populations in the vicinity of the Bonneville Hatchery tule program (McElhany et al. 2007). The WLC-TRT established MAT values for both "critical" (very high risk of extinction) and "viable" (low risk of extinction) status. Thresholds for Chum Salmon were identified, but there was insufficient data to assess the status of Chum populations in the Columbia River ESU, so they are not presented here. The MAT values for "critical" status for Gorge and Hood populations of Chinook, Coho, and steelhead are summarized in Table 2.2.2.

The recently completed *Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead* (LCRCRP) adopts the biological criteria for achieving delisting that were established by the WLC-TRT. The WLC-TRT criteria use a scoring system that is based on each population's 100-year probability of extinction, as categorized into "extinction risk classes." The criteria do not require each population to be "viable" (i.e., having a low extinction risk), but do require a specific number of viable populations and an aggregate level of extinction risks for all populations within strata and across ESUs that are intended to assure the ESU exists into the future.

Population assessments were completed, using the best available data and scientific inference, to determine current status, in terms of extinction risk class, and improvements necessary to lower extinction risk (i.e., "gaps" to other risk classes). Consistent with NMFS guidance, this extinction risk assessment took into account a number of biological population parameters related to salmonid viability, including abundance, productivity, spatial distribution, and diversity. A sophisticated quantitative model was used to assess population abundance and productivity parameters relative to extinction risk. Assessments were done for all Oregon LCR populations, excluding chum, which are considered functionally extirpated (i.e., locally extinct) from the Oregon portion of the ESU. Table 2.2.2 summarizes the status of Chinook, Coho and Steelhead in the Gorge stratum of the Lower Columbia River ESU's.

Table 2.2.2. Abundance, risk status, critical and viable thresholds for the lower Columbia River fall Chinook, Coho and winter Steelhead populations.

Chinook (fall)		Abundance	Current Risk	MAT Critical	MAT Viable
	Lower Gorge	74	VH	<150	750
	Upper Gorge	17	VH	<150	750
	Hood	144	VH	<400	800
Coho					
	Lower Gorge	22	VH	600	1100
	Upper Gorge/Hood	41	VH	1200	2200
Steelhead (winter)					
	Lower Gorge	550	M (H)	<150	625
	Upper Gorge	151	VH (H)	<150	625
	Hood	1,127	M	<225	750
	Hood (Summer)	35	VH	<225	750

- Provide the most recent 12 year (e.g. 2003-2015) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data. Although Bonneville Dam serves as a counting station in this portion of the Gorge, those passage count data cannot be used to infer spawning levels on nearby populations. For Coho the most recent estimates for the Gorge stratum is 287, 537, and 1,143 for years 2008, 2009, and 2010, respectively (ODFW 2011). For Chinook there are very few data available on wild fish. Current natural spawning numbers are thought to be ~100 fish in Lower Gorge tributaries of Washington (LCFRB 2010) but is likely comprised of mostly hatchery fish of tule and up-river bright stocks. Likewise for steelhead, very few data are available.

- Provide the most recent 12 year (e.g. 2005-2014) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

Although the adult-fish return of Bonneville Hatchery tule program began in 2011 there is not enough research data of the tule stratum due to inadequate samples to determining the proportion of hatchery-origin and listed natural-origin fish on natural spawning grounds.

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

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

Incidental take of the lower Columbia River Chinook, Coho, upper Columbia Chinook, Columbia River Chum, steelhead, Pink Salmon and Sockeye Salmon may occur during tule

fall Chinook broodstock collection at Tanner Creek adult fish trapping facility. If trapped, the listed natural fish are hauled above Bonneville Dam for release. Also, there may be competitive interactions for food and space between hatchery-released tule fall Chinook Salmon and listed naturally-produced salmonids in the Columbia River downstream of Bonneville Dam, but these effects have not been quantified.

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

Table 2.2.3-1. Listed natural fish captured and released unharmed during brood collection of Coho, Tule, and upriver bright fall Chinook Salmon at Bonneville Hatchery, 2011-2016.

Species	2011	2012	2013	2014	2015	2016
Coho Salmon	1,384	619	1,280	710	289	451
Chum Salmon	0	0	4	12	46	8
Chinook Salmon	0	704	2,095	1,636	2,129	1,497
Pink Salmon	0	0	2	0	4	0
Sockeye Salmon	0	0	1	0	3	0
Steelhead	12	49	90	108	92	28

Source: ODFW's Hatchery Management System (HMS) database.

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

The projected annual incidental take of listed natural adult fish during broodstock collection at Bonneville Hatchery are presented below in Table 2.2.3-2. These fish will be hauled for release above Bonneville Dam for upstream migration, and no lethal take is expected during the operation.

Table 2.2.3-2. Projected annual take levels of listed salmonids during brood collection of Tule, Coho and Chinook Salmon at Bonneville Hatchery.

Action	Lower Columbia Chinook (Tule)		Upper Columbia Chinook (URB)		Columbia Chum		Lower Columbia Coho		Summer Steelhead		Pink Salmon		Sockeye Salmon	
	Life stage[b]	Estimated Annual take	Life stage[b]	Estimated Annual take	Life stage[b]	Estimated Annual take	Life stage[b]	Estimated Annual take	Life stage[b]	Estimated Annual take	Life stage[b]	Estimated Annual take	Life stage[b]	Estimated Annual take
Observe or harass a)	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0
Collect for transport b)	A	0	A	0	A	0	A	0	A	0	A	0	A	0
Capture, handle, and release c)	A, J	1800	A, J	600	A, J	20	A, J	300	A, J	100	A, J	2	A, J	1
Capture, handle, tag mark/tissue sample, and release d)	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0
Removal (broodstock)e)	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0
Intentional lethal take f)	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0
Unintentional lethal take g)	A, J	< 5	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0
Other take (specify) h)	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0	A, J	0

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

Instructions:

1. An entry for a fish to be taken should be in the take category that describes the greatest impact.
2. Each take to be entered in the table should be in one take category only (there should not be more than one entry for the same sampling event).
3. If an individual fish is to be taken more than once on separate occasions, each take must be entered in the take table.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

If take levels are expected to exceed the levels shown in the plan as a result of tule broodstock collection at Bonneville Hatchery (Table 2.2.3b), the trap operation and collection method would respond by implementing alternative strategies including changes in timing of trap operation and/or return of listed natural fish back to Tanner Creek.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

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

• *Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead (ODFW and NMFS 2010)*

This document provides direction for the management of fish populations to protect and enhance naturally spawning populations in adjacent populations to the Bonneville tule program by identifying and addressing factors that impact those populations.

- Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead (ODFW and NMFS 2010).

- ESA Recovery Plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead (NMFS 2013).

• *Native Fish Conservation Policy* (OAR 635-007-0502 through -0509), and
• *Fish Hatchery Management Policy* (OAR 635-007-0542 through 0548)

The policies outlined in these documents further refine the objectives for conservation of native fish stocks and limiting the impacts of hatchery produced fish on those native stocks. The Native Fish Conservation Policy (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. These conservation plans are to contain an assessment of the status of each native stock, a description of the desired biological status relative to measurable biological attributes, a description of short and long term management strategies to

address the primary limiting factors, short and long term monitoring and research needs, and a description of measurable "trigger" criteria which would indicate a change in status or a need to modify or expand recovery efforts.

The Fish Hatchery Management Policy (FHMP) compliments the NFCP in providing direction for the application of hatcheries as a fisheries management tool. The FHMP promotes the use of best management practices to ensure conservation of both naturally-produced native fish and hatchery-produced fish in Oregon. The policy requires a hatchery management plan for each program, and requires effective coordination planning be done cooperatively with other state, federal, and tribal management partners, as well as with university programs and the public. The policy provides general fish culture and facility guidelines and measures to maintain the genetic resources of native fish populations spawned or reared in captivity.

- *Fish Health Management Policy* (OAR 635-007-0960 to 635-007-1000)

This policy was developed to "minimize the impact of fish diseases on the state's fish resources." The policy applies to all forms of fish hatchery operations, including Salmon and Trout Enhancement Program (STEP) projects, and to all importation, transportation, release, and rearing of non-aquaria species within the State of Oregon. The goal is to inspect and detect disease agents in order to contain and treat them, and thus curtail potential impacts on existing fish populations.

- *US vs. Oregon*

This program aids in fulfillment of annual management agreements between the states of Oregon and Washington, the Federal Government, and the Columbia River Treaty Tribes under the jurisdiction of the US District Court.

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

The tule fall Chinook program is consistent with the following policies, plans, agreements and permits:

- US V Oregon Treaty
- Mitchell Act
- Fisheries Management and Evaluation Plan- Lower Columbia River Chinook in Oregon Freshwater Fisheries of the Lower Columbia River Tributaries Between the Pacific Ocean and Hood River.
- NMFS 2008 Biological Opinion on Artificial Propagation in the Columbia River Basin.
- Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead

- Native Fish Conservation Policy.
- Hatchery Management Policy.
- Fish Health Management Policy.
- IHOT policies and Procedures for anadromous Salmon hatcheries.
- NPDES permit for hatchery operations.

3.3) Relationship to harvest objectives.

The current program on tule production at Bonneville Hatchery is relatively new, beginning with the first release of sub-yearling smolts in 2009. This is a harvest mitigation program and its main objective is to increase the harvest of tule Chinook Salmon by commercial and recreational fishermen in the Pacific Ocean and in the lower Columbia River. All smolts are ad-clipped for selective harvest, and certain numbers of smolts are tagged with coded-wires in order to estimate survival, harvest locations, fishery contribution, stray rates etc.

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

The current Bonneville tule program originated with the release of sub-yearling smolts into Tanner Creek in 2009 and estimated contribution to various fisheries is based on limited wire tag recovery data. The eggs for 2009 - 2014 Bonneville sub-yearling releases came from tule program at Spring Creek NFH. The HGMP for the Spring Creek tule program reported that SCNFH releases contributed significantly to Chinook Salmon harvest in Ocean (including Canadian) and in-river commercial, sport, and tribal fisheries. It was expected that the current tule program at Bonneville would make similar contributions to the fisheries.

Recent CWT recovery data verifies adults from Bonneville tule releases are being caught in both commercial and recreational fisheries in the ocean and in the Columbia River. Overall contributions to fisheries have been increasing each year since the program's inception. Tables 3.3.1a and 3.3.1b show percentages of estimated CWT's recovered in fisheries by brood year and return year, respectively. Although the recovery data for the 2012 cohort is incomplete, the groups continue to contribute, on average, 46.25% of their production to commercial and sport fisheries annually (Table 3.3.1b).

Escapement is the number of fish that were not harvested in fisheries. It includes fish collected at the hatchery, on spawning grounds and in freshwater traps. Escapement is covered in more detail in section 11. On average, 53.8% of adults produced from the Tanner Creek program have escaped ocean and freshwater fisheries from 2011-2016. Expansions of recovered CWT's in relation to the number of CWT's in the release group can be used to estimate contributions to fisheries and escapement. The estimated numbers of fish harvested in fisheries and returning to hatcheries are presented in Table 3.3.1c

Table 3.3.1a. Percentage of total estimated recovered CWT's from Bonneville tule releases contributing to Commercial and Sport Fisheries in Ocean and Freshwater by brood year and tagcode. Survival percentage (SAR) includes fisheries and escapement.

Brood Year	Release Date	Tagcode	Ocean		Freshwater		% of CWT recoveries to Fisheries	Overall Survival (%) SAR
			Comm	Sport	Comm	Sport		
2008	05/16/09	090198	11.9%	10.3%	18.1%	0.0%	40.4%	0.22
2009	5/3/10	090326	12.8%	16.2%	12.4%	1.7%	43.1%	0.23
2010	5/25/11	090486	14.3%	11.9%	19.6%	2.9%	48.7%	0.22
2011	5/18/12	090571	19.7%	12.1%	16.8%	1.6%	50.3%	0.50
2012[1]	5/17/13	090568	19.9%	6.8%	13.5%	2.6%	42.9%	0.45

Table 3.3.1b. Percentage of estimated recovered CWT's from Bonneville tule releases contributing to Commercial and Sport Fisheries in Ocean and Freshwater by return year.

Return Year	Ocean		Freshwater		Yearly % to Fisheries	Yearly % to Escapement
	COMM	SPORT	COMM	SPORT		
2011	11.6%	9.9%	17.1%	1.1%	39.6%	60.4%
2012	15.6%	14.9%	14.5%	1.9%	47.0%	53.0%
2013	9.8%	15.8%	18.6%	1.9%	46.2%	53.8%
2014	19.5%	12.9%	16.8%	1.0%	50.2%	49.8%
2015	21.0%	5.6%	11.4%	3.2%	41.1%	58.9%
2016	4.3%	13.2%	13.0%	6.7%	37.2%	62.8%
Median	15.63%	12.85%	16.84%	1.93%	46.2%	53.8%

[a]Data for 2016 return is incomplete for ocean commercial fisheries and is not included in the median calculation.
Source: RMIS database 2017.

Table 3.3.1c. Estimated numbers of Chinook harvested in fisheries and returning to the hatchery from Bonneville Hatchery releases, brood years 2008-2012. Numbers are fish equivalents based on the number of CWT's recovered.

			Ocean		Freshwater				
Brood Year	Ad+CWT	Total Released	Comm	Sport	Comm	Sport	Esc	Total	SAR (%)
2008	163,683	2,492,752	653	565	989		3,261	5,468	0.22
2009	169,767	2,869,669	834	1,056	810	111	3,709	6,519	0.23
2010	170,842	2,753,210	850	709	1,168	174	3,061	5,962	0.22
2011	171,083	2,687,942	2,643	1,621	2,252	218	6,656	13,390	0.50
2012[1]	168,873	2,784,983	2,479	843	1,678	327	7,104	12,431	0.45

[1]Data for brood year 2012 is incomplete. Source: RMIS database 2017.

3.4) Relationship to habitat protection and recovery strategies.

There is no known natural salmonid production in lower Tanner Creek, which serves as the hatchery's water source and fish release point. Thus, no habitat protection or recovery strategies have been developed or necessary for Tanner Creek.

Habitat protection and recovery strategies were developed in the draft Lower Columbia River and Estuary Bi-State Sub-basin Plan (LCREP 2004) and the Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead (ODFW and NMFS 2010). The Bonneville tule fall Chinook Salmon program will be operated in consistent with these habitat protection and recovery strategies.

One of the major factors inhibiting natural production of tule fall Chinook Salmon in the main-stem Columbia River below Bonneville Dam is the impact of Bonneville Dam operation. If mitigation goals are to be achieved, continued hatchery production will be necessary to replace the harvest opportunities that were lost due to habitat degradation or loss.

3.5) Ecological interactions.

(1) Species that could negatively impact the program include:

- Avian predators, such as great blue herons, Caspian terns, cormorants, and gulls,
- Mammalian predators such as river otters, harbor seals, or sea lions,
- Introduced fish species such as American Shad, Walleye, Smallmouth Bass, and Channel Catfish,
- Northern Pikeminnow,
- Out-of-basin hatchery salmonid releases,
- Known or unknown aquatic non-indigenous animals and plants.

The majority of the preceding species can be characterized as predators of juvenile

salmonids, or competitors which may negatively affect Bonneville tule fall Chinook juvenile survival after release. In recent years, Caspian terns (*Sterna caspia*) have colonized the Columbia River estuary; the colony currently represents the largest in North America. Recent estimates of annual Caspian tern predation on salmonid smolts have been as high as about 25 million (Roby et al. 1998). Caspian tern predation is highest on large smolts, such as steelhead or Coho that spend 1-2 years rearing in freshwater. Predation is lower on smaller, ocean-type salmonids such as fall Chinook and Chum Salmon that emigrate as sub-yearlings. Northern Pikeminnow (*Ptychocheilus oregonensis*) have been estimated to annually consume millions of juvenile salmonids in the lower Columbia River (Ward et al. 1995). Most Northern Pikeminnow predation is thought to occur downstream of Dams. Pikeminnow abundance in the Columbia River estuary is likely low; therefore, Pikeminnow effects are expected to be highest near the mouth of Tanner Creek and diminish with distance downstream. Walleye (*Sander vitreus*), Smallmouth Bass (*Micropterus dolomeiui*), and Channel Catfish (*Ictalurus punctatus*) have been estimated to consume substantial numbers of emigrating juvenile salmonids (Zimmerman 1999). The impacts from these species are thought to be highest around Dams and throughout impounded reaches of the Columbia River (Zimmerman and Parker 1995). Like Pikeminnow, their abundance in the Columbia River estuary is thought to be low; thus, their predation effects on the lower Columbia River and the estuary should be highest near Bonneville Dam and progressively decrease with distance downstream.

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

American Shad (*Alosa sapidissima*) and large out-of-basin hatchery salmonid releases represent potential competitors of juvenile Bonneville tule fall Chinook and may decrease juvenile survival through density dependent competition effects. In the lower Columbia River and estuary, juvenile American shad were described as year-round residents in all areas of the estuary (Bottom et al. 1984). Multiple studies have found overlap in both habitat use and diet items in juvenile American Shad and both sub-yearling and yearling salmonids (McCabe et al. 1983; Bottom et al. 1984), suggesting competition for food and space. Additionally, other hatchery fish may be a source of competition for Bonneville tule fall Chinook. The potential exists for large-scale hatchery releases of fry and fingerling ocean-type Chinook Salmon to overwhelm the production capacity of estuaries (Lichatowich and McIntyre 1987). Estuaries may be “overgrazed” when large numbers of ocean-type juveniles enter the estuary en masse (Reimers 1973; Healey 1991). Food availability may be negatively affected by the temporal and spatial overlap of juvenile salmonids from different locations. Competition for prey may develop when large releases of hatchery salmonids enter the estuary (Bisbal and McConnaha 1998), although

this issue remains unresolved (Williams et al. 1998).

Aquatic non-indigenous species introductions in the lower Columbia River represent permanent alterations of the biological integrity of the ecosystem for numerous reasons. Impacts of introduced species are unpredictable, introduced species alter food web dynamics, and introduced species are a conduit for diseases and parasites (Waldeck et al. 2003). Significant changes in estuary faunal and floral communities have occurred through species introductions, but, for the most part, the effects of these species introductions have not been assessed. Several nonnative invertebrate species have expanded their populations dramatically since introduction, particularly the Asian bivalve, *Corbicula fluminea*. Additionally, ecosystem effects of non-indigenous aquatic plants are a concern for many resource managers. Of particular interest in the Columbia River estuary and lower main-stem are four plants considered noxious weeds: purple loosestrife (*Lythrum salicaria*), Eurasian water milfoil (*Myriophyllum spicatum*), parrot feather (*Myriophyllum aquaticum*), and Brazilian elodea (*Egeria densa*). Effects of these non-indigenous species on Bonneville tule fall Chinook Salmon are unknown.

(2) Species that could be negatively impacted by the program include:
Lower Columbia River Chinook Salmon,
Lower Columbia River Chum Salmon,
Lower Columbia River steelhead trout,
Lower Columbia River Coho Salmon,
Out-of-basin wild salmonids using the Columbia River estuary.

Wild juvenile salmonids using the Columbia River estuary may be affected by releases of Bonneville tule fall Chinook Salmon smolts through competitive interactions for food and space. The influence of these hatchery juveniles as predator for other species migrating through the lower Columbia is unknown and is expected to be low as they are released as small sub-yearling and in lower numbers, yearling smolts. Release of yearling tule juveniles, however, will be discontinued after 2018 release. Some researchers claim that releases of hatchery juveniles in general attract predators, thereby increasing predation on wild juvenile salmonids (Bayer 1986; Collis et al. 1995) while other researchers suggest that releases of hatchery fish may overwhelm predators, thereby providing a competitive advantage to wild juvenile salmonids that have better predator avoidance capability than hatchery fish (Petersen and De Angelis 1992).

As adults, Bonneville tule fall Chinook Salmon will return at a time of year that overlaps the run timing of other lower Columbia River fall Chinook, Chum Salmon, Coho Salmon, and possibly summer and winter runs steelhead. However, wild fall Chinook, Chum, steelhead, and Coho are not present in Tanner Creek. Thus, ecological interactions with wild adult salmonids are restricted to the Columbia River migration corridor and should be minimal as they would be harvested by commercial and recreational fishermen. Harvest impacts will be regulated through the federal and state limits. Also, genetic interactions with wild fall Chinook is assumed to be limited to the main-stem Columbia River where some stray Bonneville tule fall Chinook may spawn with wild fall Chinook in the vicinity of Tanner Creek.

Genetic Introgression- Genetic introgression may occur if hatchery adults spawn in the wild. It is possible that interbreeding between hatchery-produced tule and naturally-produced fall Chinook may degrade genetic quality of wild populations below Bonneville Dam. However, data of such interbreeding and genetic introgression are not currently available. Also, all the program fish shall have identifiable ad-clip marking and shall be heavily harvested in the ocean, estuary, and the lower Columbia River by commercial and recreational fisheries.

Transmission of Diseases- There is potential that disease agents from hatchery-reared tule fall Chinook Salmon may be transmitted to the effluent that drains into Tanner Creek and the lower Columbia River. To minimize the disease risks the hatchery operation follows the Fish Health Management Policy and IHOT standards and protocols for fish culture operations. Fish health status is regularly inspected each month, and prior to transfer and pre-release. Fish are treated per pathologist's recommendation, and only certified fish are released into the river.

Food Competition in the Estuary and the Ocean: Releasing 5 million sub-yearling yearling tule smolts from Bonneville Hatchery may cause density-dependent effects during years of low ocean productivity, especially in nearshore areas affected by upwelling (Chapman and Witty 1993). To date, research has not demonstrated that hatchery and naturally produced salmonids compete directly in the ocean, or that the survival and return rates of naturally produced and hatchery origin fish are inversely related to the number of hatchery origin smolts entering the ocean (Enhancement Planning Team 1986). If competition occurs, it is most likely to occur in near-shore areas when (a) up-welling is suppressed due to warm ocean temperatures and/or (b) when the abundance or concentration of smolts entering the ocean is relatively high. However, we are only beginning to understand the food-chain effects of cyclic, warm ocean conditions in the eastern North Pacific Ocean and associated impacts on salmon survival and productivity (Beamish 1995; Mantua et al. 1997). Consequently, effects of the potential competitive interactions in the ocean cannot be discounted (Emlen et al. 1990).

(3) Species that could positively impact program: There are no species that are known to positively impact the program. Stream enrichment in Tanner Creek would provide little benefit to the program fish because hatchery fish released into Tanner Creek enter the main-stem Columbia River shortly after release. There is little, if any, extended juvenile rearing that may occur in Tanner Creek.

(4) Species that could be positively impacted by program: There are no species that are known to be positively impacted through the program. There is no known natural production of fish in the lower reach of Tanner Creek and surplus hatchery adults are not returned to Tanner Creek to serve as a nutrient or food base. The sub-yearling and yearling tule release has the potential for playing a role in the population dynamics of predator-prey relationships and community ecology during low productivity and shifting climatic cycles.

SECTION 4. WATER SOURCE

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

Bonneville Hatchery:

Bonneville Hatchery operates on a combination of well water (14,500 gpm) and Tanner Creek surface water supply. Water flow for production averages 19,680 gallons per minute (gpm) for the year. The water meets or exceeds the recommended IHOT water quality guidelines for temperature, ammonia, carbon dioxide, chlorine, pH, copper, dissolved oxygen, hydrogen sulfide, dissolved nitrogen, iron, and zinc. To ensure uninterrupted water supply to the hatchery the water intakes are equipped with flow alarms, to alert hatchery staff to emergency situation. Also, continued water supply is ensured by redundant power supply provided by Bonneville Dam. The water supply does not impose any production limitations.

Washougal Hatchery:

The hatchery has a total of 15,061 gpm water rights from three sources.

Table 4.1: Water sources and qualities of Washougal Hatchery.

Water Source	Water Right	Available Water Flow	Avg Water Temp. (°F)	Usage	Limitations
Washougal River (surface)	S2-25274C WRIS	10.0 cfs	48	Rearing	Limited water during summer months due to low flows. Temps in lower river can reach the 70s in the summer.
		12.0 cfs	48		
Boyles Creek (spring water)		5.5 cfs	45	Rearing	Limited water during summer months due to low flows.
Bob Creek (surface)		3.0 cfs	45	Rearing, incubation	

Four electric pumps deliver river water to the hatchery at 1600 gpm each from intakes on the Washougal River. Two turbine-driven pumps can also provide water at up to 2000 gpm each; the turbine pumps provided up to 700 gpm prior to replacement in 2012. An emergency generator located in the pump house can run the electric pumps in case of power outage. During lower-use periods (November/December), the river intake supplies 3,500 gpm (7.8 cfs); from March through August, use increases to 7,500 gpm (16.7 cfs).

Spring water from Boyles Creek, located approximately 75 yards from the hatchery, supplies 2300 gpm (5.1 cfs) non-turbid and minimal silt-laden water to the hatchery during high flow river events and is used for ponds 13 thru 24 as well as 27 for fall Chinook rearing. Since this is a short stream from a spring source, the agency has determined there are no fish populations within this stretch and does not need a screen

intake. A gravity intake on Bob Creek is located 1/3 mile from the grounds and supplies 2.5 cfs for incubation.

During summer, water from the river intake reflects elevated temperatures. Water temperature data collected at the Washougal Salmon Hatchery between 1987 and 1991 also documents high water temperatures in the upper Washougal basin. During this five-year recording period, water temperatures at the hatchery frequently exceeded 17.8°C during July, August and September; in some cases for as long as 17 days in a row.

4.2) Indicate the risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, of effluent discharge.

Both facilities (Bonneville and Washougal) are operated within the limitations established in the National Pollutant Discharge Elimination System (NPDES) permits, to comply with the federal Clean Water Act and water quality standards for hatchery effluents.

The intake screens at the Bonneville Hatchery comply with NOAA Fisheries screening criteria.

Intake structures of Washougal Hatchery, however, were designed and constructed to specifications at the time the Washougal facility was built. The *Mitchell Act Intake and Screening Assessment* (2002) has determined that the intake screens and velocity at Washougal Hatchery are not compliant with NOAA fish screening standards. The allowable velocity of 0.40 fps is exceeded and the backup pump is too close to the screen area, causing high approach velocities. The Washington Department of Fish and Wildlife (WDFW) has requested funding for future scoping, design, and construction work of a new intake system. And, Bob Creek in not a fish-bearing stream.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

All broodstocks for the program fish are collected at Bonneville Hatchery as they return to the hatchery in late August and September. To enter the hatchery, adult fish swim the length of the fish ladder to the adult collection channel at the base of the adult holding pond. From the collection channel, adult fish are lifted into the spawning building by means of a wet well and elevator basket, anesthetized (using electro- anesthesia), sorted, enumerated and directed into appropriate holding ponds by Bonneville Hatchery staff.

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

Bonneville Hatchery staff return all unmarked adult fish trapped at Bonneville Hatchery

to the Columbia River. Fish are transported and released upstream of Bonneville Dam. Bonneville Hatchery has an on-station adult transport truck and tank to use in transportation of adult fish back to the upriver above Bonneville Dam.

5.3) Broodstock holding and spawning facilities.

Adult fish enter the mouth of Tanner Creek from the Columbia River and swim ~ ¼ mile upstream to the entrance of Bonneville Hatchery fish ladder and adult collection system. The fish ladder terminates at the adult collection channel where adults are held in a collection channel until they can be brought into the spawning building, enumerated and directed into the appropriate adult holding ponds. Each holding pond is provided with 5,000 gpm of Tanner Creek and well water.

5.4) Incubation facilities.

Table 5.4-1. Incubation facilities at Bonneville Hatchery.

Incubator Type	Units (#)	Flow (gpm)	Volume (ft^3)	Loading-Eyeing (eggs/unit)	Loading-Hatching (eggs/unit)
Vertical stacks (Heath)	1,800	5.0	NA	Not used	5,000 eggs/tray
Deep troughs	300	12.0	1.9	35,000 eggs/basket	Not used

Bonneville Hatchery uses well water exclusively to incubate eggs and fry. Water temperature is monitored daily and recorded for use in monitoring egg and fry development. Well water temperatures in incubation facilities vary between 49ºF and 55ºF. Dissolved oxygen (DO) levels are monitored as needed to confirm that DO levels are within the rearing parameters at maximum oxygen demand. Use of well water ensures that siltation is not an issue at Bonneville. Each top incubation tray and head box is equipped with alarm system to instantly notify hatchery staff of any water supply disruptions.

Table 5.4-2. Incubation facilities at Washougal Hatchery.

Type	Units (number)	Size			Flow (gpm)	Volume (cu.ft.)	Loading (eggs/unit)
		Length	Width	Depth			
Vertical Heath Stack Tray Units (16 trays/stack)	72 (1,152 trays)	24-in	25-in	4-in	3-5	0.55/tray	8,000
Fiberglass Deep Troughs (green eggs)	4	14-ft	3-ft	25-in	8-12	87	1,000,000

At Washougal Hatchery, fertilized eggs are incubated in the deep troughs until eyed stage, then moved to Heath stack incubators for hatching. Washougal Hatchery will receive about 2.2 million tule fall Chinook eyed eggs annually from Bonneville Hatchery for incubation and fry rearing, to produce 1.8 million sub-yearling smolts for acclimation at Bonneville Hatchery and release into Tanner Creek. Spring water taken from Bob Creek is used to incubate eyed-eggs.

5.5) Rearing facilities.

Bonneville Hatchery has the following rearing infrastructure to accommodate tule Chinook rearing until release into Tanner Creek.

Table 5.5-1. Rearing facilities at Bonneville Hatchery.

Number of ponds	Pond type	Volume (cu.ft)	Length (ft)	Width (ft)	Depth (ft)	Flow (gpm)	Max flow index
28	concrete	3,780	75	16.8	3	650	NA
26	concrete	4,800	80	20	3	700	NA
12	Canadian Troughs	94	16	3	2	50	NA

Table 5.5-2. Rearing facilities at Washougal Hatchery.

Pond Type	Units (No.)	Volume (cu.ft)	Size			Flow (gpm)	Max. Flow Index	Max. Density Index
			Length (ft.)	Width (ft.)	Depth (ft.)			
Concrete Raceways	12	4800	80	20.0	3.0	500	2.69	0.17
Concrete Raceways	12	8300	135	17.5	3.5	450		
Concrete Rearing Pond	1	85,500	475	40	4.5	11,000	2.26	0.26

Swim up fry are ponded into concrete raceways. After initial rearing in concrete raceways, sub-yearlings are mass marked with ad-clip, and 150,000 are CWT for Bonneville fish. The fish are then moved to a large concrete rearing pond until release or shipment to Bonneville Hatchery.

Earthen pond 27 was modified in 2010 to help reduce loading densities. This pond has been modified to a concrete raceway measuring 475’ X 40’ X 4.5’.

5.6) Acclimation/release facilities.

Fish are directly released from the rearing ponds into Tanner Creek, which is ~ ¼ mile from the main-stem Columbia River. Sub-yearlings received from Washougal Hatchery will be placed into ponds vacated by the May release of Tanner Creek sub-yearlings into Tanner Creek.

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

Water intake at Bonneville Hatchery was interrupted twice in 2017 due to massive ice pellet deposition in Tanner Creek. This has happened numerous times in the past whenever there was a major ice storm event in the gorge. Fortunately, the facility has well-water to offset the loss of Tanner Cr. water.

Washougal Hatchery has experienced operational difficulties during drought events, which caused problems in water availability and quality (temperature). Icing and slushing problems during the winter within the ponds can be a problem. Otherwise, the facility does not experience abnormal operational difficulties.

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

Bonneville Hatchery:

The hatchery-produced tule Chinook Salmon (stock 14) is not an ESA-listed population. The facility is sited at a location that has very negligible risk of catastrophic fish loss due to flooding. To avoid fish losses due to water system failure, the hatchery has a centralized monitoring and alarm system with low flow and water level alarms located throughout the system. This alarm system is connected to a hardwired and radio notifications system. During fish rearing season, an "on-call" schedule ensures that someone is monitoring the alarm system at all times. Also, Bonneville Hatchery can use well water as a back-up system from the aquifer under the Columbia River. The wells have two different electrical sources that are supplied directly from Bonneville Dam.

Fish health and disease transmission issues are addressed as per Oregon Fish Health Management Policy, and following Policy and Procedures for Columbia Basin Anadromous Salmonid Hatcheries (IHOT 1995). Fish health condition is inspected at least once in every month, and all measures are taken as per suggestion/prescription of a fish health specialist, to prevent outbreak and/or transmission of diseases.

Washougal Hatchery:

- All pumps, incubation and rearing receptacles have water loss alarms.
- One main river pump is kept specifically as a back-up in case of mechanical failure.
- Backup generator system is automatic in case of power loss.
- Multiple water sources (Boyles and Bob Creeks) are gravity-fed and can be used in case of total power and/or backup generator failure.
- Staff is available 24/7 to respond to pump failure, water loss, and flooding events.
- Aeration pumps are used to maximize the water conditions in the adult collection pond during periods of low water quality which benefits fish held until sorting can be accomplished.
- Fish health protocols through broodstock collection, incubation and rearing phases are followed and monitored monthly.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

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

6.1) Source.

Hatchery-origin adult fish returning to Bonneville Hatchery will be the main source of broodstock for this tule fall Chinook Salmon program. Should a shortage of broodstock occur at Bonneville Hatchery, hatchery-origin tules returning SCNFH may be used as a backup source for broodstock. The backup broodstock may be spawned at SCNFH and fertilized green or eggs may be shipped to Bonneville Hatchery.

6.2) Supporting information.

6.2.1) History.

The following historical background of tule broodstock was taken from the SCNFH tule HGMP (2004). The tule fall Chinook program at SCNFH started in 1901 when fall Chinook Salmon eggs were collected from both the White Salmon and the Little White Salmon rivers. Some of these eggs were incubated in spring water coming out of the basalt cliffs about a mile west of the confluence of the White Salmon and Columbia rivers. Within a few years adult salmon started returning to this spring water and eggs were collected.

In the past, adult tule fall Chinook collected from the White Salmon and Little White Salmon rivers provided the original source of eggs for the SCNFH. Eggs were collected from the White Salmon starting in 1901 and continued uninterrupted until 1964. Eggs were also collected from the White Salmon in 1986 and 1987.

In 1972, 12 million eggs from the Toutle River State Hatchery (Washington Department of Fish and Wildlife) were brought into Spring Creek. The Toutle River stock originated from Spring Creek. Toutle River State Hatchery eggs were fertilized with Spring Creek NFH males and egg loss exceeded 50%. Less than 5 million smolts were released from this group.

In 1986, 1.1 million eggs were transferred from Little White Salmon National Fish Hatchery. These adults were strays from Spring Creek that entered the Little White Salmon River.

During the mid-80's through the mid 90's Spring Creek experienced some major shortfalls in adult survival. To ensure that program goals were met, eggs were imported from several other hatcheries. In 1987 and 1988 adult females were transferred from Bonneville State Hatchery (Oregon Department of Fish and Wildlife). These eggs were

fertilized with Spring Creek NFH males. In 1987 and 1988, 6.1 and 13.1 million eggs were collected, reared and released at Spring Creek NFH.

For the Bonneville Hatchery tule fall Chinook program, Spring Creek National Fish Hatchery transferred five million "tule fall Chinook" eyed eggs (early spawning stock) to Bonneville Hatchery in the fall of 2008. And then transfer of approximately three million Spring Creek stock tule eggs from SCNFH to Bonneville Hatchery continued through the fall of 2013. Thus, Bonneville Hatchery released Spring Creek stock tule juveniles from the spring of 2009 through 2014. Beginning with the return year or brood year 2014, Bonneville Hatchery was able to complete the development of a locally adapted tule broodstock which is now Tanner Creek stock-14, and being used for the program.

6.2.2) Annual size.

Because of high mortality of adult tule fall Chinook Salmon in holding ponds about 3,200 hatchery-origin adult tule fall Chinook will be collected (including mortalities) for broodstock purpose (assuming sex ratio of 1:1), to meet the NMFS' recommended release goal of 5,000,000 or equivalent sub-yearling smolts annually (Table 1.7-1). All broodstocks are hatchery-origin fish; no wild fish are retained or used for broodstock.

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

No wild fish have been taken for broodstock since the onset of Bonneville Hatchery tule fall Chinook Salmon program in 2009, and there is no plan to incorporate listed natural fish into broodstock for spawning.

6.2.4) Genetic or ecological differences.

It is assumed that the genotypic and phenotypic characteristics of the present hatchery population are similar to the original natural stock from the White Salmon River; but there is little if any recent data concerning this subject (source: SCNFH tule HGMP).

6.2.5) Reasons for choosing.

The current population size of listed natural tule fall Chinook below Bonneville Dam cannot withstand the annual removal of 3,200 adults for broodstock purpose. Therefore, it became necessary to identify a source of hatchery-origin adults that are genetically similar to the natural tule populations below Bonneville Dam. In Section 6.2.1, it has been reported that in 1987 and 1988 adult females were transferred from Bonneville State Hatchery (Oregon Department of Fish and Wildlife) to fertilize eggs with Spring Creek NFH males, when 6.1 million and 13.1 million eggs, respectively, were collected, reared and released from Spring Creek NFH. It is assumed that the hatchery-produced tule at SCNFH have some genetic linkage with the local tule populations below Bonneville Dam, and therefore, was chosen for broodstock development. And since the brood year 2014, only hatchery-origin tule fall Chinook returning to Bonneville Hatchery are being used as broodstock for the program.

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

ESA-listed natural fish are not selected for broodstock or spawning for Bonneville Hatchery tule fall Chinook program. Any listed natural fish that are trapped during brood collection are carefully handled with minimal stress and transported by truck and released above Bonneville Dam to continue their migration upstream for natural spawning. Hatchery-origin tule salmon returning to Bonneville Hatchery are easily identified as adipose fin-clipped.

SECTION 7. BROODSTOCK COLLECTION

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

Adult fish are collected at Bonneville Hatchery as they volitionally return to the hatchery trapping facility.

7.2) Collection or sampling design.

Broodstock are collected as they return to Bonneville Hatchery. Adult fish typically begin to return to the hatchery in late August and are collected until the migration to the hatchery stops in early October. Returning adults enter the collection channel by means of the fish ladder. From the collection channel, adult fish are lifted into the spawning building by means of a wet well and elevator basket, anesthetized (using electro-anesthesia), sorted, enumerated and directed into appropriate holding ponds by hatchery staff.

7.3) Identity.

The adult tule fall Chinook are easily distinguished from other fall Chinook stocks and salmonid species based on coloration. All tule fall Chinook juveniles released from Bonneville are adipose fin-clipped in order to distinguish between returning naturally-produced and hatchery-produced tule adults. In addition, certain numbers of fish are also coded-wire tagged to verify origin, age and release group upon return to the hatchery.

The majority of tule fall Chinook collected and processed at Bonneville Hatchery during the years 2012-2016 were of Spring Creek stock origin released either at Spring Creek Hatchery or Bonneville Hatchery (Table 7.3a). In 2013, the Little White Salmon NFH release of Spring Creek stock contributed to 28.2% of the hatchery return as well. In 2016, fish returning from the Tanner Creek stock releases contributed to 34% of the collection at Bonneville. It is expected that the Tanner Creek stock releases will dominate the hatchery returns as the last Spring Creek stock releases from Bonneville mature and return to the hatchery.

Table 7.3a. Stock composition of hatchery-origin tules collected and processed at Bonneville Hatchery from 2012-2016, derived from estimated CWT recoveries expanded for release totals.

		Return Year				
Hatchery	**Stock**	**2012**	**2013**	**2014**	**2015**	**2016**
Big Creek and Klaskanine	Big Creek	0	0.3%	0.2%	0	0.2%
Bonneville	Spring Cr	69.7%	37.3%	37.3%	36.1%	26.6%
Bonneville	Tanner Creek	0	0	0	0	34.0%
Little White Salmon NFH	Spring Cr	18.9%	28.2%	15.0%	17.8%	4.8%
Spring Creek NFH	Spring Cr	11.3%	34.1%	47.6%	46.0%	34.3%
Washougal	Washougal R	0.1%	0.1%	0	0	0.1%

Source: RMIS database 2017.

Broodstock are randomly chosen from ripe adults on each spawn day. In 2015 and 2016, data was collected in order to differentiate between fish that were used for broodstock and those that were not. Tables 7.3b and 7.3c indicate the approximate proportions of different stocks and ages at return of fish spawned in 2015 and 2016.

Table 7.3b. Estimated stock composition of Chinook randomly chosen and used for Tanner Creek tule broodstock in 2015. Percentages based on CWT recoveries.

Releasing Hatchery	**Stock**	**Age 2**	**Age 3**	**Age 4**	**Age 5**
Bonneville	Spring Creek	0.0%	35.3%	15.7%	0.0%
Little White Salmon NFH	Spring Creek	0.0%	19.6%	0.0%	0.0%
Spring Creek NFH	Spring Creek	0.0%	15.7%	0.0%	0.0%
Other	Other	3.9%	7.8%	0.0%	2.0%

Source: RMIS database, CWTF 2017

Table 7.3c. Estimated stock composition of Chinook randomly chosen and used for Tanner Creek tule broodstock in 2016. Percentages based on CWT recoveries.

Releasing Hatchery	**Stock**	**Age 2**	**Age 3**	**Age 4**	**Age 5**
Bonneville	Tanner Creek	23.8%	0.0%	0.0%	0.0%
Bonneville	Spring Creek	0.0%	37.6%	11.9%	0.0%
Little White Salmon NFH	Spring Creek	1.0%	6.9%	2.0%	0.0%
Spring Creek NFH	Spring Creek	0.0%	0.0%	10.9%	0.0%
Washougal	Washougal	0.0%	0.0%	1.0%	1.0%
Other	Other	0.0%	1.0%	3.0%	0.0%

Source: RMIS database, CWTF 2017

7.4) Proposed number to be collected:

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

It is expected that about 3,700 hatchery-origin tule adults (assuming 1:1 sex ratio) will be collected, to produce to meet the NMFS' recommended release goal of 5,000,000 sub-yearlings annually (Table 1.7-1). Jacks are not included in the broodstock.

7.4.2) Broodstock collection levels for the last twelve years, or for most recent years available:

The number of male, female, and jack tule Chinook Salmon collected at Bonneville hatchery between 2013 and 2016 are presented in Table 7.4.2-1. Based on returns from the past years, Bonneville Hatchery will have enough adults returning to perpetuate the program.

Table 7.4.2-1. Tule fall Chinook Salmon broodstock collected at Bonneville Fish Hatchery, brood years 2013-2016 (Source: ODFW's HMS).

Brood Year	Collected			Retained for Broodstock			Spawned		Surplus			Mortality		
	Females	Males	Jacks	Females	Males	Jacks	Females	Males*	Females	Males	Jacks	Females	Males	Jacks
2013	3,266	4,611	1,703	516	1,138	176	195	190	3,069	4,421	1,703	2	0	0
2014	8,649	9,219	2,022	1,142	674	930	518	462	7,507	8,317	1,977	169	170	0
2015	12,554	10,131	2018	672	705	0	587	587	11,882	9,426	2,018	68	94	0
2016	3,569	3,119	1,719	1,068	1,050	0	792	738	2,501	2,069	1,719	135	152	0

*includes jacks

In 2013, Bonneville Hatchery began collecting broodstock for the Tanner Creek stock tule fall Chinook Salmon program. Table 7.4.2-2 shows the number of fish spawned, egg production and average fecundity of Bonneville Hatchery-produced tule fall Chinook Salmon.

Table 7.4-2. Number of tule fall Chinook Salmon spawned, egg-take and average fecundity, brood years 2013-2016.

Brood Year	Spawned Males	Spawned Females	Egg-take	Average Fecundity	Comment
2013	190	195	987,586	5,065	All eggs of 2013 BY contributed to Big Creek tule Chinook program
2014	462	518	2,690,605	5,194	
2015	587	587	2,678,224	4,563	
2016	738	792	3,510,543	4,433	

Source: HMS database, ODFW

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

Adult fish returning to Bonneville Hatchery that are in excess of production requirements are sold through competitive bid process, given to any treaty obligated tribes if requested, or donated to Oregon Food Bank to feed the needy people with quality protein or disposed of to a landfill if the flesh quality is below standard for human consumption.

7.6) Fish transportation and holding methods.

At Bonneville, adults typically begin to return to the hatchery in late August and continue to arrive on site through early October. Adult holding ponds are supplied a flow of 5000 gpm of Tanner Creek and well water. Ponds are checked daily for any moribund or dying fish. All fish are held on site until ripe. The start of the spawning season at Bonneville begins in mid-September and continues for about three weeks.

7.7) Describe fish health maintenance and sanitation procedures applied.

At Bonneville Hatchery, the following fish health maintenance and sanitation procedures for brood fish are followed. At spawning, ovarian fluid from 60 females and tissues from 60 adult fish are collected to ascertain viral and bacterial infections and to provide a health profile of brood fish. Personnel from Corvallis Fish Health Services test for pathogens including: infectious hematopoietic necrosis virus (IHNV), infectious pancreatic necrosis virus (IPNV), viral hemorrhagic septicemia virus (VHSV), and *Renibacterium salmoninarum*. When warranted by increased loss of broodstock, more in depth fish health exams will take place to test for additional bacterial, viral and parasitic infections. Guidelines for inspections can be found in the American Fisheries Society-Fish Health Section (AFS-FHS Suggested procedures for the detection and identification of certain finfish and shellfish pathogens, 2010 edition). Sanitation procedures meet or exceed the minimum required guidelines set forth in the ODFW Fish Health Management Policy (2003.)

7.8) Disposition of carcasses.

The spawned out carcasses are disposed of and taken to a landfill. These carcasses are disposed of off-site by a commercial waste management company.

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

As mentioned throughout the document, all brood for the tule program at Bonneville Hatchery are now collected at Bonneville Hatchery. Although the tule fall Chinook stock at Bonneville Hatchery is relatively pathogen-free, fish health maintenance and sanitation procedures are followed to minimize transmission of disease agents to the watershed.

SECTION 8. MATING

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

8.1) Selection method.

At Bonneville Hatchery, ripe tule fall Chinook broodstock drift to the to the effluent end of the adult holding pond, "fall back" into the collection channel for transfer to the spawning building. Later in the season, all adults are seined into the collection channel for transfer into the spawning building and checked for ripeness. All ripe females on a given day are spawned. The ripe females for spawning are randomly selected on a given spawning day. Inferior quality eggs taken from any females may be destroyed and discarded. One-salt ocean jacks are not intentionally used for spawning.

8.2) Males.

The goal is to spawn fish using the sex ratio of 1 male to 1 female whenever possible, but due to spawning of all ripe females on a given day this ratio may not consistently occur, and consequently, the male to female ratio could be 1:2. And the males of larger-size may be preferred for spawning, if adequate numbers are available.

8.3) Fertilization.

The following spawning and fertilization procedure is followed. On a given spawning day, fish are lifted from the collection channel into the spawning building by means of a wet well and elevator basket. The fish are transferred to an anesthetic container where they are anesthetized (using electro- anesthesia) then transferred to the sorting table and sorted for ripeness. All female fish assessed to be ripe are quickly euthanized and bled using a pneumatic guillotine then sent to the bleed/rinse table. Ripe male fish are sent to

other side of the sorting table where they are euthanized using a pneumatic thumper and placed in a rack for milt extraction into a Dixie Cup. All unripe fish are returned to the holding ponds. Eggs are removed from the female fish by cutting the abdomen open with a Zak safety knife. Eggs from a single female are placed in a single bucket and fertilized with milt from a single male (1:1 spawning ratio). After a few minutes, fertilized eggs are combined with six other females into a transfer bucket for transport to the incubation building where the milt is washed from the eggs, and water-hardening occurs. The fertilized eggs from seven females are placed into a basket in bulk incubation troughs, where they remain until they attain eyed stage. All equipment used for mating are routinely disinfected with an iodine solution. Any vessels used to hold eggs or sperm are for single use only or are disinfected between individual fish.

8.4) Cryopreserved gametes.

Not applicable.

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

As mentioned in section 8.2, a male to female spawning ratio of 1:1 will be used to the best ability of hatchery staff and available brood, to maintain genetic diversity within the hatchery-produced population. Sanitation and disinfection protocols are followed to prevent cross contamination between individuals and transmission of disease agents to the watershed.

SECTION 9. INCUBATION AND REARING -

9.1) Incubation:

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

Number of tule fall Chinook Salmon eggs taken in the past for Bonneville Hatchery tule program and survival rates are presented below in Tables 9.1.1a, 9.1.1b and 9.1.1c.

Table 9.1.1a. Number of eyed eggs shipped from Spring Creek National Fish Hatchery to Bonneville (2008-2013) and green eggs produced a Bonneville Hatchery (2013-2015).

Brood Year	Eyed Eggs Received from National Spring Creek Hatchery	Tule Eggs taken at Bonneville Hatchery
2008	3,000,000	0
2009	3,000,000	0
2010	3,000,000	0
2011	2,978,041	0
2012	3,000,000	0
2013	3,001,840	987,586
2014	0	2,690,605
2015	124,700	2,678,224
2016	0	3,510,543

Source: ODFW's HMS database.

The following table shows the survival of SCNFH-origin eggs to fry, fry to ponding, and ponding to release (sub-yearling and yearling smolts) at Bonneville Hatchery.

Table 9.1.1b. Survival of Spring Creek stock tule fall Chinook from eyed eggs to fry, fry to ponding, and ponding to sub-yearling smolts at Bonneville Hatchery, brood year 2008-2013.

Brood Year	Eyed Eggs Received	Eyed Egg to Fry Survival	Fry to Ponding Survival	Ponding to Release Survival
2008	3,000,000	99.70%	99.50%	83.70%
2009	3,000,000	99.50%	98.30%	97.80%
2010	3,000,000	99.60%	97.70%	94.20%
2011	2,978,041	98.92%	98.90%	91.20%
2012	3,000,000	98.66%	99.16%	94.20%
2013	3,001,840	98.70%	97.92%	93.50%

Source: ODFW's HMS database.

Table 9.1.1c. Percent survival of Spring Creek stock tule fall Chinook from eyed eggs to release.

Brood Year	Eyed Eggs	Number Released	Eyed Egg to Release
2008	3,000,000	2,492,752	83.1%
2009	3,000,000	2,869,669	95.7%
2010	3,000,000	2,753,210	91.8%
2011	2,978,041	2,687,942	90.3%
2012	3,000,000	2,784,983	92.8%
2013	3,001,840 Eyed Eggs + 1,816,247 fingerlings from SCNFS	4,466,592	~88.3%

Source: ODFW's HMS database.

Table 9.1.1c. Percent survival of Tanner Creek stock tule fall Chinook reared at Bonneville Hatchery from green and eyed eggs to release.

Brood Year	Egg Take	Eyed Eggs	Number Released	Green Egg to Release	Eyed Egg to Release
2013	987,586	912,317	839,727	85.03%	92.0%
2014	2,690,605	2,527,748	1,761,717	65.48%	69.7%
2015	2,678,224	2,513,683	1,992,130[1]	74.4%[1]	79.3%[1]
2016	3,510,543	3,289,222	NA	NA	NA

[1]Spring Creek stock portion (124,700 eyed eggs) not included in release number.
Source: ODFW's HMS database.

Survival of Tanner Creek-origin tule eyed eggs at Washougal Hatchery:

The first shipment of 366,600 tule eyed eggs from Bonneville to Washougal Hatchery occurred in 2016 (11/8/16). Incubation and fry rearing took place at Washougal Hatchery, and survival of these eyed eggs to sub-yearling smolts was more than 99%, which were returned to Bonneville Hatchery on 5/9/17, for acclimation and release into Tanner Creek.

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

Per program requirement, Bonneville Hatchery will spawn enough females to meet the gradually increasing smolts production goal. Eggs surplus to the production goal shall be destroyed by freezing and be disposed of or given to the Oregon Coast Aquarium or local zoos to feed the animals.

9.1.3) Loading densities applied during incubation.

Fertilized eggs are placed in bulk incubation baskets in troughs at a density of 7 females per basket where they remain until eyed egg stage. At eye-up stage, eggs are shocked, Jensorted, enumerated, and then placed in vertical incubator trays at a density of 5,000 eggs/tray. Eggs are incubated with a flow of 5 gpm of well water.

Eyed eggs at Washougal Hatchery are incubated in Heath Stack Trays at a density of 8,000 eggs/tray (Table 5.4.2).

9.1.4) Incubation conditions.

Bonneville Hatchery:
Bonneville Hatchery incubation water temperature is manually monitored and monitored using a Hobo temperature logger to record temperatures of incubation well water. Well water temperatures vary between 49ºF and 55ºF. Dissolved oxygen (DO) levels are monitored occasionally to confirm that DO levels are within rearing parameters at maximum oxygen demand. Incubation densities are kept low enough so that low DO condition does not arise. Use of well water ensures that siltation does not become an issue. Each top incubator tray is equipped with low flow alarm system, and a flow alarm

is also fixed on the head box to alert personnel of any water supply disruptions.

Washougal Hatchery:

IHOT species-specific incubation recommendations are followed for water quality, flows, temperature, and incubator capacities. Incubation water temperature is monitored by thermograph and recorded and temperature units (TU) are tracked for embryonic development. Eyed-eggs are loaded into the stack incubators, at 8000 egg/tray, and incubated on surface water, at a flow of 5 gpm. All eggs are treated with formalin dripped at 1:600 to control *Saprolegnia* until hatched. Dissolved oxygen (DO) content is monitored and have been at acceptable levels of saturation with a minimum criteria of 8 ppm to 10 ppm. Siltation is controlled with rodding, as needed.

9.1.5) Ponding.

At Bonneville Hatchery fry are ponded in early to mid-December once they are ~100% button-up. The average size of fish at ponding is ~1,300 fish/lb.

At Washougal Hatchery, fry are typically ponded to the raceways starting in January, when the yolk slit is closed to approximately 1-mm wide (approximately 1600 TUs) or KD factor (95% yolk absorption).

9.1.6) Fish health maintenance and monitoring.

Bonneville Hatchery:

Loss of eggs from fungal infestation is controlled treating with 1,667 ppm formalin, three times a week. Egg mortality on average is less than 5%; majority of the dead and unfertilized eggs are removed during the shocking and Jensorting process (at eye-up). Losses incurred during and after hatching are typically less than 3%, and are removed manually by hatchery staff. Eggs are inventoried and dead eggs or deformed embryos are removed and disposed of as described in the disease control guidelines, to prevent transmission of pathogens to the receiving watershed. Appropriate IHOT, Pacific Northwest Fish Health Protection Committee (PNFHPC) and ODFW Fish Health Management policies are followed for fish health inspections and management. ODFW fish pathologists examine fish health conditions on regular basis once in a month. Whenever needed, fish are treated per prescriptions written by pathologists.

Washougal Hatchery:

Staff conducts daily inspection, visual observation and sampling from eye, fry fingerling and sub-yearling stages. As soon as potential problems are seen, these concerns are immediately communicated to the WDFW fish health specialist. In addition, fish health specialists conduct inspections monthly. Potential problems are managed promptly to limit mortality and reduce possible disease transmission. Disease treatment varies with the pathogen encountered, but is generally antibiotic in nature for bacterial infections and bath or drip treatments with chemotheraputants for external infections.

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

Bonneville Hatchery:
Bonneville Hatchery-produced tule Chinook is not an ESA-listed population, and therefore, listed fish are not affected by the incubation procedures. Disinfection procedures are implemented during incubation that prevents pathogen transmission between stocks of fish on site. Dead or culled eggs are discarded in a manner that prevents transmission to the receiving watershed. Water supply system to the incubation facilities is equipped with alarm system to address any emergency situation.

Washougal Hatchery:
- IHOT and WDFW fish health guidelines followed.
- Multiple units are used in incubators.
- Splash curtains can isolate incubators.
- Temperature, dissolved oxygen, and flow are monitored.
- Dead eggs are discarded in a manner that prevents disease transmission.

9.2) Rearing:

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

Rearing of program fish takes place at Bonneville Hatchery. See Section 9.1.1 for survival rates data by life stages.

As of writing this HGMP (October 2017), incubation and rearing of a portion of the 2016 brood year Tanner Creek-origin tule eyed eggs to sub-yearling stage occurred at Washougal Hatchery. The survival rate was more than 99%.

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

Bonneville Hatchery:
The goal for rearing density at Bonneville Hatchery is at density index (DI) of less than 0.2 for sub-yearling. Actual densities infrequently exceed a DI of 0.3. The flow index (FI) goal at Bonneville is 1.7, with actual levels occasionally exceeding a FI of 1.7. The juvenile rearing density and loading guidelines used at Bonneville Hatchery are based on (Density index [weight of fish/(rearing volume × length of fish)] (Piper et al. 1982)- Pipers optimum Density index- 0.3) and (Flow index [weight of fish/(length of fish × inflow)] (Piper et al. 1982) Pipers optimum Flow index- 1.5 @ 50 F & 5000' or 1.8 @ sea level). Also, the IHOT standards for water quality, density and loading criteria, alarm systems, and predator control measures are followed.

Washougal Hatchery:
Loading and density levels at Washougal Hatchery conforms to standards and guidelines set forth in *Fish Hatchery Management* (Piper et. al. 1982), the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). IHOT standards are followed for fish loading and density along with space, flows and water qualities.

Densities are kept at or below 3.3 lbs /gpm and 0.5 lbs /cu ft. before the last loading reduction in the fall of the year. Trough maximum loading is 40 lbs at 12 gpm (3.33 lbs/gpm). Tank and raceway maximum loading for early rearing is 132 lbs for the tanks at 40 gpm (3.3 lbs/gpm) and 800 lbs per raceway at 300 gpm.(2.66 lbs/gpm). The final loading per raceway is approximately 3200 lbs. at 300 gpm (10.6 lbs/gpm).

9.2.3) Fish rearing conditions.

Bonneville Hatchery:
Water temperature at Bonneville Hatchery is monitored by Hobo temperature loggers which records temperatures for all water coming into the hatchery for downloading to a computer, as well as continuous temperature readings displayed on the alarm system computer. The water source is well water which provides water with a consistent temperature of 49-55°F. Dissolved oxygen is monitored weekly with a portable DO meter. Ponds are cleaned weekly and mortalities are picked daily. Fish health is inspected by ODFW Fish Pathologist in every month and treated, as needed. Flow in the rearing ponds is ~650 gpm, and in Canadian troughs it ranges from 50-60 gpm. Sub-yearlings are reared on well water only, and the yearlings are primarily both in well and Tanner Creek water in the winter months.

The IHOT standards are followed for water quality, alarm systems, predator control measures to provide the necessary security for the cultured stock, loading criteria and rearing density. Settleable solids, unused feed and feces are removed periodically to ensure proper cleanliness of rearing facilities. Also, the juvenile rearing density and loading guidelines at the facility may be modified based on standardized agency guidelines, life-stage specific survival studies conducted at other facilities, staff experience (e.g. trial and error) and other criteria, for increased survival and to produce healthy smolts.

Washougal Hatchery:
IHOT standards are followed for water quality, alarm systems, predator control measures (netting), loading and density. Fish are reared in six raceways. Temperature, dissolved oxygen and pond turnover rate are monitored. Settleable solids, unused feed and feces are removed regularly to ensure proper cleanliness of rearing containers.

Fish are mass-marked when they are about 180 fpp, depending on growth rates and water temperature, starting in mid-April, and lasting for about six weeks; fish are ad-clipped and coded-wire tagged in May. After marking, tule Chinook are transferred to the concrete rearing pond (Pond 27), where they remain until the fish are shipped back to Bonneville Hatchery for acclimation and release into Tanner Creek.

Table 9.2.3: Monthly average surface water temperature (°F), Washougal River.

Month	Average Water Temperature (ºF)
January	39.3
February	42.1
March	43.4
April	45.6
May	50.6
June	54.1
July	61.4
August	60.8
September	56.8
October	47.5
November	44.1
December	38.7

Source: WDFW Hatchery Records 2014.

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

Table 9.2.4a. Monthly fish growth (fish/lb) for tule fall Chinook Salmon at Bonneville Hatchery.

Monitoring Time	Size (fish/lb) Sub/Yearling
January 1	1045
February 1	255/705
March 1	141/425
April 1	95/250
Mid-April: Release	77
May 1	192
June 1	136
July 1	88
August 1	48
September 1	30
October: Release	21
November 1	15
December 1	14
January 1	12
February 1	11
March: Release	10

Source: HMS, ODFW

Table 9.2.4b: Monthly fish growth information of tule fall Chinook by length (mm), weight (fpp), condition factor and growth rate at Washougal Hatchery.

Rearing Period	Length (mm)	Weight (fpp)	Condition Factor	Growth Rate
January	34.4	1200	Na	Na
February	38.4	794	Na	0.338
March	42.7	579	Na	0.271
April	54.9	271	Na	0.532
May	68.1	142	Na	0.476
June	80.2	78	4.03	0.4507

Source: WDFW Hatchery Records.

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

See Tables 9.2.4a and 9.4.2b for monthly fish growth data (fish/lb) at Bonneville and Washougal hatcheries. No energy reserve data are available.

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

Table 9.2.6a. Information of food, feeding, fish size, and food conversion ratio for tule fall Chinook at Bonneville Hatchery.

Food Type/Size	Daily Application	Size Range of Fish (fish/lb)	Food Conversion Ratio
BioVita Starter #0	8 times/day	1000 - 570	0.26
BioVita Starter #1	6 times/day	570 - 300	0.51
BioVita Starter #2	4-6 times/day	300-150	0.70
BioClark's Fry 1.2mm	4-6 times/day	150 - 90	0.80
BioClark's Fry 1.5mm	3-4 times/day	90 - 60	0.90
BioClark's Fry 2.0mm	3-4 times/day	60 - 25	0.90
BioClark's Fry 2.5mm	3-4 times/day	25 - 11	1.10

Source: ODFW's HMS database.

Table 9.2.6b Food type, feeding rate, and food conversion ratio for tule fall Chinook at Washougal Hatchery.

Rearing Period (fpp)	Food Type	Application Schedule (#feedings/day)	Feeding Rate Range (%B.W./day)	Lbs. Fed Per gpm of Inflow	Food Conversion During Period
Feb-Jun	Starter feed	8*	1.0-2.0	<0.10/gpm**	0.65
May-Jun	Fry feed	8*	1.0-2.0	<0.10/gpm**	0.75

Source: WDFW hatchery records.

* Frequency of feeding decreases as fish grow from fry (hourly) to smolt (once or twice daily)

** Lbs. fed per gpm in standard raceways. Parameters for larger rearing containers may exceed this due to increased volume and turnover rates.

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

Bonneville Hatchery:
The ODFW Fish Health Management Policy and IHOT fish health guidelines are followed to prevent disease transmission between lots of fish on site, or transmission or amplification to or within the watershed. The juvenile rearing density and loading guidelines used at the facility are based on standardized agency guidelines, life-stage specific survival studies conducted at other facilities, staff experience (e.g. trial and error) and other criteria, to produce healthy smolts with higher survival. Bonneville Hatchery ponds are cleaned weekly. Mortalities are picked daily, and fish are inspected by pathologists monthly and fish are treated as necessary.

Washougal Hatchery:
Fish Health Monitoring. Fish health monitoring policy guidance includes: *Fish Health Policy in the Columbia Basin*. Details hatchery practices and operations designed to stop the introduction and/or spread of any diseases within the Columbia Basin. Also, *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (Genetic Policy Chapter 5, IHOT 1995). A fish health specialist inspects fish monthly and checks both healthy and presence of symptomatic fish. Based on pathological or visual signs by the crew, age of fish and the history of the facility, the pathologist determines the appropriate tests. External signs such as lesions, discolorations, and fungal growths will lead to internal examinations of skin, gills and organs. Kidney and spleen are checked for BKD. Blood is checked for signs of anemia or other pathogens. Additional tests for virus or parasites are done if warranted.

Disease Treatment. As needed, appropriate therapeutic treatment will be prescribed to control and prevent further outbreaks. Mortality is collected and disposed of at a landfill. Fish health and/or treatment reports are kept on file.

Sanitation. All eggs brought to the facility are surface-disinfected with iodophor (as per disease policy). Every effort is made to prevent the horizontal spread of pathogens by splashing water. All equipment (nets, tanks, boots, etc.) is disinfected with iodophor between different fish/egg lots. Different fish/egg lots are physically isolated from each other by separate ponds or incubation units. Footbaths containing disinfectant are strategically located on the hatchery grounds to prevent spread of pathogens. Mortalities are collected and disposed of at a landfill.

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

At Bonneville Hatchery, the migratory state of the tule smolts is determined by age, size, physical appearance and behavior. No gill ATPase enzyme activity is measured.

Sub-yearlings of tule fall Chinook reared at Washougal Hatchery are transferred back to Bonneville in May/June whenever needed. No ATPase studies are conducted.

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

No natural rearing methods are currently employed either at Bonneville or Washougal Hatchery.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

The hatchery-produced fall Chinook in the lower Columbia River is not an ESA-listed population, and since no wild fish are incorporated into broodstock it is unlikely that listed fish are affected by the rearing procedures. However, all equipment is disinfected prior to or between uses in rearing ponds, and fish health management policies and protocols are strictly followed to minimize transmission of disease agents to the watershed. Also, see Sections 5.8, 6.3, 7.9, 8.5 and 9.1.7, for risk aversion measures that are applied at both Bonneville and Washougal facilities.

SECTION 10. RELEASE

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

10.1) Proposed fish release levels.

Table 10.1-1. Proposed fish release levels of Bonneville Hatchery tule fall Chinook program, release year 2018.

Age Class (Rearing site)	Maximum Number	Size (fish/lb)	Release Date	Location
Eggs	0	0	N/A	N/A
Unfed Fry	0	0	N/A	N/A
Fry	0	0	N/A	N/A
Fingerling	0	0	N/A	N/A
Sub-yearling (Bonneville)	1,600,000 ± 5% 400,000 ± 5%	60-80 fish/lb 15-20 fish/lb	Late May October	Tanner Creek Tanner Creek
Sub-yearling (Washougal)	1,500,000 ± 5%	60-80 fish/lb	Early June	Tanner Creek
Yearling smolts	None (see Table 1.7-1)*	N/A	March 1	Tanner Creek

*None, as the scheduled yearling smolts were released as sub-yearling in early September 2017 due to wild forest fire in the Eagle Creek area.

Table 10.1-2. Proposed fish release levels of Bonneville Hatchery tule fall Chinook program, from release year 2019 to onwards.

Age Class (Rearing site)	Maximum Number	Size (fish/lb)	Release Date	Location
Eggs	0	0	N/A	N/A
Unfed Fry	0	0	N/A	N/A
Fry	0	0	N/A	N/A
Fingerling	0	0	N/A	N/A
Sub-yearling (Bonneville)	1,600,000 ± 5% 400,000 ± 5%	60-80 fish/lb 15-20 fish/lb	May October	Tanner Creek Tanner Creek
Sub-yearling (Washougal)	1,800,000 ± 5%	60-80 fish/lb	June	Tanner Creek

10.2) Specific location(s) of proposed release(s).
Stream, river, or watercourse: Tanner Creek
Release point: River Mile 0.25
Major watershed: Lower Columbia River
Basin or Region: Columbia River Basin

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

The current tule fall Chinook program at Bonneville Hatchery began with the first release of sub-yearling smolts in 2009. The following table shows the number of fish released in the past three years and their average size and release stage. All fish are released directly into adjacent Tanner Creek from hatchery rearing ponds.

Table 10.3. Actual number and size (fish/lb) of tule fall Chinook released from Bonneville Hatchery, RY 2009-2017.

Release Year	Release Month	# of sub-yearlings released	# of Yearlings Released	Avg. Size (fish/lb)
2009	May	2,492,752		105.0
2010	May	2,869,669		80.8
2011	May	2,753,210		80.0
2012	May	2,687,942		97.7
2013	May	2,784,983		85.5
2014	May	4,466,592		82.9
2015	April	1,226,051		77.2
2015	October	340,452		20.8
2016	February		195,214	10.0
2016	April	1,582,652		79.9
2016	September	404,466		20.5
2017	March		121,606	10.3
2017	May	1,674,313		77.6
2017	June	787,832		71.1
2017	September	624,771*		~20

Source: ODFW HMS database.
*Early emergency release due to devastating forest fire in the Eagle Creek areas.

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

Table 10.4. Brood year, release date, number released and location and type of release for tule fall Chinook released from Bonneville Hatchery, BY 2008-2016.

Brood Year	Release Date	Number Released	Location	Release Type
2008	5/15/2009	2,492,752	Tanner Creek	Forced
2009	5/3/2010	2,869,669	Tanner Creek	Forced
2010	5/25/2011	2,753,210	Tanner Creek	Forced
2011	5/18/2012	2,687,942	Tanner Creek	Forced
2012	5/19/2013	2,784,983	Tanner Creek	Forced
2013	5/16/2014	4,466,592	Tanner Creek	Forced
2014	4/20/2015	1,226,051	Tanner Creek	Forced
2014	10/6/2015	340,452	Tanner Creek	Forced
2014	2/26/2016	195,214	Tanner Creek	Forced
2015	4/15/2016	1,582,652	Tanner Creek	Forced
2015	9/29/2016	404,466	Tanner Creek	Forced
2015	3/21/2017	121,606	Tanner Creek	Forced
2016	5/1/2017	1,674,313	Tanner Creek	Forced
2016	6/12/2017	787,832	Tanner Creek	Forced
2016	9/5/2017	624,771*	Tanner Creek	Forced

Source: ODFW's HMS database.
*Early emergency release due to devastating forest fires in the Eagle Creek areas.

All fish are forced released directly into Tanner Creek from hatchery rearing ponds.

10.5) Fish transportation procedures, if applicable.

No transportation is required as fish are released directly from the hatchery rearing ponds into Tanner Creek.

10.6) Acclimation procedures (*methods applied and length of time*).

All releases occur from the hatchery rearing ponds and no further acclimation is applied.

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

All smolts (~100%) will be adipose fin-clipped and certain numbers of smolts will have CWT in order to generate information of fishery contribution, stray rate and survival to adults.

In addition to ~100% ad-clip, the Bonneville Hatchery reared sub-yearling groups scheduled for release in May and October will have 150,000 and 50,000 CWT, respectively. And, it is intended that all sub-yearlings reared at Washougal Hatchery will have ad-clip and 150,000 Ad+CWT at Washougal Hatchery site prior to shipment to Bonneville Hatchery although 2017 early releases of Washougal fish had no CWT.

Table 10.7. Brood Year, Tagcode and CWT marking of sub-yearling and yearling tule smolts released from Bonneville Hatchery, BY 2008-2016.

Brood Year	Tagcode	# AD+CWT	Total # Released	Release stage	Month Released
2008	090198	163,683	2,492,752	Sub-yearling	May
2009	090326	169,767	2,869,669	Sub-yearling	May
2010	090486	170,842	2,753,210	Sub-yearling	May
2011	090571	171,083	2,687,942	Sub-yearling	May
2012	090568	168,873	2,784,983	Sub-yearling	May
2013	055430	105,582	913,983	Sub-yearling	May
2013	055476	100,470	1,294,025	Sub-yearling	May
2013	090864	164,113	2,258,584	Sub-yearling	May
2014	090922	152,397	1,226,051	Sub-yearling	April
2014	090947	43,726	340,453	Sub-yearling	October
2014	090948	39,976	195,214	Yearling	February
2015	091009	160,298	1,582,652	Sub-yearling	April
2015	091037	42,916	404,466	Sub-yearling	September
2015	091034	16,805	121,606	Yearling	March
2016	091137	167,037	1,674,313	Sub-Yearling	May

Source: ODFW's CWTF.

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

Tule fall Chinook fingerlings in excess of 5% of the release goal will be considered as surplus and may be killed humanely and/or given to zoo authorities to feed the zoo animals.

10.9) Fish health certification procedures applied pre-release.

Per ODFW's Fish Health Management Policy, fish health are examined prior to any transfer and within six weeks prior to release. Only health certified fish are released.

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

Bonneville Hatchery is not in a location that is prone to flooding. However, if Tanner Creek water diminishes, managers will consult with other hatcheries for available rearing space to continue the rearing.

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

Ecological interactions with other species are minimized by releasing smolts into Tanner Creek, where listed fish are not usually present. The released smolts quickly enter the main-stem Columbia River and are expected to promptly out-migrate to the estuary through the Columbia River migration corridor. Tanner Creek is not a designated habitat for salmonid spawning or rearing use. Also, the main-stem Columbia River is the main migration corridor for anadromous species and assumed that the released out-migrating tule smolts will have minimal competitive interactions for food and space with the ESA-listed out-migrating fish.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

See Section 1.10 for the "Performance Indicator" that will be monitored and measured. These monitoring (e.g. release number, mark retention, CWT recovery, creek survey, fish health monitoring, water quality monitoring etc.) are a part of the ODFW's regular activities.

The goal of Bonneville Hatchery tule fall Chinook Salmon program is to produce

~25,000 adult fish for the Ocean and freshwater harvests and for hatchery broodstock. One of the purposes for reprogramming the tule production at Bonneville Hatchery was to terminate the early releases of tule fall Chinook from Spring Creek NFH that led to ongoing disputes over fish passage measures and spill at Bonneville Dam (BPA, USACE, USFWS, NMFS and ODFW 2008). Additional goals of the production shift to Bonneville Hatchery are to increase recruitments of tules for fisheries below Bonneville Dam with increased survivals as the juveniles would no longer require to navigate downstream through Bonneville Dam. Performance indicators for survival, harvest and stray rates will be accomplished by continuing mass marking and coded-wire tagging of release groups. Recoveries from representative groups of CWT fish will be used to estimate harvest contributions, harvest locations, stray rates, and evaluate the effectiveness of the release strategies (size at release and release timing).

These goals are being addressed through the following project tasks:

1. Evaluate conformance to program release goals by monitoring release numbers, size at release and release time. (Table 10.3)
2. Report numbers of juvenile fish released and associated marks to the Regional Mark Processing Regional Database (RMIS) to facilitate reporting of recoveries by regional agencies. (Table 10.7)
3. Monitor progress toward program goal of 25,000 adult fish return to fisheries and hatchery through analysis of CWT recoveries and adult returns. (Table 3.3.1c, Table 11.1.1g)
4. Track development of Tanner Creek origin tule stock—monitor stock composition of adults taken for brood. (Table 7.3b, Table 7.3c)
5. Monitor adult, jack collection numbers, and numbers of males and females used for broodstock. (Table 7.4-2)
6. Calculate egg to smolt survivals within the hatchery to evaluate accordance with established program rearing and survival goals. (Table 9.1.1)
7. Monitor egg collection ensure that fish retained for broodstock produce sufficient gametes to sustain the program. (Table 7.4-2)
8. Assess impact rates on adult ESA-listed salmonids by counting and documenting number of clipped and non-clipped tule Chinook handled during collection at Bonneville Hatchery. (Table 2.2.3-1)
9. Estimate overall harvest and contribution of program fish to ocean and freshwater fisheries. (Table 3.3.1a-c)
10. Estimate overall survival of Tule program release groups (SAR's). (Table 3.3.1a)
11. Use CWT and scale analysis and bio-data sampling to determine the age composition of return and average length at return by sex and age. Document and assess trends to monitor potential indicators of decreasing diversity of Tanner Cr stock. (Table 11.1.1f, Table 11.1.1g)

12. Conduct spawning ground surveys to monitor numbers of adults on spawning grounds, if funding and personnel are available. (no resources available)
13. Assess impact rates on adult ESA-listed salmonids by monitoring stray rates in watersheds close in proximity to the programs' release site (Tanner Creek). (no resources available)
14. Calculate individual fecundities from representative sample of females used for brood stock to monitor changes over time, if adequate resources (space and funding) are available. (no resources available)

Modification of traditional sub-yearling release strategy:

Tanner Creek tule sub-yearling releases have historically experienced lower overall survival rates than those released at Spring Creek NFH or at Little White Salmon NFH. In the mid-1950's and again in late 1970's and early 1980's, a couple of the Bonneville tule production groups were released as larger-sized yearlings the following spring to investigate whether timing and size impacted survivals and fishery contributions. Estimated survivals of the yearling groups were generally three to six times greater than their corresponding sub-yearling releases, however a greater proportion of the fish returning from yearling releases were younger and smaller at age of maturity.

A study comparing the relative survival of two similar sized groups of 1954 brood Tanner Creek stock from Bonneville Hatchery indicated that fish retained until the following spring--the yearling group—resulted in ~15x the fishery contribution of the sub-yearling group. Lack of standardized and comprehensive fishery sampling may have contributed to the small numbers of adults identified as coming from the sub-yearling releases. The majority of the recoveries from the yearling releases were recovered at Bonneville and nearby hatcheries. The size and age at return for adults recovered from these two release strategies differed as well. Fish returning from the yearling release group returned at smaller sizes at age than the sub-yearling group. The age class structure of the yearling release group was skewed toward the younger years, and a greater proportion of males to females in the younger age classes was observed as compared to the sub-yearling release.

A similar study design comparing 1955 and 1956 brood sub-yearling and yearling releases into Gnat Creek was even less conclusive. Bonneville-origin sub-yearlings from the 1955 brood had twice the survival of the yearling group that released a year later (the opposite of what was seen in the 1954 release from Bonneville), however the adult return of the yearling group from the 1956 brood had 30x the survival of their sub-yearling siblings. Time of ocean entry and poor ocean conditions may have impacted survivals more than the rearing strategy itself. Juveniles from both study groups released in spring of 1957 experienced very low survivals.

In order to maximize the survival of the lower river stock tule releases, beginning with the 2014 brood year, the plan is to evaluate three different release strategies to determine which strategy provides the greatest overall survival and contribution to fisheries.

Secondly, to determine whether rearing fish to the yearling stage would be a cost effective means of maintaining fishery contribution rates while rearing and releasing fewer fish. Data from recent studies suggests that smolts released as yearlings may migrate faster than sub-yearling releases. This may contribute to less predation on the out-migrating smolts and less interaction with listed natural fish in the estuary.

Tanner Creek Tule releases will be divided into three groups released at three or two different sizes and different times of the year (Table 11.1.1a). All smolts (100%) will have adipose fin clip, and each representative release group will have CWT marks (see Section 10.7) for program evaluation. Fish will be tagged in March for scheduled May-June releases and in late July for the October and following March releases. Fish will be raised using standard rearing procedures and will be released directly into Tanner Creek from Bonneville Hatchery.

Compromise of Yearling study:

Experimental yearling releases were slated to occur for at least the first 3 years of the Bonneville tule program. However, a couple of unforeseen incidents occurred that impacted the releases. The 2014 brood year yearling release became infected with *Renibacterium salmoninarum* (causal agent of Bacterial Kidney Disease (BKD)) in February 2016. Disease and high mortality remained prevalent despite formalin treatments. Although the planned release date was mid-late March, the fish were released in February to protect adjacent ponds from lateral transfer of BKD. Survival of this release group in relation to others may be impacted.

The 2015 brood year yearling release occurred as planned. Fish were released on March 24, 2017 at 10 fpp. The 2015 brood year sub-yearling releases also occurred as planned so there should be recovery data available to compare performance under the different strategies for that cohort. However, hatchery staff reported that 2015 BY fish suffered from BKD and IHN, fish were aggressively culled to remove sick fish, and it was worst release group yet.

The 2016 brood year yearling and sub-yearling releases occurred earlier than planned. In August 2017, over 600,000 Tanner Creek stock tules were on-station at Bonneville slated for an October sub-yearling release (400k) and a yearling release (200k) the following March. This group also had BKD and mortality was increasing just before the fire. The forest fire in early September impacted water supply to Bonneville Hatchery necessitating an early release of both groups in September.

Program Modifications (Spring 2017):
The original agreement stipulated that up to 5 million sub-yearlings would be released once the Bonneville tule program reached full production. Five million sub-yearlings at 80 fpp equates to 62,500 lbs of fish. The numbers of fish and sizes at release for the 3-year yearling/sub-yearling study and fall release were determined in accordance with the total poundage guidelines. The initially planned release sizes in Table 11.1.1a were the equivalent of 60,000 total pounds of fish.

Table 11.1.1a. Initially planned release sizes, release months, number tagged and total release of Tanner Creek stock tules from Bonneville Hatchery, 2013-2016 brood years.

Release Month	Size at Release (fpp)	Number ADCWT	Total Release through 2018	Rearing Location
April-May	80.0	150,000	1,600,000	Bonneville
Sept-October	20.0	40,000	400,000	Bonneville
March	10.0	25,000	200,000*	Bonneville

*No yearling smolts release will occur in 2018, as these fish were released on emergency in early September 2017 due to wild forest fire in the Eagle Creek areas.

In 2017, the Tanner Creek Tule Chinook program underwent a couple modifications. On June 12, an additional 787,832 sub-yearlings at 72 fpp were released from Bonneville hatchery. And 365,059 of the juveniles released on June 12 had been reared at Washougal Hatchery in Washington and transferred to Bonneville at 195 fpp in May.

Table 11.1.1b shows the most recent modifications to the Bonneville Tule Chinook program. In order to increase rearing space at Bonneville Hatchery, a portion of the Tanner Creek egg-take, approximately 1.9 million eyed eggs, will be shipped from Bonneville Hatchery to Washougal Hatchery in November. Fish will be reared at Washougal until May when they will be transferred back to Bonneville. There they will be acclimated and released one month later in June.

Table 11.1.1b. Planned release sizes, release months, number tagged and total release of Tanner Creek stock tules from Bonneville Hatchery, 2017-2021 brood years.

Release Month	Size at Release (fpp)	Number ADCWT	Total Release through 2022	Rearing Location
April-May	80.0	150,000	1,600,000	Bonneville
June	80.0	(150,000)*	1,800,000**	Washougal
October	20.0	50,000	400,000	Bonneville

*Intend to have Ad+CWT at Washougal Hatchery.
**For 2017 brood year, planned release number 1,500,000.

Age Composition:

Prior to the 1997 return year, fish originating from Bonneville Hatchery releases matured at 4 different age classes (ages 2-5) along with as small number of 6-year olds recovered in 1986 in ocean fisheries (Table 11.1.1c). In 1996, a CWT from a 5-year old Tanner stock tule was recovered in the freshwater sport fishery. For the next 13 years, Bonneville Hatchery did not release tule Chinook Salmon as production was dependent on the SCNFH facility. In 2009, Bonneville resumed releases of tule Chinook into Tanner Creek.

Table 11.1.1c. Historical age structure of tules from Bonneville Hatchery releases, brood year groups 1976-2012.

Brood Year Range	Percent of cohort return by age				
	2	3	4	5	6
1976-1979	4.7%	62.4%	32.3%	0.7%	0.0%
1980-1989	9.7%	71.7%	18.3%	0.3%	0.1%
1990-1995	8.1%	69.2%	21.6%	1.0%	0.0%
2008-2012	5.7%	77.6%	16.7%	0.1%	0.0%

Source: RMIS database 2017.

With the recent restructuring of Columbia River tule production and eventual transfer of 5-million of the smolt production to Bonneville, the impact on age composition of the population as well as potential changes to length at maturity and average fecundity are being monitored. During spawning and processing of tule returns at Bonneville, all fish are scanned for CWT's, and all wire-tagged fish have lengths and sex noted and recorded. Scales are collected on a portion of the wire-tagged fish for verification of scale analysis. Additional scale sampling is conducted on the non-tagged fish. Approximately 20% of the entire return to Bonneville is sampled through a combination of scales and wires.

The coded-wire tag recoveries from the initial May 2009 release of sub-yearling smolts indicate that most of the fish are maturing as 3 year olds (75%). This trend appears to be continuing (Tables 11.1.1d and 11.1.3e). The 2011 brood year release had the lowest percentage of 2 year olds and highest percentage of 4 year olds for brood years 2008-2011.

In 2015, the first CWT-tagged sub-yearling group of Tanner Creek origin stock was released. The previous year, a small group of untagged sub-yearlings had been released into the North Fork of the Klaskanine River in April. Coded-wire tag recoveries from the Tanner Creek stock releases are being recovered in fisheries and at Bonneville Hatchery.

Table 11.1.1d. Estimated CWT recoveries from Bonneville tule releases, brood years 2008-2014.

Brood year	Tag Code	# Ad+CWT released	Return year 2010	2011	2012	2013	2014	2015	2016	Total
2008	090198	163,683	28	271	60					359
2009	090326	169,767		44	296	46				386
2010	090486	170,842			16	284	70			370
2011	090571	171,083				19	660	172	1	852
2012[1]	090568	168,873					48	601	105	754
2013[1]	055430	105,582						17	71	88
2013[1]	055476	100,470						22	74	96
2013[1]	090864	164,113						8	50	58
2014[1]	090922	152,397						1	451	452
2014[1]	090948	26,210							5	5

[1] Data are incomplete for 2012-2014 brood years.
Source: RMIS database 2017.

Table 11.1.1e. Age composition percentages for Spring Creek stock Tules released from Bonneville Hatchery based on estimated CWT recoveries, brood years 2008-2013.

Brood Year	Tag_Code	% of cohort return by age 2	3	4	5
2008	090198	7.9%	75.4%	16.7%	0.0%
2009	090326	11.4%	76.8%	11.8%	0.0%
2010	090486	4.2%	76.8%	19.0%	0.0%
2011	090571	2.3%	77.4%	20.2%	0.1%
2012[1]	090568	6.3%	79.7%	14.0%	0.0%
2013[1]	055430	19.4%	80.6%	0.0%	0.0%
2013[1]	055476	23.2%	76.8%	0.0%	0.0%
2013[1]	090864	14.0%	86.0%	0.0%	0.0%

[1] Data are incomplete for 2012 and 2013 brood years.
Source: RMIS database 2017.

Size at Maturity

In 2015 and 2016, both disposition and biological data were collected on CWT tagged fish in order to differentiate fish used for broodstock from non-broodstock fish. Many Columbia River hatchery programs have seen a trend in recent years of younger fish returning but at lengths that overlap with those of older fish. This has resulted in an over representation of younger age fish in the broodstock contributing gametes to hatchery programs. Recent studies and return data from other hatchery programs over time

indicate age at return may be genetically inherited.

Table 11.1.1f shows the percentages of males and females used for broodstock and their respective ages for return years 2015 and 2016. Table 11.1.1g shows the average fork length and associated age for CWT tagged fish used for broodstock. In 2016, twenty three of seventy-eight CWT-tagged males that, at time of spawning had been classified as adult males, were actually 2-year old jacks. Scale analysis on a sample of non-wire-tagged fish indicated a similar proportion. The incorporation of younger age fish in the broodstock may be exacerbating the problem of early maturing returns. For 2017, adjustments have been made to limit use of males that fall within the fork length range where equal numbers of 2 and 3 year olds are likely based on results from the 2016 return.

Table 11.1.1f. Percentages of Males and Females used in Tanner Creek broodstock by Age (from CWT recoveries).

Return Year	Sex	AGE 2	3	4	5
2015	Female	0.0%	66.7%	22.2%	11.1%
	Male	4.8%	81.0%	14.3%	0.0%
2015 Total		**3.9%**	**78.4%**	**15.7%**	**2.0%**
2016	Jack	100.0%	0.0%	0.0%	0.0%
	Female	0.0%	38.1%	61.9%	0.0%
	Male	29.5%	48.7%	20.5%	1.3%
2016 Total		**24.8%**	**45.5%**	**28.7%**	**1.0%**

Table 11.1.1g. Average Fork Lengths of Males and Females used in Tanner Creek broodstock by Age (from CWT recoveries).

Return Year	Sex	AGE 2	3	4	5
2015	Female		729	868	845
	Male	350	758	851	
2015 Total		**350**	**753**	**855**	**845**
2016	Jack	583			
	Female		738	825	
	Male	656	757	881	760
2016 Total		**650**	**754**	**856**	**760**

Escapement and stray rates:

Fish escapement numbers are the returning adult fish that "escaped" the commercial and sport fisheries. Escapement is quantified through recoveries at hatcheries, in-stream traps and spawning grounds. The majority of fish not caught in the fisheries return to Bonneville Hatchery. Table 11.1.1e lists the estimated number of coded-wire tags and their general locations. A small number (5.9% or less) have been recovered at other hatcheries and on spawning grounds of the White Salmon and Little White Salmon

Rivers above Bonneville Dam. It is hypothesized that the minimal straying to locations above Bonneville Dam will be reduced as a result of the transition to on-station Tanner Creek stock rather than shipments of Spring Creek stock eggs from Spring Creek NFH. Table 11.1.1f lists the estimated numbers of fish returning to escapement locations based on the numbers of coded-wire tags that were recovered in those locations and the size of the smolt release associated with each tagcode. All CWT recoveries from spawning grounds have been from 3-year old fish.

Table 11.1.1e. Estimated number of CWT recoveries and escapement locations for 2008-2012 brood year releases of Spring Creek stock tules from Bonneville Hatchery.

				Escapement Location			
Brood Year	Tag Code	Ad+CWT	Number Released	Bonneville Hatchery	Other Hatchery	Spawning Ground	Total Escapement
2008	090198	163,683	2,492,752	213	1	-	214
2009	090326	169,767	2,869,669	212	3	5	219
2010	090486	170,842	2,753,210	187	3	-	190
2011	090571	171,083	2,687,942	399	12	13	424
2012	090568	168,873	2,784,983	431	-	-	431
2013	055430	105,582	913,983	62	-	-	62
2013	055476	100,470	1,294,025	55	-	-	55
2013	090864	164,113	2,258,584	34	-	-	34

Source: RMIS database 2017.

Table 11.1.1f. Equivalent numbers of fish returning to the hatchery and escapement locations for 2008-2012 brood year releases of Spring Creek stock tules released from Bonneville Hatchery.

			Escapement Location			
Brood year	Tag Code	Stock_ Source	Bonneville Hatchery	Other Hatchery	SGS	Total Escapement
2008	090198	Spring Creek	3,245	16	-	3,261
2009	090326	Spring Creek	3,585	48	76	3,709
2010	090486	Spring Creek	3,011	50	-	3,061
2011	090571	Spring Creek	6,268	185	203	6,656
2012	090568	Spring Creek	7,104	-	-	7,104
2013	055430	Spring Creek	538	-	-	538
2013	055476	Spring Creek	711	-	-	711
2013	090864	Spring Creek	469	-	-	469

Source: RMIS database 2017.

Survival Rates:

Survival rates, otherwise referred to as Smolt to Adult Return (SAR's) or recovery percentages, are used to evaluate the overall performance of hatchery production releases and compare various release strategies. Beginning with brood year 2013, releases of Spring Creek stock from Bonneville Hatchery were supplanted by Tanner Creek stock releases.

Recent tule program releases from Bonneville Hatchery and their associated overall survivals (SAR's) are shown in table 11.1.1g. Percent survival or SAR was calculated as [(total

estimated CWT's recovered/number of CWT-tagged fish released)*100]. And, the estimated number was calculated by multiplying the observed number of recovered CWT's by an expansion factor for the particular fishery and stratum. The CWT expansion factor was calculated by dividing the total catch by the sampled catch. For example, if 172 fish were sampled in a fishery where 560 fish were actually caught, the expansion factor would be 560/172 or 3.26. Therefore, if out of the 172 sampled fish, 90 of them had CWT's, then the observed number of CWT's would be 90 and the estimated number of CWT's would be 90 x 3.26 = 293.

Releases of Spring Creek tule stock may not represent the future performance of the Tanner Creek stock releases but are included to show the transition period from one stock to the other. The coded-wire tag recovery data necessary to estimate SAR's is incomplete for brood years 2013 and later.

Table 11.1.1g. Smolt-to-adult survival (%) for releases of Spring Creek and Tanner Creek stock tule Chinook Salmon released into Tanner Creek from Bonneville Hatchery, brood years 2008-2016. Incomplete recovery data for brood year 2013-2015. Yearling releases in bold font.

Brood Year	Rel Year	Rel Mon	Stock Source	Tag Code	# CWT Tagged	Total Released	# Est CWT Recoveries	SAR %
2008	2009	05	Spring Creek	090198	163,683	2,492,752	359	0.22
2009	2010	05	Spring Creek	090326	169,767	2,869,669	386	0.23
2010	2011	05	Spring Creek	090486	170,842	2,753,210	370	0.22
2011	2012	05	Spring Creek	090571	171,083	2,687,942	852	0.50
2012	2013	05	Spring Creek	090568	168,873	2,784,983	754	0.45
2013	2014	04	Tanner Creek	untagged	--	839,727	--	--
2013	2014	05	Spring Creek	090864	164,113	2,258,584	58	0.04
2013	2014	05	Spring Creek	055476	100,470	1,294,025	96	0.10
2013	2014	05	Spring Creek	055430	105,582	913,983	88	0.08
2014	2015	04	Tanner Creek	090922	152,397	1,226,051	452	0.30
2014	2015	10	Tanner Creek	090947	43,726	340,453	0	0.00
2014	**2016**	**02**	**Tanner Creek**	**090948**	**26,210**	**195,214**	**5**	**0.02**
2015	2016	04	Tanner Creek	091009	160,298	1,582,652	2	0.00
2015	2016	09	Tanner Creek	091037	42,916	404,466	-	-
2015	**2017**	**03**	**Tanner Creek**	**091034**	**16,805**	**121,606**	**-**	**-**
2016	2017	05	Tanner Creek	091137	167,037	1,674,313	-	-

Source: RMIS database 2017.

Distribution and Range:

Tule fall Chinook released from Bonneville Hatchery are harvested in Ocean fisheries ranging from the southern coast of Oregon to the western coast of Vancouver Island in British Columbia (Figure 1). The ocean troll fisheries off the coasts of Vancouver Island and Washington State and the recreational fisheries off the Washington coast account for the majority of ocean harvest. Most of the freshwater catch occurs in the zone 4 and zone 5 commercial fisheries downstream of Bonneville Dam although some fish are caught in sport fisheries near the mouth of the Columbia River.

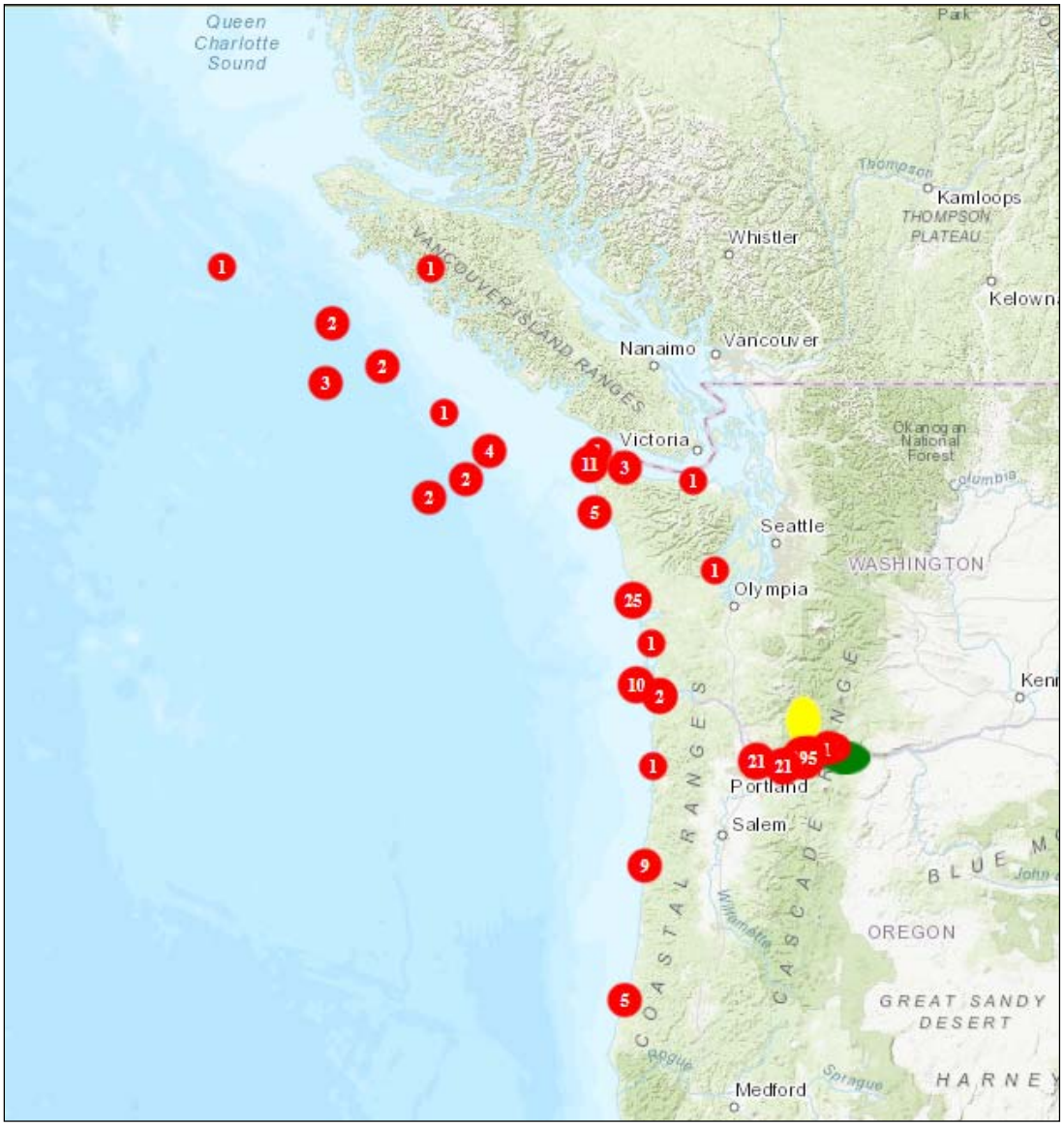

Figure 1. Distribution of Bonneville tule fall Chinook in ocean and freshwater fisheries.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

Funding for the implementation of some of the monitoring activities is included in the

hatchery budgets provided by the NMFS (e.g. fish rearing, pathology, marking, water quality etc.). These activities along with creel survey and CWT recovery are conducted by ODFW staff as routine work. If NMFS requires or suggests further monitoring then additional funding may be requested from NMFS.

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

It is expected that some of the monitoring and evaluation activities (mostly broodstock trapping) may have adverse impacts on ESA-listed natural fish migrating through the Columbia River which may volitionally enter the adult trapping facility at Bonneville Hatchery. Capture, handle and release of listed natural adult fish, and other potential indirect impacts due to hatchery operations, fry releases etc. have been adequately addressed in the respective sections to minimize the effects.

SECTION 12. RESEARCH

12.1) Objective or purpose.

No research program has been proposed under this program except the monitoring and evaluation activities described under Sections 1.10 and 11.1.

12.2) Cooperating and funding agencies.
Not applicable.

12.3) Principle investigator or project supervisor and staff.
Not applicable.

12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.
Not applicable.

12.5) Techniques: include capture methods, drugs, samples collected, tags applied.
Not applicable.

12.6) Dates or time period in which research activity occurs.
Not applicable.

12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.
Not applicable.

12.8) Expected type and effects of take and potential for injury or mortality.
Not applicable.

12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table".
Not applicable.

12.10) Alternative methods to achieve project objectives.
Not applicable.

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.
Not applicable.

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.
Not applicable.

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: Scott Patterson, Fish Propagation Program Manager, ODFW

Signature: _____ Date: _____

ATTACHMENT 1. DEFINITION OF TERMS REFERENCED IN THE HGMP TEMPLATE.

Augmentation- The use of artificial production to increase harvestable numbers of fish in areas where the natural freshwater production capacity is limited, but the capacity of other salmonid habitat areas will support increased production. Also referred to as "fishery enhancement".

Critical population threshold- An abundance level for an independent Pacific salmonid population below which: depensatory processes are likely to reduce it below replacement; short-term effects of inbreeding depression or loss of rare alleles cannot be avoided; and productivity variation due to demographic stochasticity becomes a substantial source of risk.

Direct take- The intentional take of a listed species. Direct takes may be authorized under the ESA for the purpose of propagation to enhance the species or research.

Evolutionarily Significant Unit (ESU) - NMFS definition of a distinct population segment (the smallest biological unit that will be considered to be a species under the Endangered Species Act). A population will be/is considered to be an ESU if 1) it is substantially reproductively isolated from other conspecific population units, and 2) it represents an important component in the evolutionary legacy of the species.

Harvest project- Projects designed for the production of fish that are primarily intended to be caught in fisheries.

Hatchery fish- A fish that has spent some part of its life-cycle in an artificial environment and whose parents were spawned in an artificial environment.

Hatchery population- A population that depends on spawning, incubation, hatching or rearing in a hatchery or other artificial propagation facility.

Hazard- Hazards are undesirable events that a hatchery program is attempting to avoid.

Incidental take- The unintentional take of a listed species as a result of the conduct of an otherwise lawful activity.

Integrated harvest program- Project in which artificially propagated fish produced primarily for harvest are intended to spawn in the wild and are fully reproductively integrated with a particular natural population.

Integrated recovery program- An artificial propagation project primarily designed to aid in the recovery, conservation or reintroduction of particular natural population(s), and fish produced are intended to spawn in the wild or be genetically integrated with the targeted natural population(s). Sometimes referred to as "supplementation".

Isolated harvest program- Project in which artificially propagated fish produced primarily for harvest are not intended to spawn in the wild or be genetically integrated with any specific natural population.

Isolated recovery program- An artificial propagation project primarily designed to aid in the recovery, conservation or reintroduction of particular natural population(s), but the fish produced are not intended to spawn in the wild or be genetically integrated with any specific natural population.

Mitigation- The use of artificial propagation to produce fish to replace or compensate for loss of fish or fish production capacity resulting from the permanent blockage or alteration of habitat by human activities.

Natural fish- A fish that has spent essentially all of its life-cycle in the wild and whose parents spawned in the wild. Synonymous with natural origin recruit (NOR).

Natural origin recruit (NOR)- See natural fish.

Natural population- A population that is sustained by natural spawning and rearing in the natural habitat.

Population- A group of historically interbreeding salmonids of the same species of hatchery, natural, or unknown parentage that have developed a unique gene pool that breed in approximately the same place and time, and whose progeny tend to return and breed in approximately the same place and time. They often, but not always, can be separated from another population by genotypic or demographic characteristics. This term is synonymous with stock.

Preservation (Conservation)- The use of artificial propagation to conserve genetic resources of a fish population at extremely low population abundance, and potential for extinction, using methods such as captive propagation and cryopreservation.

Research- The study of critical uncertainties regarding the application and effectiveness of artificial propagation for augmentation, mitigation, conservation, and restoration purposes, and identification of how to effectively use artificial propagation to address those purposes.

Restoration- The use of artificial propagation to hasten rebuilding or reintroduction of a fish population to harvestable levels in areas where there is low, or no natural production, but potential for increase or reintroduction exists because sufficient habitat for sustainable natural production exists or is being restored.

Stock- (see “Population”).

Take- To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

ATTACHMENT 2. AGE CLASS DESIGNATIONS BY FISH SIZE AND SPECIES FOR SALMONIDS RELEASED FROM HATCHERY FACILITIES.

(Source: Washington Department of Fish and Wildlife, November, 1999).

SPECIES/AGE CLASS	SIZE CRITERIA Number of fish/pound	SIZE CRITERIA Grams/fish
Chinook Yearling	<=20	>=23
Chinook (Zero) Fingerling	>20 to 150	3 to <23
Chinook Fry	>150 to 900	0.5 to <3
Chinook Unfed Fry	>900	<0.5
Coho Yearling 1/	<20	>=23
Coho Fingerling	>20 to 200	2.3 to <23
Coho Fry	>200 to 900	0.5 to <2.3
Coho Unfed Fry	>900	<0.5
Chum Fed Fry	<=1000	>=0.45
Chum Unfed Fry	>1000	<0.45
Sockeye Yearling 2/	<=20	>=23
Sockeye Fingerling	>20 to 800	0.6 to <23
Sockeye Fall Releases	<150	>2.9
Sockeye Fry	> 800 to 1500	0.3 to <0.6
Sockeye Unfed Fry	>1500	<0.3
Pink Fed Fry	<=1000	>=0.45
Pink Unfed Fry	>1000	<0.45
Steelhead Smolt	<=10	>=45
Steelhead Yearling	<=20	>=23
Steelhead Fingerling	>20 to 150	3 to <23
Steelhead Fry	>150	<3
Cutthroat Trout Yearling	<=20	>=23
Cutthroat Trout Fingerling	>20 to 150	3 to <23
Cutthroat Trout Fry	>150	<3
Trout Legals	<=10	>=45
Trout Fry	>10	<45

1/ Coho yearlings defined as meeting size criteria and 1 year old at release, and released prior to June 1st.

2/ Sockeye yearlings defined as meeting size criteria and 1 year old.

ADDENDUM A. PROGRAM EFFECTS ON OTHER (AQUATIC OR TERRESTRIAL) ESA-LISTED POPULATIONS. (Anadromous salmonid effects are addressed in Section 2)

15.1) List all ESA permits or authorizations for USFWS ESA-listed, proposed, and candidate salmonid and non-salmonid species associated with the hatchery program.

None. The approved HGMP for this program will serve as ESA take permit or authorization.

15.2) Describe USFWS ESA-listed, proposed, and candidate salmonid and non-salmonid species and habitat that may be affected by hatchery program.

There are three non-anadromous and/or non-salmonid species of fish in the LCR that are federally listed under the ESA (Table 15.2-1). Other ESA listed species are listed in table 15.2-2.

Table 15.2-1. Federal USFWS-listed, non-anadromous and/or non-salmonid fish species that could be incidentally affected by the hatchery program.

Species	Population	Status	Range in Lower Columbia River Basin	Type of Interaction with Salmon and Steelhead
Bull Trout (*Salvelinus confluentus*)	Columbia River	Threatened	Lower Columbia River Mainstem	Predator of juvenile salmon and steelhead
Eulachon (*Thaleichthys pacificus*)	Southern DPS	Threatened	Columbia River and tributaries	Freshwater prey of salmon and steelhead
Green Sturgeon (*Acipenser medirostris*)	Southern DPS	Threatened	Columbia River Estuary	By-catch in salmon fisheries

Table 15.2-2. Other USFWS-listed or candidate species in the area of the hatchery program.

Group	Name	Population	Status
Marine Mammals	Killer whale (*Orcinus orca*)	Southern Resident	Endangered
Mammals	Columbian white-tailed deer (*Odocoileus virginianus leucurus*)	Columbia River DPS	Endangered
Mammals	Red tree vole (*Arborimus longicaudus*)	North Oregon Coast DPS	Candidate
Birds	Short-tailed albatross (*Phoebastria (=Diomedea) albatrus*)	Entire	Endangered
Birds	Yellow-billed Cuckoo (*Coccyzus americanus*)	Western U.S. DPS	Threatened
Birds	Western snowy plover (*Charadrius alexandrinus nivosus*)	Pacific coastal pop.	Threatened
Birds	Northern spotted owl (*Strix occidentalis caurina*)	Entire	Threatened
Birds	Marbled murrelet (*Brachyramphus marmoratus*)	CA, OR, WA	Threatened
Birds	Streaked Horned lark (*Eremophila alpestris strigata*)		Threatened
Insects	Oregon silverspot butterfly (*Speyeria zerene hippolyta*)	Entire	Threatened
Flowering Plants	Nelson's checker-mallow (*Sidalcea nelsoniana*)		Threatened

15.3) Analyze effects.

Direct take of Bull Trout, Eulachon, and Green Sturgeon will not occur as a result of this hatchery program. There could be indirect interaction effects on the fish species listed in table 15.2-2 but any effect would be negligible and unmeasurable.

It is expected that, no take of USFWS-listed species (Table 15.2-2) will occur nor will they be adversely affected by operation of tule fall Chinook Salmon program at Bonneville Hatchery.

15.4) Actions taken to minimize potential effects.

No take of USFWS-listed species is expected due to this tule fall Chinook Salmon program at Bonneville Hatchery.