

Infrastructure and Operations Audit: Lyons Ferry Fish Hatchery 2024



Lyons Ferry Fish Hatchery Lower Snake River Compensation Plan

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Executive Summary

On February 22, 2023, Chris Starr, Facility Coordinator LSRCP, Nathan Wiese, Program Coordinator LSRCP, Derek Gloyn, Lyons Ferry Hatchery Manager, Ace Trump, Lyons Ferry Hatchery Complex Operations Manager, conducted a high-level half-day infrastructure and operations assessment of the Lyons Ferry Fish Hatchery (LFH). On March 28, 2024, Chris Starr, Facility Coordinator LSRCP, Nathan Wiese, Program Coordinator LSRCP and Ace Trump, Lyons Ferry Hatchery Complex Operations Manager reviewed the infrastructure and operations assessment in preparation of the steelhead review by the Independent Scientific Review Panel (ISRP) in January 2025. A secondary facility assessment addressing steelhead trout (*Oncorhynchus mykiss*) production at LFH was completed on September 12, 2024, by Shawn Sanders – LSRCP/FWS Fish Biologist, Derek Gloyn – Lyons Ferry Hatchery Manager, and Ace Trump – Lyons Ferry Hatchery Complex Operations Manager.

This document provides the LSRCP and stakeholders appropriate conceptual-level information and documentation to address the infrastructure challenges at this facility. The Audit findings are subsequently incorporated into the 10-year strategic plan for LSRCP. The audit results provide the documentation to develop solutions which logically and methodically allocate resources, budgets, and supportive programs to meet program goals, improved long-term fish escapement to all program facilities.

This audit is a kick-off effort to assess all spring/summer Chinook rearing facilities within the LSRCP program following the 10-year spring/summer Chinook Program Review for the Independent Scientific Review Panel (ISRP) in December 2022. With this review, the LSRCP intends to identify strategies toward improving performance of achieving project area goals of 58,700 spring/summer Chinook salmon adult returns. From 2004-2017, the LSRCP averaged 29,115 spring/summer Chinook salmon adult returns and failed to achieve the project area goal on any year during the period. The follow-up review intends to identify strategies towards optimizing performance to achieve project area goals of 55,100 steelhead adult returns. From 2004-2017, the LSRCP averaged 70,319 spring/summer steelhead adult returns.

The Lyons Ferry audit(s) resulted in several options for increasing spring Chinook capacity including the following:

- Construction of three new rearing lakes would improve rearing conditions for several current production group and provide rearing potential for an additional 500,000 spring Chinook smolt program. Total cost is estimated at \$11M.
- Replacing the dilapidated captive brood tanks would cost about \$1.2 M, to potentially provide rearing opportunities for 500,000 spring Chinook smolt production, at an annual operation cost of approximately \$75,000.
- Experimental Age-0 spring Chinook production to 30-50 fpp releases in late May to early June, this strategy is possible with Lyons Ferry rearing temperature, 52

°F. This strategy differs from traditional September release parr programs (60-100 fpp) in size and timing. If a multi-facility strategy is considered, the LSRCP programs could produce 10-22M Age-0 smolts. The experimental strategy would displace the current sub-yearling fall-Chinook 100,000 per raceway operational protocol.

The Lyons Ferry audit(s) resulted in several options for increasing steelhead trout capacity including the following:

- Converting Lyons Ferry rearing lakes to all steelhead (400,000 each or 1.2 M total) by moving production current production goals within LSRCP facilities. The strategy could potentially free space for additional spring Chinook production totaling 2.75 – 3.5M. Total costs are estimated at \$600,000 for infrastructure/equipment and \$948,000 for annual operational expenditures associated with this alternative strategy.
- Installation of a solar shade structure over rearing raceways would reduce or eliminate sunburn, offset electrical costs, and possibly improve adult returns. Sunburn was noted in the 2023/2024 rearing cycle. The estimated cost of the project is estimated at \$5.9M.
- Expansion of the incubation building to include a separate room specific to steelhead trout egg incubation. Expanding the building would separate egg take and incubation by species and allow the facility to incubate all production on-site, thereby minimizing transfer of eggs and smolts between partner facilities. The estimated cost of the project is \$1.75M.

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1 Scope

On February 22, 2023, Chris Starr, Facility Coordinator LSRCP, Nathan Wiese, Program Coordinator LSRCP, Derek Gloyn, Lyons Ferry Hatchery Manager, Ace Trump, Lyons Ferry Hatchery Complex Operations Manager, conducted a high-level half-day infrastructure and operations assessment of the Lyons Ferry Fish Hatchery (LFH). On March 28, 2024, Chris Starr – Facility Coordinator LSRCP, Nathan Wiese – Program Coordinator LSRCP and Ace Trump – Lyons Ferry Hatchery Complex Operations Manager reviewed the infrastructure and operations assessment in preparation of the steelhead review by the Independent Scientific Review Panel (ISRP) in January 2025. A secondary facility assessment addressing steelhead trout (*Oncorhynchus mykiss*) production at LFH was completed on September 12, 2024, by Shawn Sanders – LSRCP/FWS Fish Biologist, Derek Gloyn – Lyons Ferry Hatchery Manager, and Ace Trump – Lyons Ferry Hatchery Complex Operations Manager.

This document provides the Lower Snake River Compensation Plan (LSRCP) and stakeholders appropriate conceptual-level information regarding current infrastructure challenges at this facility. Audit findings are incorporated into a 10-year strategic plan for LSRCP to maximize in-house and external improvement opportunities by developing solutions which logically allocate resources, budgets, and support programs. Resource allocation and planning will significantly improve water quality, program capacity, efficiency, and site flexibility, thereby strengthening potential opportunities for LSRCP to ultimately meet adult mitigation targets.

This audit is a kick-off effort to assess all spring/summer Chinook rearing facilities within the LSRCP program following the 10-year spring/summer Chinook Program Review for the Independent Scientific Review Panel (ISRP) in December 2022. With this review, the LSRCP intends to identify strategies toward improving performance of achieving project area goals of 58,700 spring/summer Chinook salmon adult returns. From 2004-2017, the LSRCP averaged 29,115 spring/summer Chinook salmon adult returns and failed to achieve the project area goal on any year during the period.

Historically, LSRCP adult spring/summer steelhead escapement (returns) goals were met, specifically, between 2006 and 2013, however between 2014 and present escapement has precipitously dropped. From 2004-2017, the LSRCP averaged 70,319 spring/summer steelhead adult returns. During the period of 2014 to present, steelhead escapement (returns) did not meet the annual 55,100 mitigation target. The average LSRCP escapement for 2006-2017 was 65,777, however average escapement/return between 2014-2021 was 26,418, respectively. The follow-up review intends to identify strategies towards optimizing performance to achieve project area goals of 55,100 steelhead adult returns.

2 Background

2.1 Programs

Lyons Ferry Fish Hatchery (LFH) is one of many hatchery facilities under the auspices of the LSRCP. The LSRCP has a project area goal of 58,700 spring/summer Chinook salmon adult returns to mitigate for survival reductions resulting from construction and operation of the four lower Snake River dams. However, from 2004-2017, the program failed to reach that goal and averaged 29,115 adult returns (USFWS 2020).

LSRCP funded fish production in Washington starting in 1983, with the construction of trout and steelhead rearing facilities at LFH. Construction of salmon hatchery facilities and steelhead acclimation sites followed and were completed in 1985. Production at LFH and Tucannon Fish Hatchery (TFH) is directed toward meeting established hatchery adult return goals of 18,300 fall Chinook, 1,152 spring Chinook, 4,656 summer steelhead; while additionally providing 67,500 angler days of fishing opportunity from 79,000 pounds of rainbow trout production, which are stocked at 2.5 fish per pound (fpp). In addition to the LSRCP adult return goals which are tied to mitigation responsibilities, the LSRCP hatchery program contributes to conservation efforts by maintaining and restoring native populations of salmon and steelhead. LFH also produces jumbo-sized, ~1.5 lb rainbow trout, through a cooperative agreement with the Tri-State Steelheaders (non-profit organization).

LFH (Figure 1) is located along the Snake River at river mile (RM) 59.1, directly below the confluence of the Palouse River in Franklin County, Washington (Figure 1). Initially it was operated as two separate facilities. Washington Department of Wildlife (WDW) operated the north-side hatchery, producing steelhead and rainbow trout. Washington Department of Fisheries (WDF) operated the south-side hatchery, rearing spring and fall Chinook. A merger of the two agencies in 1994 led to a merging of the two facilities and has since been operated by the Washington Department of Fish and Wildlife (WDFW) through LSRCP funding as LFH.

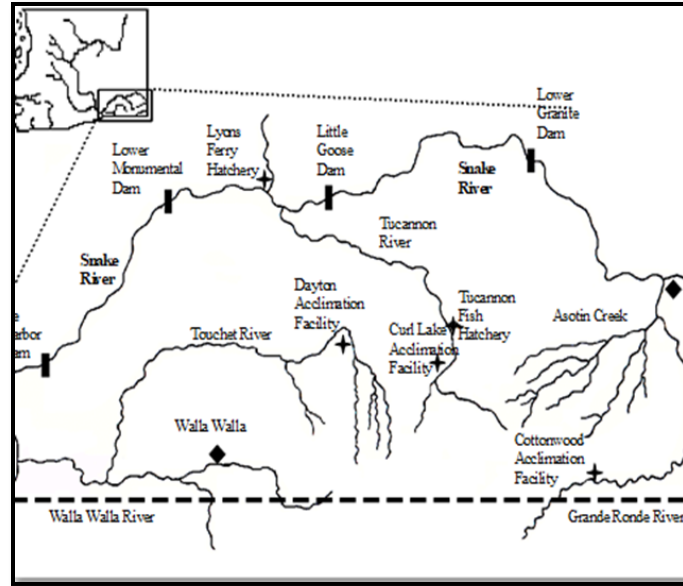


Figure 1. Map outlines all Lyons Ferry Hatchery sites and managed facilities including acclimation sites and local tributaries. The facilities are all located in SE Washington state and managed by the Washington Department of Fish and Wildlife (WDFW)

LFH facilities (Figure 2) include two incubation buildings with office space and feed storage, plus adult fish trapping, holding and spawning structures. A visitor center provides interpretive information for guests of the hatchery. There are eight residences on-site for staff to maintain security and emergency response needs.

The LFH rearing facilities include twenty-eight raceways at 10' x 100' x 2.8' and nineteen raceways at 10' x 88.5' x 3.5'. The raceways rear all species produced at LFH (spring and fall Chinook, summer steelhead, and rainbow trout). These raceways are covered in 2" square mesh netting. There are three large rearing lakes (643,500 cubic feet (ft³) of water each; 1,100' x 90' x 6.5' dimensions) which are also covered in 2" netting. Netting has significantly reduced predation since being installed in 2006-08. The steelhead and spring Chinook adult holding facilities include three 83' x 10' x 5' adult raceways with an enclosed spawning building incorporated over the center of these ponds. There are four 8.5' x 150' x 4.3' and four 10' x 150' x 4.3' adult fall Chinook salmon holding ponds, which also accommodate fall Chinook sub yearling rearing in the spring months. The incubation facilities include 112 full Heath Tray stacks (2 units of 8 trays each) of vertical incubators in the south-side hatching building, and 88 shallow eyeing/hatching troughs and four 3.75' x 27.5' x 2' intermediate rearing troughs in the north-side hatching building.

2.1.1 Fall Chinook

The Snake River fall Chinook program at LFH is the cornerstone of a highly coordinated and integrated artificial production program, implemented through the LSRCP, the Idaho Power Company (IPC) Hells Canyon Settlement Agreement, and the Nez Perce Tribal Hatchery (NPTH) with funding through the Bonneville Power Administration (BPA).

Broodstock for the program at LFH are primarily collected at Lower Granite Dam (LGR) but may be collected at LFH and NPTH if trapping at LGR is limited (generally because of high water temperatures and complementary ESA handling restrictions). The *US v OR 2018-2027 Management Agreement*, Table B4, shows priority production by release location and marking/tagging schemes for Snake River fall Chinook production at LFH and Irrigon FH (IFH)

NOAA, National Marine Fisheries Service (NMFS), first listed Snake River fall-run Chinook salmon, an evolutionarily significant unit (ESU) Chinook salmon (*Oncorhynchus tshawytscha*), as a “threatened species” under the Endangered Species Act (ESA) on April 22, 1992 (57 FR 14653) – NOAA Fisheries 2017a.

LFH was initially designed to release 9.16 million Snake River fall Chinook sub yearlings at around 90 fpp. The 2022 production release at LFH were 700,000 sub yearlings at approximately 50 fpp and 450,000 yearlings at approximately 10 fpp. LFH will transfer another 1,900,000 sub yearlings to the Fall Chinook Acclimation Program (FCAP) facilities, with size at transfer at approximately 65 - 75 fpp. Size at release goal for the FCAP facilities are 50 fpp. In addition, approximately 1,310,000 eyed eggs will be transferred to and reared at the Oregon Department of Fish and Wildlife’s (ODFW) Irrigon FH for the LSRCP and IPC programs. The size at release for the sub yearlings at Irrigon FH are also 50 fpp. The IPC program at Irrigon FH will release 1,000,000 sub yearlings into the Salmon River near Hammer Creek. Another 200,000 sub yearlings will be released into the Grande Ronde River near Cougar Creek as part of LSRCP production.

The LSRCP co-managers have discussed and agreed upon a proposal to discontinue the 450,000 fall Chinook yearling program released onsite at LFH. That proposal was approved by the *U.S. v Oregon* at a Policy Committee meeting in May 2023. Additional changes were proposed in the March 2024 Production Advisory Committee meeting. Following the policy-level approval, National Oceanic and Atmospheric Administration (NOAA) will re-initiate consultation in 2024, under the appropriate Endangered Species Act (ESA) coverage. Once these processes are completed, the integration of production strategies could be integrated as soon as Brood Year 2024. The main changes described in the proposal are summarized as:

- Conversion of all yearling production (450,000) to an additional 1,400,000 sub yearling production (An additional 950,000).
- Increase sub yearling releases at LFH from 700,000 to 1,200,000.
- Increase the 2nd (late) release of sub yearlings at Big Canyon Acclimation Facility (AF, FCAP Site) from 200,000 to 400,000.
- Re-initiate a direct stream release of sub-yearlings at Couse Creek (Snake River) with a total release of 400,000.
- Increase the Grande Ronde release from 200,000 to 500,000 and integrate an alternative release strategy, which calls for an acclimated release from Big Canyon AF in Oregon (ODFW) rather than the historical direct stream release at Cougar Creek.

2.1.2 Spring Chinook

Tucannon spring Chinook: The Tucannon River Spring Chinook Hatchery production began in 1985 using endemic broodstock. Currently, both natural origin and hatchery supplementation fish are collected for broodstock. Returning adults are collected at the Tucannon FH Rainbow Lake Intake and transported to LFH for holding, spawning, hatching and initial rearing. The release goal is 225,000 yearling smolts at 12 fpp. WDFW initiated an evaluation of alternative release strategies within the Tucannon/Snake basin and continues discussions with co-managers and NOAA Fisheries on potential releases outside the Snake River basin, including a concept to preserve the stock by rapidly reinitiating a captive broodstock program.

The Tucannon River spring Chinook Salmon is in the Snake River Spring/Summer Chinook Salmon ESU, which was listed as threatened under the Endangered Species Act in 1992 (57 FR 14,653; April 22, 1992) – NOAA Fisheries 2017b.

Touchet spring Chinook: In January 2018, WDFW brought forth a proposal to the Production Advisory Committee (PAC) to initiate a harvest mitigation program for spring Chinook in the Touchet River. This proposal was agreed to in PAC, passed on and accepted through the US vs OR Policy Committee. The HGMP for this program was submitted and approved by NOAA Fisheries in 2017. Since then, WDFW has received ~275,000 eyed Carson stock eggs annually from either the US Fish and Wildlife’s Little White Salmon or Carson hatcheries. All post-transfer rearing is performed at LFH, with the first releases occurring in 2020. A constant fractional proportion of smolts (~15,000) are PIT tagged annually preceding transfer to the Dayton AF. Smolts are reared to 12 fpp (program goal) and released from the Dayton AF in mid- to late-March. Natural Spring Chinook runs in the Walla Walla basin are believed to have been extirpated in the 1950’s. Therefore, any potential programmatic production impacts in the Walla Walla basin would only affect ESA-listed summer steelhead and bull trout.

2.1.3 Summer Steelhead

The LFH currently uses two stocks of steelhead in the Snake River basin, (Tucannon and Wallowa) and two stocks in the Walla Walla basin (Touchet and Wallowa). The Wallowa stock is a non-endemic stock and was originally collected by ODFW from Lower Snake River dams (likely comprised of both A- and B-run fish from Washington, Oregon, and Idaho), and then released in the Wallowa River in the Grande Ronde Basin. WDFW releases Wallowa stock production steelhead in the Grand Ronde and Touchet rivers, and on-station at LFH into the Snake River.

The Middle Columbia River steelhead distinct population segment (DPS) was listed as “threatened” under the Endangered Species Act of 1973 (ESA) on January 5, 2006 (71 FR 834) – NOAA Fisheries 2009. The Snake River Basin steelhead DPS were listed as a “threatened” species under the ESA on August 18, 1997 (62 FR 43937) – NOAA Fisheries 2017b. Based on those listings, the National Marine Fisheries Service

(NMFS)1999 Biological Opinion (BO) ruled that continued use of Lyons Ferry and Wallowa summer steelhead stocks were causing jeopardy to listed ESA-listed steelhead populations in the Snake and mid-Columbia rivers. It was recommended by NMFS to convert to endemic populations, where possible, which included developing new broodstocks from natural origin returns. This BO ruling/recommendation led to the creation of the Touchet and Tucannon endemic broodstock programs starting with BY2000.

Additional changes to the steelhead program are likely in response to results from evaluation of fish stock performance and ESA related concerns regarding the ongoing releases of Wallowa stock steelhead into the Snake, Touchet, and Grande Ronde rivers. Such changes may require a departure from the generally accepted steelhead mitigation model previously utilized for steelhead, which will require detailed planning to ensure a seamless implementation strategy with consideration to current and future hatchery production guidelines.

The Touchet River summer steelhead program is considered an endemic program. Adult broodfish are collected at the Dayton Adult Trap (DAT) on the Touchet River, transferred to LFH, and spawned. Eggs are incubated and juvenile offspring are reared to the smolt stage. The current annual programmatic production goal is 50,000 smolts to be reared from approximately 4.5 to 6 fpp at the Dayton AF. To theoretically replace Wallowa steelhead production in the Touchet River. A program expansion would require an annual increase production of approximately 100,000-150,000 smolts, pending a co-management agreement.

The Tucannon River summer steelhead program is also considered an endemic program, meaning all original production was derived from natural parentage, and in later years, from first generation (F1) hatchery reared endemic stock fish as well. The adult broodstock for this program are collected at Tucannon FH and their progeny planted in the Tucannon River as yearlings. The current release goal is 150,000 smolts at approximately 4.5 to 6 fpp, with 50,000 smolts released as a conservation component of the program (unclipped) and 100,000 smolts released for the program mitigation (ad-clipped) requirements. According to the Tucannon Steelhead Program broodstock sliding scale (AOP 2022) the 50,000 smolts for the conservation portion will be acquired from natural-origin returns (NORs) and unclipped endemic hatchery returns (conservation group). The 100,000 smolt for the mitigation component will come from endemic hatchery returns and consist of ad-clipped/cwt or cwt-only adults, with no NOR's at lower NOR return levels.

The Wallowa stock program was originally initiated to provide a summer steelhead fishery in the Grande Ronde River (for both Oregon and Washington anglers) and while contributing to both tribal and sport fisheries in the mainstem Columbia and Snake rivers. The overall production of this stock was increased in December 2012, once the LFH stock steelhead program was eliminated. WDFW Wallowa stock steelhead are currently in the Touchet River from the Dayton AF (100,000), Grande Ronde River from the Cottonwood AF (225,000) and the Snake River at LFH (60,000).

A recent Reciprocal Study (Release Years 2015-2018) comparing Wallowa stock steelhead reared at Irrigon FH at normal densities (DI = 0.15) compared to rearing at LFH rearing lakes in a semi-natural environment (DI = 0.01) has been completed. Data from the study demonstrates a 2:1 Smolt-to-Adult Return (SAR) for Wallowa stock steelhead reared in the LFH rearing lakes compared to those reared at Irrigon FH (Figure 2)

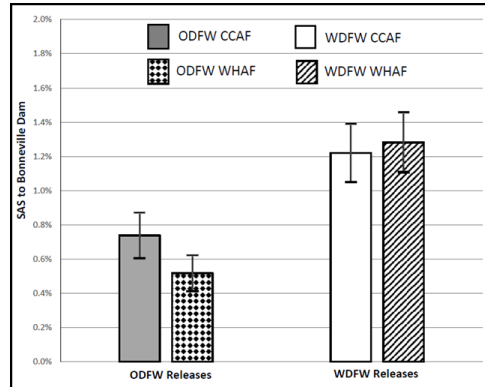


Figure 2. Estimated smolt-to-adult survival (+/- 95% Confidence Intervals) as measured by adult PIT tag detections at Bonneville Dam from the CCAF and WHAF releases, 2014-2017 pooled brood years.

In general, steelhead returns from LFH Rearing lakes (Table 1; Figure 3) within the Lower Snake River Compensation Plan (USFWS 2020) are considered significantly higher as compared to other runs/stocks.

2.1.4 Rainbow Trout

Rainbow trout are reared and planted in both southeast Washington and northwest Idaho to meet LSRCP mitigation goals in both states, to address a reduction of fishing opportunity originating from construction and operation of the four lower Snake River dams. The original LSRCP goal was set at 93,000 lbs. at 2.5 fpp (Herrig 1990). However, the WDFW determined that in-stream habitat improvements were equivalent to the annual expense of producing 7,000 lbs. of hatchery trout and a reasonable mitigation exchange. Therefore, starting in 1983 the annual production goal was reduced to 86,000 lbs. of production within the Snake River Basin. The SE Washington production goal is 79,000 lbs. and the NW Idaho production goal is 7,000 lbs. LFH rears 74,000 rainbows to 2.5 fpp (29,300 lbs.), 48,500 to 3.0fpp (16,167) and 1,000 (1,490 lbs.) toward this goal and the remainder are reared at Tucannon FH (~94,000 fish). A small, privately funded program (Tri-State Steelheaders, TSS) at the LFH rears 2,500 rainbow to 1.5 lbs. each, providing a unique fishing opportunity in local lakes. A similar program managed by the Nez Perce Tribe rears 1,600 rainbow trout annually to 1.5 lbs.

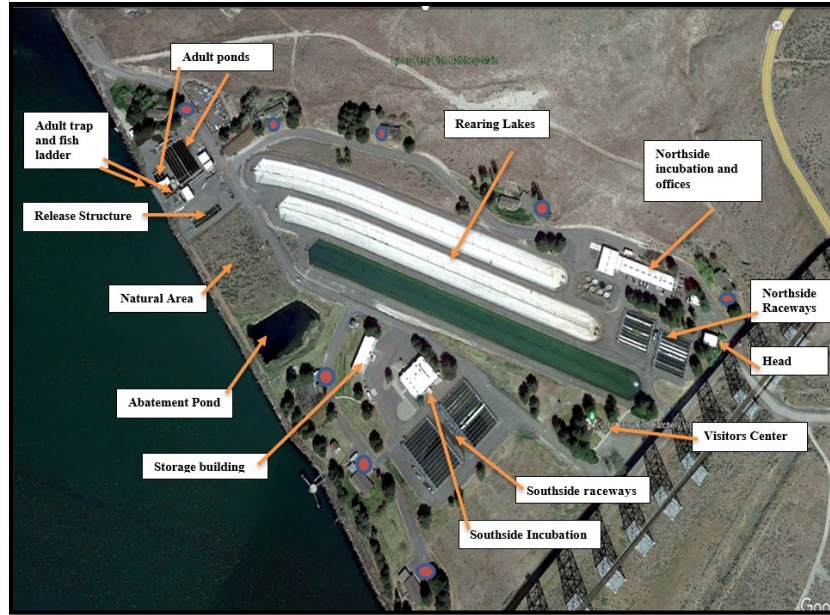


Figure 3: Aerial view of Lyons Ferry Fish Hatchery with infrastructure delineated including eight residences around the perimeter of the facility.

2.1.1 Wallowa Program

The Wallowa program is a mitigation program with a total release goal of 385,000. Approximately 225,000 are released in the Grande Ronde River, 100,000 are released in the Touchet River, and 60,000 are released at Lyons Ferry in the Snake River. Broodstock are collected at the Cottonwood Creek trap with about 100 females required to meet the current take goal of 450,000 eggs. Eggs and milt are transported back to Lyons Ferry for 1:1 fertilization and water hardened for 1 hour within vertical heath stacks. Eggs are treated daily with formalin daily. Eyed eggs are shocked, picked, and enumerated after 14 days of within tray incubation. Following this operation eyed eggs are then combined and returned to trays at a density of 10,000 eggs per tray until hatching.

Fry rear in heath trays until the fry's sac is utilized and fish button up, then fish are moved to 1' x 15' x 0.5' rearing troughs on the north side of the hatchery at 10,000 per trough and started on commercial feed. Fry are reared in troughs until they reach approximately 600-700 fpp and are transferred to outdoor raceways measuring 10' x 88.5' x 3.5' and stocked at a rate of 90,000 per raceway. In early- to mid-August the fish are marked and tagged. Fish are marked and tagged with approximately 40,000 receiving an adipose fin clip (AD) and complementary numeric Coded-wire-tag (CWT) and approximately 365,000 AD only (405,000 total) are stocked into Lake #3 for a 385,000 release. Fish from this group are transferred and reared among three different rearing and release strategies which are listed below:

- In late January Lake #3 is drawn down to collection 225,000 smolts (6.5-7.0 fpp) for transfer to the Cottonwood Creek Acclimation site (Figure 4). Cottonwood Creek is supplied by 6 cfs of flow providing ample rearing conditions for three months until smolts are released from the facility at an average of 4.5fpp.
- In late March, the lake is drawn down again for collection and transfer of 100,000 smolts to Dayton Acclimation Pond at 4.5 fpp. The Dayton smolts are acclimated for 2 weeks prior to release.
- The remaining 60,000 smolts are direct released from the pond to the Snake River from Lyons Ferry Fish Hatchery at 4.5 fpp.

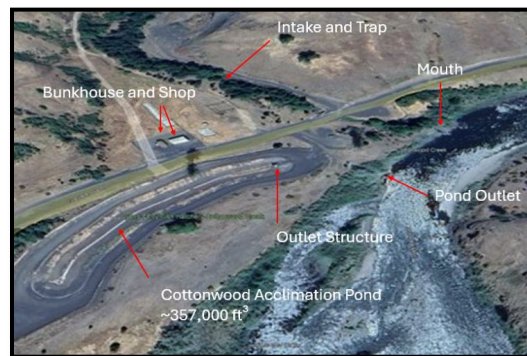


Figure 4. Aerial view of the Cottonwood Acclimation and Trap and surrounding area(s).

2.1.2 Touchet Program

The Touchet Program is a dedicated conservation program with a production goal of 50,000 steelhead. All broodstock are collected at the Dayton Adult Trap and transferred to Lyons Ferry Fish Hatchery. To meet production goals a maximum of 15 pairs of wild broodfish are required to meet the smolt release goal. All broodstock are PIT tagged at collection. Brood spawning generally occurs the second week of March until mid to late-April.

A genetic management plan requires spawning operations to utilize a 2x2 spawning matrix. Following fertilization eggs are rinsed, placed in vertical heath stacks, disinfected with iodophor, and water hardened in vertical heath stacks for one hour. Eggs from each female are placed into a separate tray (1 female/tray).

Eggs are treated daily with formalin and after 14 days eggs are shocked, picked, enumerated, and returned to the heath stack until buttoned up. When fry are fully buttoned up, they transferred to the north side incubation room, and placed in troughs at a density of 8,000 to 12,000 per trough. Following transfer to troughs feeding of commercial food is initiated.

Fry are reared to 600-700 fpp and transferred to an intermediate-sized tank measuring 3.75' x 27.5' x 2'. Fry are again transferred from intermediate tanks to raceways once DI reaches 0.15 – 0.20. Marking and tagging of this stock occurs the first week of September. The Touchet program is 100% CWT, with no adipose fin clip (AD).

Prior to release smolts are transferred to Dayton Acclimation Pond (Figure 5) for 2 weeks and are released mid-April at 4.5 to 6.0 fpp. The Dayton Acclimation Pond receives 6 cfs from the Touchet River.



Figure 5. An aerial photograph of the Dayton Acclimation Pond and site-specific structures.

2.1.3 Tucannon Program

Tucannon spawning generally occurs the second week of March until mid to late April. The conservation program is Wild x Wild and/or Wild x Endemic. The mitigation program is Hatchery x Hatchery and/or Hatchery x Endemic. A genetic spawning protocol is followed by utilizing a 2x2 spawning matrix. Eggs are rinsed, disinfected with iodophor, and water hardened in vertical heath stacks for one hour, with eggs from one female/tray.

Eggs are treated daily with formalin and after 14 days eggs are shocked, picked, enumerated, and returned to the heath stack until buttoned up. When fry are fully buttoned up, they transferred to the north side incubation room, and placed in troughs at a density of 8,000 to 12,000 per trough. Following transfer to troughs feeding of commercial food is initiated.

Fry are reared to 600-700 fpp and transferred to an intermediate-sized tank measuring 3.75' x 27.5' x 2'. Fry are again transferred from intermediate tanks to raceways once DI reaches 0.15 – 0.20. Marking and tagging occurs the first week of September. The Conservation program (50,000) is not adipose fin-clipped, but marked with a 100% CWT only. The mitigation program (100,000) is 75,000 AD clipped and 25,000 with both an AD and a CWT.

The first week of April, the conservation group is transferred to Curl Lake (Figure 6) which is supplied with 6 cfs from the Tucannon River. The week of April 15th, the

mitigation group is transferred and released directly in the river at the Tucannon Hatchery. Target release size is 4.5-6.0 fpp.



Figure 6. An aerial photograph of the Curl Lake Acclimation Pond and site-specific structures.

2.2 Infrastructure

2.2.1 Hatchery Water Supply

The Hatchery receives water through an underground/underwater 60-inch gravity line from the Marmes Pumping station and associated surge tank. There are three 300hp pumps, four 200hp pumps, and one 75hp pump. A total of 119 CFS (53,000 gpm) is the hatchery/program water right and equivalent to the maximum pumping capacity of 1175hp of on-site pumps (Figure 7). The water temperature is relatively constant at ~52 degrees F.

Pump maintenance consists of an annual pump removal and refurbishment. The refurbishment cycle takes into consideration total run time, amperage draw and fluctuations, and pump age since last overhaul.



Figure 7. An aerial photograph of the Lyons Ferry Fish Hatchery water supply and site-specific structures.

2.2.2 Hatchery Water Supply

2.2.2.1 Fall Chinook

Broodstock are primarily collected at the LGR adult trap. Trapping begins on August 18th each year. If water temperatures are too high for collection guidelines, broodstock can be collected at LFH and NPTH as well. Adults are trucked daily during the first few weeks of collection and then as water temperatures decrease and the run slows down, they are hauled less frequently. Currently the adult target is ~2,600 adults. This provides enough females and males to make programs and allows adults with coded wire tags to be collected for run reconstruction purposes. All adults are treated with Parasite -S every other day at 1:6,000 to prevent fungus growth and mortalities.

Approximately 4.6 million green eggs are taken each year. Approximately 1.31 million eyed eggs are shipped to ODFW's Irrigon FH. Of those, ~1 million sub-yearling smolts are destined for the Salmon River in Idaho for the IPC component of the Snake River fall Chinook program. Another 200,000 sub-yearling smolts are destined for the Grande Ronde River as part of the WDFW component of the Snake River fall Chinook program. LFH ships approximately 1.9 million sub-yearling smolts to the Nez Perce Tribes FCAP program annually. These sub yearlings go to Pittsburgh Landing AF, Captain John Rapids AF, and the Big Canyon AF for final rearing and release. LFH releases 450,000 yearling smolts and 700,000 sub-yearling smolts.

After fertilization, all eggs are disinfected with a 1:100 iodine solution for an hour prior to water hardening.

All females spawned are tested for *R. salmoninarum* using ELISA. The test is completed to prevent vertical transfer of this disease between adults and offspring and allows for personnel to cull/destroy females with moderate to high index values. All juveniles and eggs shipped or transferred out of Washington must be from females with

Below-low and Low optical indexes for *R. salmoninarum*. WDFW categorizes BKD-ELISA optical densities as Below low, Low, Moderate, and High (Table 3) with specific density values for each descriptor.

2.2.2.2 Spring Chinook

Tucannon spring Chinook are collected at the Tucannon FH Rainbow Lake adult trap and immediately transferred to LFH for holding and spawning. Adults start to arrive at the trap from mid-May through early July. LFH has colder water compared to Tucannon FH, the lower holding temperature reduces adult pre-spawn mortality when holding broodstock. All adults are treated with Parasite -S, every other day, at a rate of 1:6,000 to prevent fungus growth and mortalities. A maximum of 170 adults are collected for broodstock and to meet the production goal of 225,000 yearling smolts.

After fertilization, all eggs are disinfected in a 1:100 iodine solution for an hour, prior to final water hardening.

Touchet spring Chinook are collected at the DAT. The first return of adults occurred in 2022, with 24 adults (hatchery and natural origin) being collected at the trap. Many fish bypassed the DAT dam due to high water and could not be collected but continued upriver and spawned naturally in the upper Touchet River basin. This program began in 2018 and eyed eggs were received from either the USFWS's Little White Salmon Hatchery or Carson Hatchery. We plan to collect sufficient broodstock for this program to terminate out of basin egg transfers soon. All adults are treated with Parasite -S every other day at a rate of 1:600, to prevent fungus growth and mortalities.

After fertilization, all eggs are disinfected for one hour in a 1:100 iodine solution prior to water hardening. All females spawned will be tested for *R. salmoninarum* using ELISA. This allows for segregating eggs and juveniles of females with moderate to high optical indexes. WDFW categorizes BKD-ELISA optical densities as Below low, Low, Moderate, and High (Table 3) with specific density values for each descriptor.

2.2.2.3 Summer Steelhead

Touchet summer steelhead are collected at the DAT. Adults are transferred to LFH upon collection. Approximately 24 adults are needed to make the release goal of 50,000 smolts. This is a conservation program. All adults are treated with Parasite -S every other day at a rate of 1:6,000 to prevent fungus growth and mortalities.

After fertilization, all eggs are disinfected for one hour in a 1:100 iodine solution prior to water hardening.

Tucannon summer steelhead are collected at the Tucannon FH Rainbow Lake adult trap and immediately transferred to LFH for holding and spawning. Approximately 80 adults are needed to make the release goal of 150,000 smolts. This is a conservation and mitigation program. All adults are treated with Parasite -S every other day at 1:600

to prevent fungus growth and mortalities. After fertilization, all eggs are disinfected for one hour in a 1:100 iodine solution prior to water hardening.

Wallowa summer steelhead are collected at the Cottonwood Acclimation Facility (AF) adult trap. Adults are spawned at the adult trap and the gametes are brought back to LFH for fertilization and incubation. After fertilization, all eggs are disinfected for one hour in a 1:100 iodine solution prior to water hardening.

2.2.2.4 Rainbow Trout

Eyed Rainbow trout eggs are received from the WDFW Spokane Hatchery. Eggs are laid out to hatch in shallow trough baskets. Once eggs are on-site, they are immediately disinfected in a 1:100 iodine solution for 15 minutes.

2.2.3 Incubation

The incubation facilities include 112 full Heath Tray stacks (2 units of 8 trays each) of vertical incubators in the south-side hatching building, and 88 shallow eyeing/hatching troughs and four 3.75' x 27.5' x 2' intermediate rearing troughs in the north-side hatching building.

2.2.3.1 Fall Chinook

All females are incubated individually in heath stacks, maintaining their spawning number until eye up and picking. Eggs are treated with Parasite -S daily at 1:600 for 15 minutes until eye up and picking. After picking, eggs are mixed and weighed down at 5,000 eggs per tray and treatments stop.

At picking, any females with moderate or greater optical indexes are culled. Also, at this time any eggs from known stray females are culled from the program and not kept for production.

At swim up, fry are transferred from the heath stacks to outside rearing vessels and feed is introduced the day after.

2.2.3.2 Spring Chinook

Tucannon spring Chinook are incubated individually in heath stacks, maintaining their spawning number until eye up and picking. Eggs are treated with Parasite -S daily at 1:600 for 15 minutes until eye up and picking. After picking, eggs are mixed and weighed down at 5,000 eggs per tray and treatments stop. At swim up, the fry are transferred from the heath stacks to outside rearing vessels and feed is introduced the following day.

All females spawned will be tested for *R. salmoninarum* using ELISA. Eggs and juveniles from females with moderate or high optical densities will be segregated and reared separately throughout the rearing term.

Touchet spring Chinook are incubated individually in heath stacks, maintaining their spawning number until eye up and picking. Eggs are treated with Parasite -S daily at 1:600 for 15 minutes daily until eye up and picking. After picking, eggs are mixed and weighed down at 5,000 eggs per tray and treatments stop. At swim up, the fry are transferred from the heath stacks to outside rearing vessels and feed is introduced the following day.

All females spawned will be tested for *R. salmoninarum* using ELISA. Eggs from females with moderate or high optical densities will be culled (Table 3)

2.2.3.3 Summer Steelhead

Touchet summer steelhead have been incubated separately in down well isolation buckets in the past. The hatchery will continue incubating separately but will be switching to heath stacks for incubation. Eggs are treated with Parasite -S daily at 1:600 for 15 minutes daily until eye up and picking. After picking, eggs are mixed and weighed back down into heath trays and treatments stop. At swim up the fry will be transferred to shallow troughs and feed will be introduced the following day.

Tucannon summer steelhead have been incubated separately in down-well isolation buckets in the past. The hatchery will continue incubating separately but will be switching to heath stacks for incubation (2024). Eggs are treated with Parasite-S daily at 1:600 for 15 minutes until eye up and picking. After picking, eggs are mixed and weighed back down into heath trays and treatments stop. At swim up the fry will be transferred to shallow troughs and feed will be introduced the following day.

Wallowa summer steelhead have been incubated separately in down-well isolation buckets in the past. The hatchery will continue incubating separately but will be switching to heath stacks for incubation (2024). Eggs are treated with Parasite -S daily at 1:600 for 15 minutes daily until eye up and picking. After picking, eggs are mixed and weighed back down into heath trays and treatments stop. At swim up the fry will be transferred to shallow troughs and feed will be introduced the following day.

2.2.4 Nursery Rearing

LFH has 88 shallow eyeing/hatching troughs and four 3.75' x 27.5' x 2' intermediate rearing troughs in the north-side hatching building.

Shallow troughs are used primarily for starting feed on summer steelhead rainbow trout and possibly small groups of spring Chinook. Chinook only stay in long enough to be the same size as a larger group and are then mixed in outside raceways. Fish are generally no larger than 400fpp when moved to outdoor rearing units. Touchet and Tucannon steelhead start feed in the shallow troughs and are then moved to the intermediate tanks once DI and FI levels are met. From the intermediate tanks they are moved to outdoor raceways, anywhere from 150-500fpp. Rainbow trout are hatched

and feed is started in the shallow troughs. They then move to the intermediate tanks and to outdoor raceways shortly thereafter.

2.2.5 Outdoor Rearing

The LFH rearing facilities include 28 Southside raceways at 10' x 100' x 2.8' (Table 4) and 19 Northside raceways at 10' x 88.5' x 3.5'. The raceways rear all species produced at LFH (spring and fall Chinook, summer steelhead, and rainbow trout). These raceways are covered in 2" square mesh netting. There are three large rearing lakes (675,000 cubic feet (ft³) of water each; 1,100' x 90' x 6.5' dimensions; 2.25 surface acres each) which are also covered in 2" netting. Netting has significantly reduced predation since being installed in 2006-08. The steelhead and spring Chinook adult holding facilities include three 83' x 10' x 5' adult raceways with an enclosed spawning building incorporated over the center of these ponds. There are four 8.5' x 150' x 4.3' and four 10' x 150' x 4.3' adult fall Chinook salmon holding ponds, which also accommodate fall Chinook sub-yearling rearing in the spring months.

2.2.5.1 Fall Chinook

Fall Chinook are reared in approximately 19 raceways and eight adult ponds. Sub-yearlings are transferred to FCAP in April and May from raceways and adult ponds between 65 and 75 fpp. On station sub-yearlings are moved to a rearing lake after the yearling program is released directly into the Snake River and released in late May/early June at 50 fpp. Yearling fall Chinook are reared in raceways and then put directly into one of the rearing lakes at marking. They are released in late March/early April directly into the Snake River at 10 fpp.

2.2.5.2 Spring Chinook

Tucannon spring Chinook are reared in up to five raceways. At marking they are split into multiple raceways to prevent 0.16 DI exceedance, prior to the October transfer to the Tucannon FH.

Touchet spring Chinook are reared in up to five raceways. At marking they are split into multiple raceways to prevent 0.16 DI exceedance. Typically, in June, they are moved from the raceways to a rearing lake at approximately 65 fpp. In late January/early February, they are transferred to the Dayton AF for acclimation before they are released in mid-March.

2.2.5.3 Summer Steelhead

Touchet summer steelhead are moved to two outdoor raceways in July through early August. In September, they are marked, tagged, and split into three raceways for the remainder of the rearing cycle.

Tucannon summer steelhead are moved to three to five outdoor raceways in July through August. In September, they are marked, tagged, and split out into six raceways for the remainder of the rearing cycle. In March, the 50,000 smolts (conservation component) are transferred to the Curl Lake AF. In April, volitional release begins at Curl Lake AF.

2.2.5.4 Wallowa Steelhead

Wallowa summer steelhead are moved to five outside raceways in June. In September they are marked, tagged, and transferred directly into the rearing lakes. In early February, 225,000 fish are transferred to the Cottonwood AF and released in April. In late March, 100,000 fish are transferred to the Dayton AF and released in April. In April, the remaining 60,000 smolts are direct released at LFH into the Snake River at LFH at 4.5 fpp.

2.2.6 Release

2.2.6.1 Fall Chinook

In late March/early April, approximately 450,000 yearling Chinook are released from a rearing lake at 10 fpp, directly into the Snake River at LFH.

In late May/early June 700,000 sub-yearling Chinook are released from a rearing lake at 50 fpp directly into the Snake River at LFH.

2.2.6.2 Spring Chinook

In October, Tucannon spring Chinook are transferred to the Tucannon FH and released into the Tucannon River. Currently there are three release strategies being used. Approximately 20,000 smolts are released into the lower Tucannon River, approximately 0.25 miles upstream of the mouth of the Snake River. An additional 20,000 fish are transferred back to LFH from Tucannon FH where they are barge-transported to below Bonneville Dam and subsequently released. The remaining stock are direct released into the Tucannon River at Tucannon FH. All smolts are released at approximately 12 fpp.

In late January/early February, Touchet spring Chinook are transferred to the Dayton AF. In March, smolts are directly released into the Touchet River at approximately 12 fpp.

2.2.6.3 Summer Steelhead

In April, Touchet summer steelhead are transferred to the Dayton AF a week or two prior to volitional release and released directly into the Touchet River between 4.5 and 6 fpp, respectively.

Tucannon summer steelhead are transferred and directly released into the Tucannon River. The transferred group is 50,000 smolts that are taken to the Curl Lake AF, approximately five miles upstream from the Tucannon FH. Volitional release begins in

April. This is the conservation component of the program. The mitigation portion is 100,000 smolts that are transferred and direct released into the Tucannon River. Approximately 75,000 smolts are released at the Marengo Bridge and 25,000 are released near the Tucannon FH. The smolt release target of 150,000 has only been met once since increasing the program from 100,000 to 150,000 smolts in 2017, this is likely due to low return of broodfish. All smolts are released between 4.5 and 6 fpp, respectively.

2.2.6.4 Wallowa Steelhead

Wallowa steelhead are transferred to three locations. In February, approximately 225,000 smolts are transferred to the Cottonwood AF (Figure 8) and volitional releases begin in April. In late March, 100,000 smolts are transferred to the Dayton AF and volitional releases begin in April. The remaining 60,000 smolts are direct released from LFH into the Snake River in April. All smolts are released at approximately 4.5 fpp.



Figure 8. A photograph of the Cottonwood Acclimation Facility.

2.2.6.5 Rainbow Trout

Rainbow trout are planted into local lowland lakes. Planting begins in late February and continues through April. Fish are also transferred to the Nez Perce Tribe in April and May and hauled by the Nez Perce Tribe. Then fish are planted again in October in lowland lakes. Also in October, Idaho Department of Fish and Game transfer 16,000 (3.0 fpp) fish to Idaho.

2.2.7 Settling Pond

LFH has an offline settling pond, meaning that only water from rearing vessels when being cleaned goes into it. Water does not pass out of it but rather is absorbed into the ground. Production water from fish rearing goes directly out into the Snake River and is sampled per NPDES permit.

2.2.8 NPDES

The facility has always stayed within NPDES permit parameters. The current permit maximum poundage for a single month is 173,000 lbs.

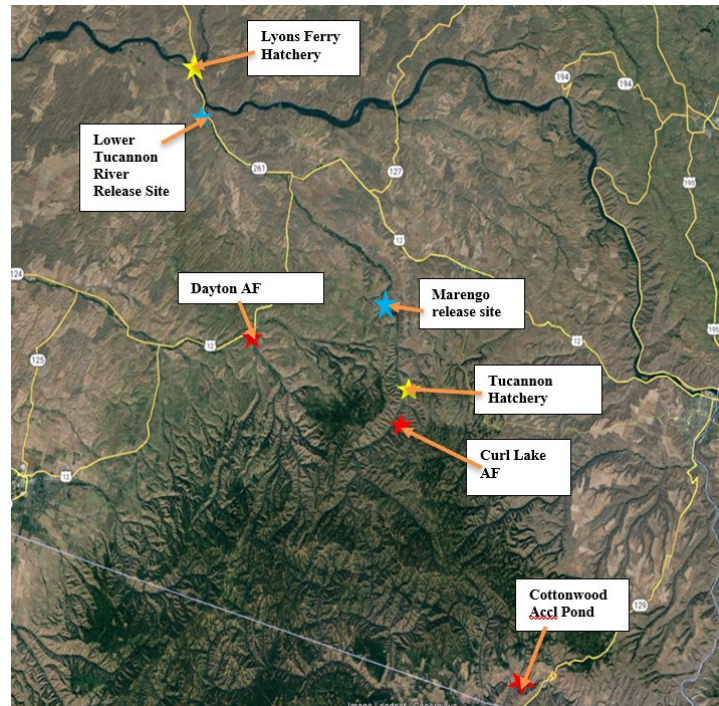


Figure 9. Aerial Map of all Lyon Ferry facilities and cooperating sites.

3 Operations

3.1.1 Marking and PIT tagging

3.1.1.1 Fall Chinook

Marking of sub-yearling production for LFH and FCAP begins in mid-March. There are seven different release groups that are marked and tagged with each group receiving ~200,000 coded wire tags (CWT) and adipose fin clips. Prior to transfer or release, all groups receive Passive Integrated Transponder (PIT) tags. The number of PIT tags per group varies.

Yearling fall Chinook are marked and tagged in July. All 450,000 juveniles are adipose fin clipped and CWT. Smolts receive PIT tags at release.

3.1.1.2 Spring Chinook

Tucannon spring Chinook are tagged in March. All 225,000 fish receive a CWT. Smolts receive PIT tags just prior to release.

Touchet spring Chinook are marked and tagged in March. Approximately 85,000 juveniles receive a CWT and all 250,000 are adipose fin clipped. Smolts receive PIT tags prior to transfer to Dayton AF.

3.1.1.3 Summer Steelhead

Touchet summer steelhead are CWT in August/September. Smolts receive PIT tags prior to transfer to Dayton AF.

Tucannon summer steelhead are marked and tagged in September. Approximately 50,000 juveniles receive a CWT only, ~25,000 are CWT and adipose fin clipped, and 75,000 are adipose fin clipped only. Smolts receive PIT tags prior to transfer or release out of LFH.

Wallowa summer steelhead are marked and tagged in July/August. All 385,000 fish are adipose fin clipped and 40,000 receive a CWT. At transfer or prior to direct release, the smolts receive a PIT tag.

3.1.1.4 Rainbow Trout

No fish are marked or tagged.

4 Operational Changes for Program Efficiency

4.1.1 Build new rearing lakes at LFH

Three new rearing lakes for LFH have previously been designed and engineered. The approximate cost at the time of engineering was around \$5.5 million without additional water to operate them. At today's costs, program and water usage changes since that time, and those anticipated soon (fall Chinook yearling to sub-yearling conversion) and adding in the needed water component for these lakes, WDFW believes that the total cost could be double of the previous estimate. Based on the size of the lakes, and anticipated stocks that will go into them, two 250hp pumps would be needed, one for operating the lakes and one for backup. For these three additional lakes WDFW would prioritize the rearing of the following programs: Touchet spring Chinook program of 250,000 smolts, the Tucannon spring Chinook program of 225,000 smolts, and the Tucannon steelhead program of 150,000 smolts. For the Tucannon steelhead program, further discussions with co-managers and NOAA Fisheries will have to occur to agree to the mixing of the conservation and mitigation fish together and allow them all to be out planted upstream of the TFH Weir (50,000 smolts for conservation and 100,000 smolts for mitigation).

These three additional rearing lakes will open one of the larger rearing lakes due to moving of the 250K Touchet River spring Chinook group. Also, raceways currently used

by Tucannon River spring Chinook and Tucannon River steelhead will open for additional rearing options.

For the approximate cost of \$11M, WDFW would initially propose an additional 500,000 spring Chinook program that would be released in the Clearwater or Salmon River basins. Other additional programs may also come to light but will again depend on multiple factors that can influence production capabilities.

4.1.2 Refurbish captive brood tanks from the 90's or replace

The captive broodstock tanks from the BPA funded Tucannon spring Chinook program from the late 1990's, could be refurbished or replaced. Alone, these tanks would provide enough room to rear ~150,000 additional spring Chinook. However, to make a more efficient use of these circular tanks that would free up additional rearing space would involve moving the rainbow trout production into these circulars. With that change, five raceways would be freed up that could produce ~500,000 more spring Chinook. Midway through rearing, these spring Chinook would then be put into one of the existing large rearing lakes (currently occupied by the yearling fall Chinook program). This new spring Chinook program would have to be released or transferred in late-March/early April prior to sub-yearling fall Chinook going into the lake the first of April annually.

As part of the refurbishing of the tanks, water needs will have to be addressed either with 1) some kind of reuse system, 2) plumbing in reuse water from the nearest bank of north-side raceways, or 3) a new well. New circular rearing tanks were investigated back in 2014-15 and the design and engineering are already completed, with the approximate cost at that time around \$1.2 million.

LFH is currently going through the process to convert the yearling fall Chinook program to sub-yearling fall Chinook. This change will increase the demand for rearing space from January to May on the facility (450,000 subs to 1,200,000 onsite and increased production for FCAP). Peak fish loading and water demand occurs in January through May annually prior to shipments to FCAP acclimation locations. At that point, all 119 cfs (53,000 gpm) of the current water right is allocated.

For the ~\$1.2M Cost, WDFW would propose an additional 500,000 spring Chinook program that would be released in the Clearwater or Salmon River basins. Operation costs of \$75,000 annually (500,000 * \$0.15/smolt).

4.1.3 Experimental Age-0 Spring Chinook Production

Currently (2022), fall Chinook salmon are reared between 10 fpp as yearlings released in March and 50 fpp as sub-yearlings and released in late May/early June. In the last decade, fall Chinook salmon sub-yearlings have survived much better than what originally occurred in the 1980s and 1990's (Bugert et al, 1997, Rosenberger et al 2017, Bumgarner et al 2022). Only, a small component (15%) of fall Chinook salmon sub-yearlings' "holdover" in the Lower Snake reservoir pools created by the hydrosystem.

However, these “holdover” sub-yearlings can account for a significant (25%+) component of the returning adult fall Chinook salmon (NOAA 2018 pg. 80). Anecdotally, these “holdover” sub-yearlings grow very quickly in the summer and fall months in the productive reaches of the Snake River reservoirs and can surpass the 10 fpp release size of comparable yearlings (Darren Ogden pers comm). However, the reservoir rearing environment has been constantly changing/fluctuating in recent years with additional predator biomass, temperature increases, etc.

Spring/summer Chinook salmon are commonly reared between 12 to 25 fpp within the LSRCF between temperatures of 36 to 55 F as yearlings and 100 fpp as sub-yearlings. At Lyons Ferry, 52 F water temperatures offer an opportunity to rear spring Chinook following a fall Chinook sub-yearling life history. Previous work with spring/summer Chinook sub-yearlings have released 100 fpp parr in the Fall (September). These releases have produced very poor adult return rates (<0.1%). Accelerating growth to target late May/early June releases at 30-50 fpp would match fall Chinook salmon releases and potentially capture the reservoir reared benefit of some smolts “holding-over” in the Lower Snake River reservoirs.

Currently, no space exists for Age-0 spring Chinook smolts at LFH. However, test programs could be explored in multiples of 100,000 per Northside raceway if alternative rearing facilities were identified for existing programs. Across the LSRCF portfolio, several facilities have water temperature profiles that have spring-released Age-0 spring Chinook potential (Table 5).

Replacing steelhead or multi-species rearing with steelhead – i.e., moving steelhead to acclimation facilities mid-winter, has the potential of 10 to 22M additional Age-0 spring Chinook at LFH, Irrigon FH, Hagerman FH, and Magic Valley Fish Hatchery.

A test program of Age-0 spring Chinook reared at LFH would need to consider multiple factors and would also need a subsequent control group of yearlings that could be compared to. Current LFH yearling spring Chinook stocks are released at mid-hydro projects and would likely not be as conducive to success.

Total costs – Unknown.

Output – Potential Age-0 smolts across program: 10 – 22M smolts.

4.1.4 Utilize Rearing Lakes for Steelhead

A recent Reciprocal Study (Release Years 2015-2018) comparing Wallowa stock steelhead reared at Irrigon FH at acceptable densities (DI = 0.15) compared to rearing in LFH rearing lakes in a semi-natural environment (DI = 0.01) is complete. Data from this study suggests a 2:1 Smolt-to-Adult Return (SAR) for Wallowa stock steelhead reared in the LFH rearing lakes, regardless of release location in the Grande Ronde Basin (Figure 2). This study was implemented because the mean SAR from LFH rearing lake steelhead averaged 2.9% compared to 1.1% at Irrigon raceway-reared

steelhead from BY97-2008. During the same timeframe, the remaining LSRCP steelhead facilities also averaged in the 1% to 1.5% range.

In February approximately 225,000 steelhead are transferred to acclimation sites. Approximately 160,000 steelhead are kept at LF until release (April) in Lake #3 (Figure 10). Operationally this strategy allows for water use to be cut by 50%, from approximately 6,000 gpm to about 3,000 gpm in Lake #3. Using this operational strategy, it would allow for the following alternative rearing strategies to be integrated:

- Lake #1 will be utilized for final rearing (April – May) of sub-yearlings fall Chinook.
- Lake #2 will be used for Touchet spring Chinook (July – January)
- Lake #2 will be used for final fall Chinook sub-yearling rearing (April – May).

However, if water supplies were maintained at 6,000 gpm each, the rearing lakes could provide steelhead rearing of approximately 400,000 smolts (4.5 fpp) each to April release for a total of 1.2 M smolts in all three rearing lakes. To gain additional water supplies, approximately 12 Southside raceways (750 gpm) rearing capacity would need alternative rearing locations.

Multiple options of “Reciprocal Study Implementation” were examined by the co-managers in 2020 and 2021. From those discussions, the first step was conversion of the fall Chinook yearlings to sub-yearlings, which is in the approval stage. Additional species swaps and conversion have a maximum potential of 2.75M to 3.5M spring Chinook yearlings at 20 fpp assuming additional LFH rearing of 800,000 steelhead (2 rearing lakes) to 4.5 fpp.

Costs are \$360,000 for 800,000 steelhead increase at LFH (\$0.45/smolt) for fish food, marking, etc. Additional costs would include in-pond aeration (\$300,000), transport tanker at LFH (\$300,000), and transportation (TBD). Additional spring Chinook up to 3.5M would cost \$533,000 annually at other facilities.

Chinook costs for an additional 2.75 M spring Chinook and 900,000 sub-yearling fall Chinook are approximately \$547,500 annually for fish food, marking, etc. at \$0.15/smolt. Transportation of Touchet spring Chinook would be backhauled on the steelhead transportation costs.

Movement of 800,000 steelhead smolts to LFH could provide an additional 8,000 steelhead annually (1.0% delta SAR on 800,000 smolts). The additional 3.5M spring Chinook smolts could provide an additional 11,900 adults (0.34% SAR on 3.5M smolts) depending on release location.

Total implementation = \$948,000 annually and \$600,000 additional transport tanker and supplemental aeration.



Figure 10. Photograph of outdoor rearing “Lake” located on Lyons Ferry FH.

4.1.5 Provide Shade for Raceways

The USFWS (2011) Hatchery Review Team identified installing shade covers over raceways to reduce stress and improve post release survival at Lyons Ferry. Also, anecdotally during 2023/2024 rearing, Fish Pathology noted sunburn in spring Chinook at Lyons Ferry. The availability of covered raceways at Lyons Ferry could provide an additional option for fish rearing without sunburn issues. A Strengths/Weaknesses/Opportunity/Threats analysis was completed for Lyons Ferry shade structures in March 2024 and the results are listed below:

4.1.5.1 Strengths

- Shading benefits smolt growth (Pickering 1987 - <https://www.sciencedirect.com/science/article/abs/pii/0044848687902262>)
- Identified by Hatchery Review Team in 2011 to reduce stress and improve post release survival.
- Aquatic Invasive Species/Disease contamination and spreading by predators from raceway to raceway.
- Baffles could be used because sunlight is eliminated resulting in less staff for cleaning efforts and reduced fish disturbance.
- Less overhead disturbance to fish from birds and less staff interaction by reduction of cleaning and feeding activities which reduces fish stress, which in turn reduces susceptibility to fish pathogens and increased survival.

- Replaces existing bird netting, which must be replaced periodically.
- Improves working conditions for staff by cooling the work area significantly if roof is tall enough.
- Improves safety by reducing staff sun exposure during summer months, and slip/fall risk during snow or ice accumulations during winter months.
- Significantly reduces algae growth on pond walls and floors. Less algae means:
 - Reduced labor costs to remove it.
 - Reduced trapped fish waste and uneaten feed (which gets caught in algae filaments) which significantly improves the fish's rearing environment.
 - Reduced Workman's Compensation claims for staff injured because of removing algae day after day and year after year, through repetitive motion physically removing it with brushes, or by lifting/carrying heavy salt sacks for salt treatments of algae. Both approaches to algae control are physically demanding and lead to injury and WC claims.
- Shading may reduce sunburn in spring Chinook.

4.1.5.2 Weaknesses

- Cost potential of \$5.9M with solar installation
- Reduces resources available for other infrastructure and program needs.
- Labor for install/removal/cleaning of baffles for marking and release (if used)

4.1.5.3 Opportunities

- Opportunity to increase adult returns.
- Improve rearing conditions for spring Chinook, steelhead, rainbow trout, and fall Chinook.
- Solar PV systems could offset electrical pumping costs.

4.1.5.4 Threats

- Catastrophic failure potential (Carson NFH rain on snow event example)
- Increased incidence of Gyrodactylus has been anecdotally noted at covered facilities.

Cost of implementation is \$5.9M with solar PV system.

4.1.6 Incubation Building Expansion

If the current Incubation Building was extended approximately 75' into the current footprint of the hatchery it would allow for a separate incubation room/area, specific to steelhead trout egg incubation. Expanding the building would separate egg take and incubation by species and allow the facility to incubate all production on-site, thereby minimizing transfer of eggs and smolts between partner facilities. The estimated cost of the project is \$1.75M.



Figure 10. Photos of Incubation Building at Lyons Ferry Hatchery.

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6 Appendix A – Production Planning

Lyons Ferry Hatchery

Chin FI=1.6 DI=.09 until marking or splitting, .14 to release as smolts or transfer as smolts. Sthd FI=1.6 DI=.09 until marking, .2 until release or transfer as smolts
Rb FI=1.6 DI=.25

1.9 mill FCAP, 700k LFH

	2022/23	Fall CK Subs 2.6 mil 26,667 LBS.	Fall CK yrings 450,000 45,000 LBS.	Tuc Spring CK 225k 9,000 LBS.	Tuca Sthd 150k 33,333 LBS.	Touchet Sthd 50k 11,111 LBS.	Touchet Spring CK 250K 20,833 LBS.	Wallowa Sthd 385 K 89,000 LBS.	RB Trout 122K 47,995 LBS.			
Pond use schematic - by stock	2022/23											
Pond	January	February	March	April	May	June	July	August	September	October	November	December
SS INC												
SS INC												
SS INC												
SS INC												
NS INC												
NS INC												
Tank 6												
Tank 7												
Tank 8												
Tank 9												
N1	NPT/LFH jumbos		NPT/LFH jumbos									
N2						Wallowa sthd						
N3	Tucannon sthd					Wallowa sthd			Tucannon sthd			
N4	Tucannon sthd					Wallowa sthd			Tucannon sthd			
N5	Tucannon sthd					Wallowa sthd			Tucannon sthd			
N6	Tucannon sthd					Wallowa sthd			Tucannon sthd			
N7	Tucannon sthd					Tucannon sthd						
N8	Tucannon sthd					Tucannon sthd						
N9	Touchet sthd					Touchet sthd						
N10	Touchet sthd					Touchet sthd						
N11		LFH subs				LFH 1+						
N12		LFH subs				LFH 1+						
N13		LFH Subs				LFH 1+						
N14		LFH Subs				LFH 1+						
N15						LFH 1+		RBT				
N16	RBT											
N17	RBT											
N18	RBT											
N19	RBT											
Lake 1	LFH 1+				LFH Subs, 700k		LFH 1+					
Lake 2	Touchet springs						Touchet springs					
Lake 3	Wallowa Sthd						Wallowa sthd					
S 1	Tou Spr											Tou Spr
S 2	Tou Spr											Tou Spr
S 3	Tou Spr											Tou Spr
S 4	Tou Spr											Tou Spr
S 5	Tou Spr											Tou Spr
S 6												
S 7												
S 8												
S 9												
S 10	Tuc Spr											Tuc Spr
S 11	Tuc Spr											Tuc Spr
S 12	Tuc Spr											Tuc Spr
S 13	Tuc Spr											Tuc Spr
S 14	Tuc Spr											Tuc Spr
S 15	BC Subs											
S 16	CJ Subs											
S 17	Pitts subs											
S 18	Pitts 2 subs											
S 19	Pitts 2 subs											
S 20	BC 2 subs											
S 21	BC 2 subs											
S 22	CJ 2 Subs											
S 23	CJ 2 Subs											
S 24		LFH 1+										
S 25		LFH 1+										
S 26		LFH 1+										
S 27		LFH 1+										
S 28		LFH 1+										
AP 1	BC Subs							Adults				
AP 2	BC Subs							Adults				
AP 3	CJ Subs							Adults				
AP 4	CJ Subs							Adults				
AP 5	LFH Subs											
AP 6	LFH Subs											
AP 7	Pitts Subs							Adults?				
AP 8	Pitts Subs							Adults?				
AP 9			Adults									
AP 10			Adults									
AP 11			Adults									

1,2,7 & 8 are smaller

Lyons Ferry Hatchery


1.9 mill FCAP, 700k LFH

Fall CK Subs	Fall CK Yrings	Tuc Spring CK	Tuca Sthd	Touchet Sthd	Touchet Spring CK	Wallowa Sthd	RB Trout
2.6 mil	450,000	225K	150k	50k	250K	385 K	122K
26,667 LBS.	45,000 LBS.	9,000 LBS.	33,333 LBS.	11,111 LBS.	20,833 LBS.	89,000 LBS.	47,995 LBS.

Pond flows by stock and month 2022/23

	January	February	March	April	May	June	July	August	September	October	November	December
Pond												
SS INC												
SS INC												
SS INC												
SS INC												
NS INC												
NS INC												
Tank 6												
Tank 7												
Tank 8												
Tank 9												
N1	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
N2							500	500	500	1,000	1,000	1,000
N3	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
N4	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
N5	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
N6	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
N7	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
N8	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
N9	1,000	1,000	1,000	1,000	1,000			500	500	500	1,000	1,000
N10	1,000	1,000	1,000	1,000	1,000			500	500	500	1,000	1,000
N11		500	500	500	1,000	1,000		1,000	1,000	1,000	1,000	
N12		500	500	500	1,000	1,000		1,000	1,000	1,000	1,000	
N13		500	500	500	1,000	1,000		1,000	1,000	1,000	1,000	
N14		500	500	500	1,000	1,000		1,000	1,000	1,000	1,000	
N15								1,000	1,000	1,000	1,000	1,000
N16	1,000	1,000	1,000	1,000		500	500	1,000	1,000	1,000	1,000	1,000
N17	1,000	1,000	1,000	1,000	1,000	500	500	1,000	1,000	1,000	1,000	1,000
N18	1,000	1,000	1,000	1,000	1,000	500	500	1,000	1,000	1,000	1,000	1,000
N19	1,000	1,000	1,000	1,000	1,000	500	500	1,000	1,000	1,000	1,000	1,000
Lake 1	4,500	4,500	4,500	4,500	4,500	6,000	6,000	6,000	6,000	4,000	4,000	4,000
Lake 2	4,000	4,000						4,000	4,000	4,000	4,000	4,000
Lake 3	6,000	6,000	3,000	3,000	3,000	3,000				4,000	4,000	4,000
S 1	750	750	750	750	750	750	750	750	750	750		500
S 2	750	750	750	750	750	750	750	750	750	750		500
S 3	750	750	750	750	750	750	750	750	750	750		500
S 4	750	750	750	750	750	750	750	750	750	750		500
S 5	750	750	750	750	750	750	750	750	750	750		500
S 6												
S 7												
S 8												
S 9												
S 10	750	750	750	750	750	750	750	750	750	750	750	500
S 11	750	750	750	750	750	750	750	750	750	750	750	500
S 12	750	750	750	750	750	750	750	750	750	750	750	500
S 13	750	750	750	750	750	750	750	750	750	750	750	500
S 14	750	750	750	750	750	750	750	750	750	750	750	500
S 15		500	500	750	750	750	750					
S 16		500	500	750	750	750	750					
S 17		500	500	750	750	750	750					
S 18		500	500	750	750	750	750					
S 19		500	500	750	750	750	750					
S 20		500	500	750	750	750	750					
S 21		500	500	750	750	750	750					
S 22		500	500	750	750	750	750					
S 23		500	500	750	750	750	750					
S 24			500	500	750	750	750	750	750	750	750	
S 25			500	500	750	750	750	750	750	750	750	
S 26			500	500	750	750	750	750	750	750	750	
S 27			500	500	750	750	750	750	750	750	750	
S 28			500	500	750	750	750	750	750	750	750	
AP 1		500	500	1,000	1,000	1,000	1,000		750	750	750	750
AP 2		500	500	1,000	1,000	1,000	1,000		750	750	750	750
AP 3		500	500	1,000	1,000	1,000	1,000		750	750	750	750
AP 4		500	500	1,000	1,000	1,000	1,000	1,000	750	750	750	750
AP 5		500	500	1,000	1,000	1,000	1,000	1,000				
AP 6		500	500	1,000	1,000	1,000	1,000	1,000				
AP 7		500	500	1,000	1,000	1,000	1,000	1,000	750	750	750	750
AP 8		500	500	1,000	1,000	1,000	1,000	1,000	750	750	750	750
AP 9				350	350	350	350	350	350	350	350	350
AP 10												
AP 11				350	350	350	350	350	350	350	350	350

7 Appendix B – Water Quality

		Water Analysis Report Soil, Water and Forage Testing Laboratory Department of Soil and Crop Sciences 2610 F&B Road, 2478 TAMU College Station, TX 77843-2478 979-845-4816				
Report generated for: Kelly Britt WDFW Lyons Ferry Hatchery 2927 W Waikiki Rd SPOKANE, WA 99208		Visit our website: http://soiltesting.tamu.edu				
Laboratory #: 35045346 Customer Sample ID: Head Trough - 12/8/2021 Date Processed: 1/10/2022 Sample from Franklin, WA County Water Source =Well		Format based on publication SCS-2002-12 Water Use =Aquaculture				
Parameter analyzed	Results	Units	Method	V. Limiting	Limiting	Acceptable
Calcium (Ca)	21	ppm	ICP	Publications on aquatic and pond water quality can be downloaded at: soiltesting.tamu.edu/webpages/publications.html		
Magnesium (Mg)	14	ppm	ICP			
Sodium (Na)	20	ppm	ICP			
Potassium (K)	5	ppm	ICP			
Boron (B)	0.02	ppm	ICP			
Carbonate (CO ₃)	13	ppm	Titr.			
Bicarbonate (HCO ₃)	145	ppm	Titr.			
Sulfate (SO ₄ ²⁻ calculated from total S)	16	ppm	ICP			
Chloride (Cl ⁻)	12	ppm	Titr.			
Nitrate-N (NO ₃ -N)	0.09	ppm	Cd-red.			
Phosphorus (P)	0.04	ppm	ICP			
pH	10.41		ISE			
Conductivity	219	umhos/cm	Cond.			
Hardness	6	grains CaCO3/gallon	Calc.			
Hardness	108	ppm CaCO3	Calc.			
Alkalinity	140	ppm CaCO3	Calc.			
Total Dissolved Salts (TDS)	246	ppm	Calc.			
SAR	0.8		Calc.			
Iron (Fe)	0.05	ppm	ICP			
Zinc (Zn)	0.03	ppm	ICP			
Copper (Cu)	< 0.01	ppm	ICP			
Manganese (Mn)	0.03	ppm	ICP			
Arsenic (As)	< 0.030	ppm	ICP			
Barium (Ba)	0.024	ppm	ICP			
Nickel (Ni)	< 0.005	ppm	ICP			
Cadmium (Cd)	< 0.003	ppm	ICP			
Lead (Pb)	< 0.004	ppm	ICP			
Chromium (Cr)	< 0.007	ppm	ICP			
Fluoride (F)	0.33	ppm	ICP			
Charge Balance (cation/anion* 100)	90		Calc.			
ppm=parts per million-milligrams per liter N/A, not applicable for this water use /2021 Descriptions of each water parameter, potential use issues and target levels are provided in publication SCS-2002-10, Description of Water Analysis Parameters. ICP, Inductively coupled plasma; Titr., titration; ISE, Ion selective electrode; Cd-red., cadmium reduction; cond., conductivity; calc., calculated						

8 Tables

Table 1. Steelhead Smolt to Adult Survivals (SAS) by basin, Brood Year 2000-2012

Clearwater FH	Hagerman NFH	Magic Valley FH	Imnaha – Irrigon FH	Grande Ronde – Irrigon/Lyons Ferry FH	SE WA – Lyons Ferry FH
1.37%	1.32%	1.03%	1.63%	1.78%	2.16%

Table 2. Smolt-to-Adult Survival (Total SAS) – WDFW Steelhead, spring Chinook, and Fall Chinook programs from Lyons Ferry/Tucannon Complex.

Species	Spring Chinook	Fall Chinook			Summer Steelhead				
		Tucannon	Snake	Snake	Snake	Tucannon	Touchet	LFH / Wallowa	LFH / Wallowa
Stock	Tucannon	Snake	Snake	Snake	Tucannon	Touchet	Wallowa	Wallowa	Wallowa
Smolt Age	1+	1+	0	0	1+	1+	1+	1+	1+
Release Location	Tucannon	Snake @LFH	Snake @LFH	Grande Ronde	Tucannon	Touchet	Grande Ronde	Snake @LFH	Touchet
Brood Year									
2000	0.15	2.06	0.15	---	---	---	2.34	1.68	1.20
2001	0.09	2.04	0.30	---	---	---	1.94	1.85	1.78
2002	0.10	0.50	0.15	---	---	---	1.92	2.25	2.00
2003	0.10	1.65	0.11	---	0.57	0.44	2.36	1.63	2.01
2004	0.18	2.16	0.08	0.08	0.80	0.28	1.34	1.93	1.62
2005	0.46	1.51	1.67	0.37	1.91	0.43	3.50	2.56	2.71
2006	1.09	7.24	0.24	---	1.95	0.98	3.35	2.59	3.38
2007	0.23	3.25	3.13	0.52	4.61	1.10	7.85	6.59	5.96
2008	0.37	3.64	0.46	0.35	---	0.37	2.13	3.37	2.49
2009	0.13	2.77	1.71	1.50	1.28	0.88	3.47	3.94	3.10
2010	0.10	4.06	2.16	0.39	0.97	0.26	1.02	1.70	0.95
2011	0.28	3.06	0.78	1.01	1.25	0.46	2.42	2.67	2.47
2012	0.25	1.89	1.49	0.57	0.56	0.40	2.98	3.36	2.42
2013	0.18	1.29	0.68	0.35	0.97	1.40	3.09	1.90	1.22
2014	0.21	1.66	0.70	0.68	0.21	0.18	0.58	1.19	0.65
2015	0.09	0.63	0.20	0.02	0.64	0.65	2.26	1.46	1.25
2016	0.01	0.31	0.28	0.36	0.31	0.48	0.83	0.62	0.82
2017		0.30	0.31	0.54	0.48	0.37	1.36	1.85	1.04
2018			0.61	0.74	0.10	0.07	0.67	0.75	0.59
2019					0.70	0.14	2.84	1.80	2.64
Average	0.24	2.22	0.80	0.53	1.08	0.52	2.41	2.28	2.02
Geomean	0.16	1.65	0.47	0.36	0.75	0.41	2.01	1.99	1.71

Table 2. Smolt-to-Adult Survival (Total SAS) – WDFW Steelhead, spring Chinook, and Fall Chinook programs from Lyons Ferry/Tucannon Complex. (Updated 2024)

Species	Spring Chinook	Fall Chinook			Summer Steelhead				
	Tucannon	Snake	Snake	Snake	Tucannon	Touchet	LFH / Wallowa	LFH / Wallowa	LFH / Wallowa
Stock	1+	1+	0	0	1+	1+	1+	1+	1+
Smolt Age	1+	1+	0	0	1+	1+	1+	1+	1+
Release Location	Tucannon	Snake @LFH	Snake @LFH	Grande Ronde	Tucannon	Touchet	Grande Ronde	Snake @LFH	Touchet
Brood Year									
2000	0.15	2.06	0.15	---	---	---	2.34	1.68	1.2
2001	0.09	2.04	0.3	---	---	---	1.94	1.85	1.78
2002	0.1	0.5	0.15	---	---	---	1.92	2.25	2
2003	0.1	1.65	0.11	---	0.57	0.44	2.36	1.63	2.01
2004	0.18	2.16	0.08	0.08	0.8	0.28	1.34	1.93	1.62
2005	0.46	1.51	1.67	0.37	1.91	0.43	3.5	2.56	2.71
2006	1.09	7.24	0.24	---	1.95	0.98	3.35	2.59	3.38
2007	0.23	3.25	3.13	0.52	4.61	1.1	7.85	6.59	5.96
2008	0.37	3.64	0.46	0.35	---	0.37	2.13	3.37	2.49
2009	0.13	2.77	1.71	1.5	1.28	0.88	3.47	3.94	3.1
2010	0.1	4.06	2.16	0.39	0.97	0.26	1.02	1.7	0.95
2011	0.28	3.06	0.78	1.01	1.25	0.46	2.42	2.67	2.47
2012	0.25	1.89	1.49	0.57	0.56	0.4	2.98	3.36	2.42
2013	0.18	1.29	0.68	0.35	0.97	1.4	3.09	1.9	1.22
2014	0.21	1.66	0.7	0.68	0.21	0.18	0.58	1.19	0.65
2015	0.09	0.63	0.2	0.02	0.64	0.65	2.26	1.46	1.25
2016	0.01	0.31	0.28	0.36	0.31	0.48	0.83	0.62	0.82
2017	0.01	0.3	0.31	0.54	0.48	0.37	1.36	1.85	1.04
2018		0.46	0.61	0.74	0.1	0.07	0.67	0.75	0.59
2019					0.7	0.14	2.84	1.8	2.64
2020					0.29	0.34	1.05	1.05	1.91
Average	0.22	2.13	0.80	0.53	1.04	0.51	2.35	2.23	2.01
Geomean	0.14	1.54	0.48	0.38	0.71	0.41	1.95	1.93	1.72

Table 3. WDFW categorizes BKD-ELISA optical densities for *R. salmoninarum*.

- Below low = < 0.099,
- Low = 0.099 to 0.198,
- Moderate = 0.199 to 0.448,
- High = > 0.448

Table 4. Rearing units at Lyons Ferry FH, defined by total number, volume, and flow (gpm) for each type of rearing unit.

Rearing Unit	Total Number	FT ³	Flow Each (gpm)
Southside Raceways	28	2,640	500-750
Northside Raceways	19	2,880	500-1,000
Rearing Lakes	3	675,000	3,000-6,000
Adult Ponds (1,2,7,8)	4	5,483	500-1,000
Adult Ponds (3-6)	4	6,450	500-1,000
Adult Ponds (9-11)	3	4,150	300-700

Fall Chinook – 0.09 DI until marking, 0.16 DI until splitting or at release.

Spring Chinook – 0.09 DI until marking, 0.16 DI until splitting or at release.

Summer Steelhead – 0.09 DI until marking, 0.25 DI until splitting or at release.

Rainbow – 0.09 DI until ~100fpp, 0.25 DI until splitting or release.

Table 5. LSRCP facility/site comparison by temperature

Facility	Temperature
Lyons Ferry Fish Hatchery	52 F
Irrigon Fish Hatchery	55 F
Hagerman National Fish Hatchery	59 F
Magic Valley Fish Hatchery	59 F