Infrastructure and Operations Audit: Hagerman National Fish Hatchery, 2024

Hagerman National Fish Hatchery
Lower Snake River Compensation Plan

Sage Hallenbeck
Idaho Department of Fish and Game

Nathan Wiese
U.S. Fish and Wildlife Service

Contacts

Idaho Department of Fish and Game
Brian Thompson
Hatchery Manager
Hagerman National Fish Hatchery
3059-D National Fish Hatchery Rd.
Hagerman, ID 83332
Phone: 208-837-4896
E-mail: brian.thompson@idfg.idaho.gov

Idaho Department of Fish and Game
Sage (Hallenbeck) Pike
Assistant Hatchery Manager
Hagerman National Fish Hatchery
3059-D National Fish Hatchery Rd.
Hagerman, ID 83332
Phone: 208-837-4896
E-mail: sage.hallenbeck@idfg.idaho.gov

Idaho Department of Fish and Game
Brandon Filloon
Complex Manager
324 417 E #1
Jerome, ID 83338
Phone: 208-512-9988
E-mail: brandon.filloon@idfg.idaho.gov

Idaho Department of Fish and Game
Cassie Sundquist
Production Program Coordinator
600 S Walnut
Boise, ID 83707
Phone: 208-287-2780
E-mail: cassie.sundquist@idfg.idaho.gov

U.S. Fish and Wildlife Service
Nathan Wiese
Program Coordinator
Lower Snake River Compensation Plan Office
1387 S Vinnell Way, Suite 343
Boise, ID 83709
Phone: 208-514-5644
E-mail: nathan_wiese@fws.gov

Executive Summary

On August 2, 2022, Nathan Wiese, Program Coordinator LSRCP, Brian Thompson, Hatchery Manager, and Sage Hallenbeck, Assistant Hatchery Manager, conducted a high-level one-day infrastructure and operations assessment of the Partial Recirculating Aquaculture System (PRAS) at the Hagerman National Fish Hatchery. A return visit was made by Nathan Wiese and Chris Starr, LSRCP and Brian Thompson, Hatchery Manager, and Sage Hallenbeck, Assistant Hatchery Manager in March 2024. A final facility assessment addressing steelhead trout (*Oncorhynchus mykiss*) production was made by Shawn Sanders – LSRCP/FWS Fish Biologist, Brian Thompson – Hatchery Manager, Sage Hallenbeck – Assistant Hatchery Manager, and Brandon Filloon – Complex Manager on September 16, 2024, to record any additional program needs.

The purpose of this document is to provide the Lower Snake River Compensation Plan (LSRCP) and other stakeholders ample conceptual-level information of the current infrastructure challenges. The goal is to incorporate audit findings into a 10-year strategic plan for LSRCP that will maximize in-house and external improvement opportunities by developing solutions that fit resources, budgets, and supportive programs in a logical sequence. These efforts are intended to significantly improve water quality, program capacity, efficiency, and flexibility at the facility and ultimately increase opportunities for LSRCP to meet adult mitigation targets.

The LSRCP plans to assess all steelhead rearing facilities within the program prior to the 10-year spring/summer Chinook Program Review for the Independent Scientific Review Panel (ISRP) in January 2025. With this review, the LSRCP 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 Hagerman audit(s) resulted in several options for increasing steelhead trout capacity including the following:

- Modify Operational Management and Production of steelhead trout to maintain a (Maximum) 1.2 Flow Index. This decision would be based on flow rates and likely reduce production of steelhead trout at Hagerman National Fish Hatchery.
  Cost (Savings of fish food expenditure) – ($100,000)

- Develop Acclimation Facilities for early Transfer – This rearing strategy would add acclimation facilities in the release site watershed for final rearing of steelhead trout. The costs attributed to this strategy are the construction of an acclimation facility.
  Cost – $1.75M

- Shade Production of Raceways – Installation of a solar shade structure over rearing raceways would reduce or eliminate sunburn, offset electrical costs, and possibly improve adult returns.
  The estimated cost of the project is estimated at $5.9M.

- Change serial reuse conditions to reduce disease risk – The design would build 11 paired raceways with three pass serial reuse.
  Cost – $4.7M

- Add Keyways to existing raceways – Adding keyways to existing raceways will improve fish rearing conditions post marking/transfer from hatchery tanks.
  Cost – $40,000

- Use Trout raceways for continued Density dependence study work – Low rearing density (DI=0.02 vs 0.15) in steelhead has improved post-release performance to adult returns within the LSRCP. Additional work would be beneficial in raceway rearing conditions to determine the optimal rearing density to maximize adult returns.
  Cost – $100,000 annually

- Connect Spring 17 water source to Main Spring – Connection of Spring 17 to Main Spring would provide up to 5 cfs (pending water right increase) to the Main Spring collection area and subsequently supply the existing steelhead raceways.
  Cost – $50,000

Table of Contents

1 Scope **6**
2 Background **7**
2.1 PRAS Background 8
2.2 Infrastructure 10
2.2.1 Hatchery Water Supply 10
2.2.2 Broodstock Collection 10
2.2.3 Incubation 10
2.2.4 Nursery Rearing 10
2.2.5 Outdoor Rearing 11
2.2.6 Release 11
2.2.7 Settling Pond 12
3 Operations **12**
3.1.1 Marking 12
3.1.2 PIT Tagging 12
4 Operational/Infrastructure Changes for Program Efficiency **12**
4.1.1 Reduce Steelhead Production to 1.2 Flow Index Level 12
4.1.2 Develop Acclimation Facilities for early Transfer 13
4.1.3 Shade Production Raceways 14
4.1.4 Change serial reuse conditions to reduce disease risk 15
4.1.5 Add Keyways to existing raceways at 50 feet 15
4.1.6 Use Trout raceways for continued Density dependence study work 15
4.1.7 Connect Spring 17 water source to Main Spring 16
5 References **17**
6 Appendix A. Brood Year Summaries from Hagerman NFH **18**
7 Appendix D. Water Quality Parameters **19**
8 Tables **20**

1 Scope

On August 2, 2022, Nathan Wiese, Program Coordinator LSRCP, Brian Thompson, Hatchery Manager, and Sage Hallenbeck, Assistant Hatchery Manager, conducted a high-level one-day infrastructure and operations assessment of the Partial Recirculating Aquaculture System (PRAS) at the Hagerman National Fish Hatchery. A return visit was made by Nathan Wiese and Chris Starr, LSRCP and Brian Thompson, Hatchery Manager, and Sage Hallenbeck, Assistant Hatchery Manager in March 2024. A final facility assessment addressing steelhead trout (*Oncorhynchus mykiss*) production was made by Shawn Sanders – LSRCP/FWS Fish Biologist, Brian Thompson – Hatchery Manager, Sage Hallenbeck – Assistant Hatchery Manager, and Brandon Filloon – Complex Manager on September 16, 2024, to record any additional program needs.

The purpose of this document is to provide the Lower Snake River Compensation Plan (LSRCP) and other stakeholders ample conceptual-level information of the current infrastructure challenges. The goal is to incorporate audit findings into a 10-year strategic plan for LSRCP that will maximize in-house and external improvement opportunities by developing solutions that fit resources, budgets, and supportive programs in a logical sequence. These efforts are intended to significantly improve water quality, program capacity, efficiency, and flexibility at the facility and ultimately increase opportunities for LSRCP to meet adult mitigation targets.

The LSRCP plans to assess all steelhead rearing facilities within the program prior to the 10-year spring/summer Chinook Program Review for the Independent Scientific Review Panel (ISRP) in January 2025. With this review, the LSRCP intends to identify strategies towards optimizing performance to achieve project area goals of 55,100 steelhead adult returns. 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

The Hagerman National Fish Hatchery (Hatchery) is located along the Snake River, about 30 miles west of Twin Falls, Idaho at a point three miles south and two miles east of Hagerman, Idaho. The Hatchery was authorized by *46 Stat, 371* on May 21, 1930, and was established in 1932. Construction of the physical facilities commenced in 1932; fish production began in 1933. The primary goal of the Hatchery, at that time, was the production of rainbow trout for stocking in Idaho, eastern Oregon, and northern Nevada.

In the late 1970s the Hatchery became part of the Lower Snake River Compensation Plan (LSRCP) which was authorized by the Water Resources Development Act of 1976, Public Law 94-587. The LSRCP is designed to mitigate for fish and wildlife losses caused by the construction of four dams on the lower Snake River. For its part in the LSRCP program, the Hatchery's primary production goal was changed from resident rainbow trout to steelhead trout. The Hatchery was extensively remodeled during 1984 to accommodate this change.

The hatchery consists of 78 outside raceways of which 66 are devoted to LSRCP steelhead production and 12 are reserved for other programs which the Fish and Wildlife Service (Service) deems appropriate. Additional infrastructure on the hatchery includes two hatchery-rearing buildings with a total of 60 rearing tanks, a water chiller building, an administration-visitor facility building, a combination shop/four-stall garage, four residences, an oil/paint storage building, and two general storage buildings.

The Hatchery's water supply emanates from the Eastern Snake Plain Aquifer via a complex of springs at a constant 59 °F with a flow rate of approximately 30,000 gallons per minute (gpm).

In 2014, the LSRCP constructed a Partial Recirculating Aquaculture System (PRAS) at the Hatchery to address diminishing water supplies. The PRAS consists of three circular tanks, each 30’ diameter, 6’ deep, 3,885 ft^3 rearing volume and produce 90,000 steelhead smolts at 4.5 fish per pound (fpp), annually. The PRAS also includes three rearing vats that are 18.5’ long, 3’ wide, and 2’ deep which add an additional 111 ft^3 of rearing space (Hallenbeck 2024). Original PRAS design memos also included plans for experimental Age-0 spring/summer Chinook production (Jack Christiansen, pers. comm.) to address adult mitigation shortfalls for the LSRCP.

In 2018, the U.S. Fish and Wildlife Service and Idaho Department of Fish and Game (IDFG) finalized a Memorandum of Understanding (MOU) transferring operations and management of the Hatchery to IDFG personnel.

The LSRCP adult return goal for A-run and B-run steelhead reared at Hagerman NFH and released in the Salmon River is currently 13,600 adult steelhead to the Snake River Basin, upstream of Lower Granite Dam. To meet that goal, the Hatchery annually produces 1.56M steelhead smolts at 4.5 fpp, which matches the target length criteria of 180-250 mm (Proposed Recovery Plan for Snake River Salmon, NMFS 1995).

2.1 PRAS Background

The Hatchery PRAS has been intensively studies as a trial system since Brood Year 2014 utilizing steelhead as the only production analog. Initial studies have successfully reared steelhead at a 50% re-use rate to produce smolts (Figure 1) of identical size, health, body composition, and 90%+ on-station survival (USFWS 2016, 2017). Unfortunately, outmigration survival and resulting adult return rates are significantly lower when compared to fish reared in control raceways (Figures 1 & 2). To improve post-release performance both swimming speed and diet comparisons were examined (Figure 3).

Figure 1. Steelhead reared at Niagara Springs Fish Hatchery, Magic Valley Fish Hatchery, Hagerman National Fish Hatchery Raceways, and Hagerman National Fish Hatchery Partial Recirculating Aquaculture System, March 2021.

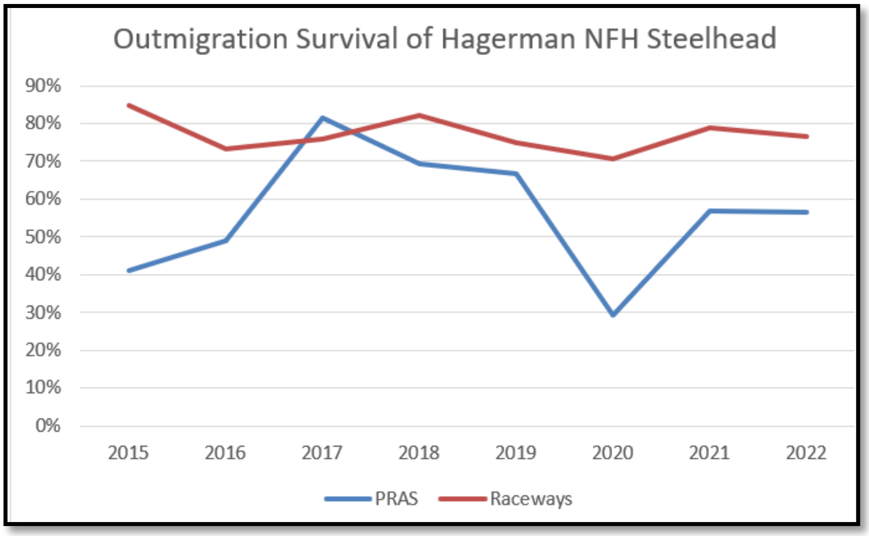

Figure 2. Outmigration survival of Hagerman National Fish Hatchery Steelhead, Release Year 2015-2022.

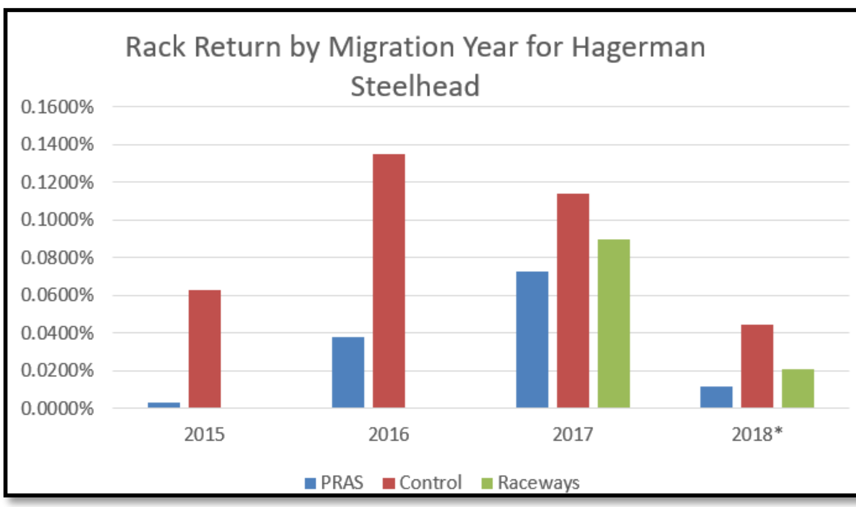

Figure 3. Rack Returns of adults from migration years 2015-2018 for control (24,000 smolts, DI=0.21), raceways (27,000 smolts, DI=0.23) and PRAS systems at Hagerman National Fish Hatchery.

In BY23, a super smolt feeding regime and acclimation was implemented to overcome outmigration challenges of the PRAS system. Unfortunately, this experiment did not show promising outmigration success. As such, the PRAS system rearing has been suspended for 2024 while needed maintenance is completed and discussions on future priorities can continue.

2.2 Infrastructure

2.2.1 Hatchery Water Supply

The Hatchery's water supply emanates from the Eastern Snake Plain Aquifer via a complex of springs at a constant 59 °F with a flow rate of approximately 30,000 gpm.

Water supply to the steelhead raceways comes from a collection of 16 spring sites and is currently (March 2024) at 23,434 gpm (52 cfs).

Supply water to the PRAS is from Spring 17 which provides approximately 4.4 cfs (1968 gpm) for the system.

2.2.2 Broodstock Collection

Steelhead broodstock are collected at the Sawtooth Fish Hatchery weir and the East Fork Salmon River satellite facility. Approximately 1.85 M green eggs are collected from 345 steelhead pairs at the Sawtooth weir and another 14 pairs at the East Fork satellite facility. Approximately 106,000 green eggs collected from 21 pairs are utilized for the PRAS units. Sawtooth Fish Hatchery ships eyed eggs to the Hatchery between 370 and 450 Temperature Units (TU's) in May and June.

2.2.3 Incubation

The Hatchery receives eyed eggs in May and June and expects a 92% eyed to release survival on-station. Upon receipt, eyed eggs are disinfected with Iodine at 100-ppm for 10 minutes and then placed into upwelling incubator at 20,000 to 30,000 eggs per jar with a flow rate of 6 to 8 gpm.

2.2.4 Nursery Rearing

The Hatchery has three hatchery buildings for early rearing. Hatchery 1 has 40 tanks (14.25' x 3.29' x 2') with 93.8 ft^3 of rearing volume each. Hatchery 2 has 20 tanks (14' x 3.08' x 2') with 86.2 ft^3 of rearing volume each. The PRAS system has 3 early rearing vats (18.5' x 3' x 2') with 111 ft^3 of rearing volume each. Flows in nursery rearing tanks (20' x 3' x 3') are ramped to and maintained at approximately 100 gpm. Fish are reared indoors to a density index of 1.0 and a 1.2 maximum flow index. Feeding typically begins 15 to 17 days post-hatch when approximately 80% of the fry achieve swim-up. During rearing in the hatchery buildings fish are fed commercially available extruded diets hourly across an 8-hour period. In late August, fish are moved utilizing marking crew fish pumps from the Hatchery Buildings to the marking trailers.

2.2.5 Outdoor Rearing

Steelhead are reared in three flow-through banks of raceways (10' x 3.08' x 100') at a maximum density index of 0.30 and a maximum flow index of 1.20. Each bank has 22 raceways for a total of 66 available raceways among three banks. All outdoor fish are hand fed daily, with floating steelhead feed, up to November. Once fish are large enough to trigger demand feeders, they are converted to a 2.5mm feed size. Once fish are feeding on the 2.5mm sized pellet, the feed is delivered to demand feeders utilizing the CableVey system. The CableVey system is an auger-fed system, stemming from bulk feed storage units on the side of raceways, which distributes feed across an entire bank of raceways.

Due to limited water supplies, 52 cfs, a total of 18 raceways are used on A-bank, 18 raceways on B-bank, and 16 raceways on C-bank to maintain a turnover of 3.4 turnovers per raceway bank (1300 gpm provided per 3,080 ft^3 raceway).

Steelhead smolt feeding schedules are programmed to meet a 4.5 fpp (215mm) target size utilizing a Hatchery constant (Hatchery constant — A single value derived by combining the factors in the numerator of the feeding rate formula. Hatchery constant = (3 x feed conversion x daily length increase x 100) / length of fish) feeding method once fish are transferred to outdoor rearing. Growth is generally regulated to meet below 0.8" per month although maximum growth could achieve 1.5" per month.

During the outside rearing cycle all raceways are cleaned at least twice weekly. Fish are sampled monthly to estimate mean size and growth rate. Length frequency checks are done periodically and just prior to release.

2.2.6 Release

All HNFH steelhead smolt releases are transferred utilizing four tanker trucks. Each tanker truck is comprised of five 1,000-gallon compartments (5,000-gallon capacity) and measure approximately 40' in length. Each compartment has fish life support (LS) systems consisting of a water agitator(s) and oxygen stones to sustain fish and reduce stress during transport. Tankers are equipped with a liquid oxygen bottle, 2 back up compressed oxygen bottles, and an 8-kW generator to operate the life support system. An alarm system on the trailer will notify the driver of any life support parameters (i.e. oxygen measurements, equipment failures, etc.) that are out of protocol. A maximum of 1,000 lbs. of steelhead can be loaded per compartment at roughly 5,000 lbs. of fish per tanker. Hauling occurs on weekdays in April. Fish transport and release hauling schedules are coordinated among hatcheries to minimize traffic and safety concerns. Integrated Hatchery Operations Team (IHOT 1995) fish transportation guidelines and New Zealand Mud Snail (NZMS) HACCP plans are followed.

PRAS steelhead study fish and control analogs from raceways are generally hauled the first week of April to the release site at the Sawtooth Weir.

2.2.7 Settling Pond

The Hatchery maintains a Best Management Practices (BMP) plan for cleaning wastes from the facility to meet National Pollutant Discharge Elimination System (NPDES) requirements. Cleaning waste is diverted to Off-Line Settling Basins (OLSB). The total surface area of the OLSB is 22,816 ft^2 which can be split into two cells (248' x 46' each). Each cell can treat a maximum of 5,750 gpm or approximately 6 outdoor raceways drained simultaneously.

3 Operations

3.1.1 Marking

Steelhead are adipose fin clipped in late August at approximately 120 fpp. Counts from marking trailer assessments are used for initial raceway inventory. Daily mortality is subtracted from each raceway to obtain a running tally on total fish numbers. Daily observational assessments are performed by hatchery staff, to specifically check for flashing and abnormal behavior, during mortality collection and feeding tasks.

Marks and tags are verified by IDFG prior to release. A length-at-release standard of 180 to 250 mm is used to guide culture practices. Hatchery managers operationally plan culture protocols and activities to meet the average size target of 215 mm at release. Sample counts are performed monthly on representative raceways and tanks. Length-frequency measurements are taken prior to transport, as well as precocial checks.

3.1.2 PIT Tagging

PIT tags are injected into 17,200 smolts annually for Comparative Smolt Survival (CSS) studies and Monitoring and Evaluation (M&E) purposes.

4 Operational/Infrastructure Changes for Program Efficiency

4.1.1 Reduce Steelhead Production to 1.2 Flow Index Level

Available water for the steelhead raceways has declined from 80 cfs (35,480 gpm) in 1988 to flows of approximately 52 cfs (23,296) in in 2024. As such, the Hagerman Flow Index now approaches 1.6 FI. A supplemental oxygen system was tested from 2014-2018 but subsequently abandoned and removed. The rental oxygen tank was returned because of the cost of rent.

Reducing the total steelhead smolt production at Hagerman would likely result in an overall improvement of culture conditions and subsequently reduce stress and disease risk and boost the probability of adult return. A Flow Index of 1.2 is generally considered acceptable for an elevation of 2900 ft and water temperature of 59 °F and is used by Magic Valley and Niagara Springs Fish Hatcheries. This Flow Index maximum would support 1,060,000 smolts at 52 cfs (23,296 gpm).

Feed cost savings of $100,000 annually.

4.1.2 Develop Acclimation Facilities for early Transfer

Both Irrigon and Lyons Ferry Fish Hatcheries have utilized acclimation sites. Acclimation sites are the final rearing facility and allow for fish to acclimate to a new water source prior to release, a direct river or volitional strategy utilized at most sites. This rearing strategy has several benefits:

1. Homing response/reduced straying – Acclimated smolts tend to home better to release locations

2. Rearing Conditions – Acclimation locations generally have lower rearing densities promoting higher smolt to adult return rates

3. Hatchery Operational Demands – Main rearing facilities would require less total space to sustain large smolts during peak Spring loading periods.

Two acclimation units (ponds) designed for approximately 500,000 steelhead would have an approximate area of 350,000 ft^3 each and with available flow of approximately 12 cfs of water. A similar acclimation pond is used at Cottonwood (Grande Ronde River) for acclimation of steelhead from 7 fpp to 4.5 fpp and has a unit area of approximately 600'x 100' x 6' (360,000 ft^3).

The location of one acclimation pond would be in the Upper Salmon Basin. Upper Salmon Basin water temperatures would be 38 °F and increase to 42 °F at release in April. These reduced temperature parameters would require HNFH to transfer fish at 5 fpp in December to January to achieve a target release size of 4.5 fpp in April. Winter driving conditions will exist to pass fish over Galena Summit during these timeframes. Consideration to variable transfer dates to suitable weather windows would need to be discussed.

This acclimation pond strategy would allow HNFH to maintain a 1.2 Flow Index onsite while producing 1.56M steelhead smolts to 4.5 fpp between both rearing strategies (onsite and acclimation site rearing).

Estimated cost of $1.75M for acclimation ponds.

4.1.3 Shade Production Raceways

4.1.3.1 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. Baffles are used at Niagara Springs Fish Hatchery for steelhead production. There is the potential to reduce rearing densities by using baffles rather than exchange rates for self-cleaning. Baffles at Hagerman would require quiescent zone modification and possible raceway modifications.
- 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. Expected life expectancy of 50 years
- Improves working conditions for staff by cooling the work area significantly
- 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 costs and concrete deterioration by using salt for algae control
    - Reduced labor costs to remove it.
    - Reduced trapped fish waste and uneaten feed (which gets caught in algae filaments) significantly improving water quality within the rearing site.

4.1.3.2 Weaknesses

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

4.1.3.3 Opportunities

- Opportunity to increase adult returns
- Improve rearing conditions and reduced stress

4.1.3.4 Threats

- Catastrophic failure potential (Carson NFH rain on snow event example)
- An increased detection rate of *Gyrodactylus* at facilities with covered raceways, has been reported, without scientific confirmation or comparison.

Estimated cost of $5.9M.

4.1.4 Change serial reuse conditions to reduce disease risk

Current raceway configuration combines water from A-bank raceways before distribution to B-bank raceways. The same configuration occurs between B-bank and C-bank raceways. Because of this configuration, disease outbreaks that occur on A-bank raceways are exposing all fish in B and C bank to increased pathogen/disease load.

In recent brood years, the facility has used $40,000 annually in medicated feed for various disease outbreaks. Pairing raceways through modification of water delivery systems would reduce disease risk between raceway banks. The design would build 11 paired raceways with three pass serial reuse.

Estimated cost is $4.7M.

4.1.5 Add Keyways to existing raceways at 50 feet

Adding keyways to existing raceways will improve fish rearing conditions post marking/transfer from hatchery tanks. To maintain Parental Based Tagging (PBT) groups, each hatchery tank is transferred into a rearing raceway at marking. After transfer, fingerling density is so low that feeding response is muted during the first 2-4 weeks.

Estimated cost is $40,000.

4.1.6 Use Trout raceways for continued Density dependence study work

Low rearing density (DI=0.02 vs 0.15) in steelhead has improved post-release performance to adult returns within the LSRCP. Determining an optimal rearing density with the intention of maximizing adult escapement would benefit long-term facility management. The existing trout raceways offer an opportunity to examine lower rearing densities with variable water exchange rates.

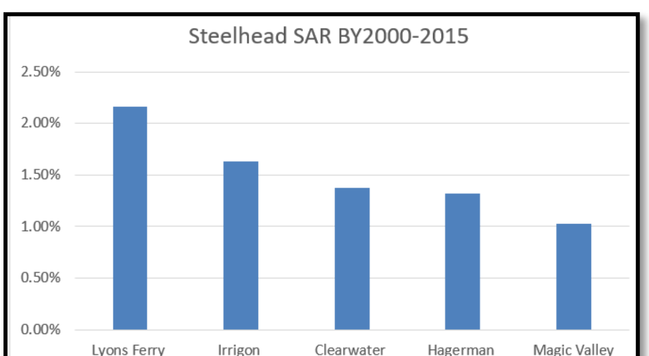

Figure 4. Comparison of SAR (%) of Steelhead Trout reared at five LSRCP hatchery sites.

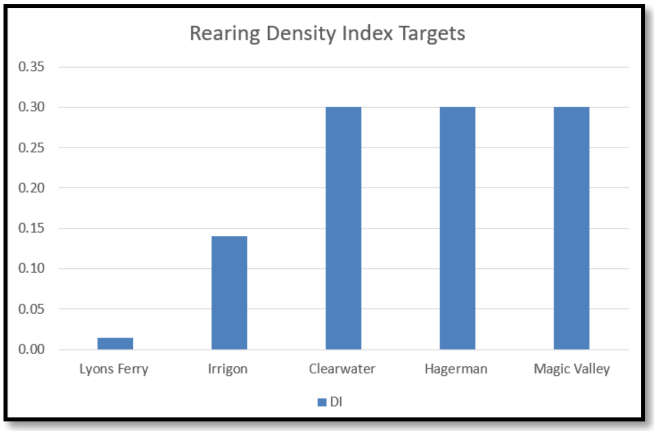

Figure 5. Comparison of Density Index Targets (maximum) at five LSRCP rearing facilities.

Estimated cost – $100,000 annually for tags, feed, and monitoring.

4.1.7 Connect Spring 17 water source to Main Spring

Connection of Spring 17 to Main Spring would provide up to 5 cfs (pending water right increase) to the Main Spring collection area and subsequently supply the existing steelhead raceways. The project could be completed by piping the existing supplies of the rainbow trout raceway headbox together with appropriately sized pipe. Additional site survey information will be required to confirm elevations for this project.

Cost estimate: $50,000

5 References

Annual Operation Plan (AOP). 2022. Annual Operation Plan for Salmon and Steelhead Production Programs in the Salmon and Snake River Basins. Prepared by Idaho Department of Fish and Game, Nez Perc Tribe, Shoshone-Bannock Tribes, U.S Fish and Wildlife Service, and Idaho Power Company. https://www.fws.gov/sites/default/files/documents/2022%20Salmon-Snake%20AOP.pdf

Hagerman National Fish Hatchery. 1977-1985. Hagerman National Fish Hatchery Annual Reports. United States Fish and Wildlife Service. Reports available from Hagerman National Fish Hatchery.

Hatchery Genetic Management Plan (HGMP). 2002. B-Run Summer Steelhead Hagerman National Fish Hatchery. United States Fish and Wildlife Service. September 20, 2002. https://www.fws.gov/sites/default/files/documents/Hagerman%20NFH%20HGMP.pdf

Integrated Hatchery Operations Team, 1995, Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries. Annual Report 1994. Report to Bonneville Power Administration, Contract No. 1992BI60629, Project No. 199204300, 119 electronic pages (BPA Report DOE/BP-60629). https://www.osti.gov/servlets/purl/877377

NMFS. 1995. Proposed Recovery Plan for Snake River Salmon. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. National Marine Fisheries Service, Portland, OR. March 1995.

NOAA. 2018. Responses of Snake River Fall Chinook Salmon to Dam-Passage Strategies and Experiences. National Oceanic and Atmospheric Administration. National Marine Fisheries, Service. August 16, 2022. https://www.webapps.nwfsc.noaa.gov/assets/26/8240_11162018_154745_Fall%20Chinook%20Transportation%202018.pdf

U.S. Fish and Wildlife Service (USFWS). 2009. Dworshak, Kooskia, and Hagerman National Fish Hatcheries. Final Report, June 2009. Hatchery Review Team, Pacific Region. U.S. Fish and Wildlife Service, Portland, Oregon.

U.S. Fish and Wildlife Service (USFWS). 2016 & 2017. Effects of a Partial Reuse Aquaculture System (PRAS) on Proximate Composition of Broodyear 2014 and 2015 Steelhead (Oncorhynchus mykiss) Reared at Hagerman National Fish Hatchery.

6 Appendix A. Brood Year Summaries from Hagerman NFH

Brood year summaries of steelhead stocked from Hagerman National Fish Hatchery, BY1987-Present. The table only includes data from raceway fish production.

Brood Year	Wt. of fish (Pounds)	#/lb	Number	Inches	Stt Water (cfs) [1]	Flow Index	lbs/gpm	Fish Production Water (cfs) [2]	Egg to Smolt Survival[3]
1987	332,325	4.66	1,550,031	8.34	65.1	1.37	11.4	78.4	72.27
1988	299,425	4.94	1,478,830	8.18	74.2	1.10	9.0	80.5	75.08
1989	339,520	4.24	1,439,266	8.60	68.6	1.28	11.0	76.1	83.08
1990	325,550	4.41	1,436,909	8.49	70.1	1.22	10.4	75.5	72.65
1991	314,255	4.62	1,453,058	8.36	65.7	1.28	10.7	72.9	89.36
1992	308,520	4.82	1,487,842	8.24	62.3	1.34	11.0	69.2	79.81
1993	329,538	4.61	1,519,168	8.37	57.3	1.53	12.8	62.9	77.12
1994	243,182	4.74	1,151,544	8.29	63.0	1.04	8.6	68.7	89.47
1995	255,750	5.20	1,329,226	8.04	63.4	1.12	9.0	70.0	93.83
1996	247,194	4.69	1,158,658	8.32	64.6	1.03	8.5	76.1	92.29
1997	233,292	4.43	1,032,407	8.48	63.4	0.97	8.2	72.6	87.96
1998	238,805	4.67	1,131,409	8.33	61.5	1.04	8.7	70.3	85.00
1999	280,805	4.18	1,174,883	8.65	62.3	1.16	10.1	71.3	83.69
2000	274,644	4.48	1,229,286	8.45	65.9	1.10	9.3	75.1	91.54
2001	306,715	4.30	1,317,888	8.57	60.4	1.32	11.3	67.4	95.65
2002	295,090	4.29	1,265,544	8.57	62.4	1.23	10.5	68.6	90.73
2003	302,622	4.38	1,324,263	8.51	62.1	1.28	10.9	66.3	92.43
2004	302,845	4.22	1,279,273	8.62	62.4	1.26	10.8	67.7	93.65
2005	277,123	5.03	1,393,929	8.13	60.7	1.25	10.2	66.0	91.66
2006	336,248	4.35	1,461,422	8.53	60.9	1.44	12.3	66.2	95.27
2007	335,658	4.13	1,387,523	8.68	61.8	1.40	12.1	65.4	90.71
2008	321,775	4.41	1,420,310	8.49	61.8	1.37	11.6	64.8	89.89
2009	319,255	4.42	1,411,833	8.48	60.7	1.38	11.7	63.2	86.77
2010	348,575	3.79	1,321,547	8.93	61.4	1.42	12.7	64.1	88.94
2011	314,585	4.46	1,401,863	8.46	60.4	1.37	11.6	63.3	93.79
2012	320,135	4.18	1,339,685	8.64	61.5	1.34	11.6	65.1	87.86
2013	313,530	4.60	1,441,167	8.37	57.7	1.45	12.1	62.1	90.88
2014	324,520	4.72	1,533,012	8.30	49.3	1.77	14.7	51.0	94.29
2015	316,820	4.80	1,426,904	8.26	57.5	1.49	12.3	64.3	86.41
2016	292,169	4.81	1,478,738	8.25	62.8	1.26	10.4	63.7	93.70
2017	277,807	4.08	1,445,747	8.72	44.4	1.60	14.0	46.6	89.39
2018	352,767	4.55	1,511,558	8.40	44.9	2.09	17.5	52.4	95.21
2019	343,357	4.25	1,442,689	8.60	56.4	1.58	13.6	62.0	90.06
2020	348,754	4.14	1,441,615	8.67	55.6	1.61	14.0	61.2	88.88
2021	352,468	4.36	1,564,190	8.52	61.4	1.50	12.8	67.0	92.85
2022	314,537	4.54	1,430,908	8.41	59.1	1.41	11.9	64.7	91.74
2023	343,829	4.55	1,553,639	8.40	51.8	1.76	14.8	57.4	94.59
Average	307,675	4.49	1,382,913	8.45	60.7	1.36	11.5	66.5	88.61

[1] Stt Water is production water available to 66 steelhead raceways in March, annually

[2] Fish Production Water includes the Display Pond and Trout Water and was estimated for Spring 17 for BY1987-1989

[3] Egg to smolt survival includes smolts/excess/releases during the brood year

[4] From 2019 to present, Fish Production Water includes STT Water, Water right from Spring 17 (4.59 CFS) and the 1 CFS that must go to the show pond for the Bliss Rapid Snails.

7 Appendix D. Water Quality Parameters

Water Quality parameters, Hagerman, Pahsimeroi, Sawtooth, Springfield Fish Hatcheries. 2021						
Primary IOC Contaminants	**Hagerman National - Spring 17**	**Hagerman National- Main Spring**	**Pahsimeroi (Ground)**	**Pahsimeroi (Surface)**	**Sawtooth**	**Springfield**
Arsenic			ND	ND	0.0025	0.0022
Barium			0.0652	0.0935	<0.05	0.080
Cadmium	<0.001	<0.001	ND	ND	<0.0005	< 0.0005
Chromium	0.00284	0.00284	0.0042	0.0029	<0.0002	0.003
Mercury	<0.01 ug/L	<0.01 ug/L	ND	ND	<0.0002	< 0.0002
Nickel			ND	ND	<0.02	< 0.02
Selenium	<0.001	<0.001	0.0014	ND	<0.0005	< 0.005
Sodium			4.5	7.4	6.6	28.0
Flouride			ND	ND	1.010	0.44
Secondary and Other IOC Contaminants						
Chloride			3.7700	4.3400	ND	36
Iron	<0.01	<0.01	0.0872	0.0189	<0.05	< 0.05
Manganese			ND	0.0018	<0.005	< 0.005
Dissolved Solids	160.000	200.000			ND	336
Zinc			0.0156	ND	<0.01	< 0.01
Silver			ND	ND	<0.001	< 0.001
Sulfate			13.8000	14.8000	6.000	54
Calcium			38.5000	42.2000	28.200	63.0
Hardness (as $CaCO_3$)	120	137	148	162	79	236
Magnesium	14.9	15.0	12.5	13.8	2.0	19.4
pH	7.4	7.7	8.0	8.0	7.5	7.4
Potassium	3.5	3.5	0.8	1.4	0.5	4.1
Lead	<0.001	<0.001	ND	ND	<0.005	< 0.005
Copper	<0.001	<0.001	ND	ND	<0.01	< 0.01
Comments						
Alkalinity (mg/l)	125.000	124.000			81.700	185
Ammonia (mg/l)	0.160	<0.05			ND	< 0.04
Gasoline (mg/l)					ND	
Lube Oil (mg/l)					ND	
Diesel (mg/l)					ND	
Nitrate/N	0.960	1.000	<1	<1	<0.02	1.9
Nitrite/N			<1	<1	<0.01	< 0.01
Flow (cfs)	2.70		0.3125	18-20	13-34	19
Temperature (°F)	59	59	50	47-53	32-72	50

8 Tables

Table 1. Hagerman NFH reared and Sawtooth release Smolt to Adult survival rate (%).

Brood Year	Salmon-Hagerman/Sawtooth
2000	1.09%
2001	1.20%
2002	1.28%
2003	0.71%
2004	1.63%
2005	1.60%
2006	1.55%
2007	2.90%
2008	0.92%
2009	1.67%
2010	1.32%
2011	1.48%
2012	1.57%
2013	1.54%
2014	0.12%
2015	0.58%
2016	0.29%
	1.26%

Table 2. Magic Valley and Hagerman Phosphorus Discharge Limits (NDPES), 2024

Month	Magic Valley Max Discharge (lbs./day)	Hagerman NFH Max Discharge (lbs./day)
January	21.7	17.8
February	21.7	17.8
March	21.7	17.8
April	21.7	17.8
May	7.7	6.0
June	7.7	6.0
July	7.7	6.0
August	7.7	6.0
September	16.2	12.8
October	16.2	12.8
November	16.2	12.8
December	16.2	12.8