CENWW-OD-DL HOLDREN (1130) January 2024

MEMORANDUM THRU:
Robert Lustig, Operations Project Manager Lower Granite Dam

FOR Chief, Operations Division
ATTN: Chris Peery

SUBJECT: Submission of 2023 Adult and Juvenile Fish Facility Monitoring Report, Lower Granite Dam.

1. Enclosed find the 2023 Adult and Juvenile Fish Facility Monitoring Report Lower Granite Dam, as requested.

2. If you have any questions contact Elizabeth Holdren at Lower Granite Dam, (509) 843-2263

ELIZABETH HOLDREN
Lead Supervisory Fisheries Biologist,
Lower Granite Dam

Enclosure

ADULT AND JUVENILE FISH FACILITY MONITORING REPORT

LOWER GRANITE DAM

2023

Elizabeth A. Holdren

Project Lead Supervisory Fisheries Biologist

And

David Miller

Project Assistant Supervisory Fisheries Biologist

Lower Granite Dam

U.S. Army Corps of Engineers

TABLE OF CONTENTS

LIST OF TABLES

APPENDIX

INTRODUCTION

The following report on fishway activities at Lower Granite Dam is required under the Endangered Species Act consultation on the operation of the Federal Columbia River Power System and its associated fish passage facilities. This report summarizes the operation and maintenance of adult fish passage facilities at Lower Granite Dam, including the results of visual inspections of the fishway conducted by fisheries biological staff during the adult fish passage period of March 1 to December 31, 2023. Inspection readings are provided in Appendix 1. Recommendations are provided for correcting problems found. This report also contains a synopsis of juvenile fish facility operations. Additional information on juvenile fish collection and transportation activities at Lower Granite Dam can be found in the "2023 Juvenile Fish Collection and Bypass Report, Lower Granite Juvenile Fish Facility".

River Conditions

Average daily river flows exceeded 100 kcfs on 34 days during the 2023 season with an average total river flow of 53.00 kcfs. The highest daily average flow for the March 26-November 1 collection season was 180.82 kcfs May 23. Lowest daily average flow for the season was 14.9 kcfs October 22. Spill for juvenile fish passage occurred on 152 days from April 3 through midnight on August 31. LWG spilled up to the 125% total dissolved gas (TDG) water quality maximum (gas cap) for 16 hours a day and performance standard spill (20 kcfs) for up to 8 hours per day during the spring spill season (April 3-June 20). Summer spill of 18 kcfs began at 0001 hours on June 21 and ended at 2400 hours August 31. Removable spillway weir (RSW) only operation started August 16 and ended August 31. Spill was distributed according to the Fish Passage Plan (FPP) Tables LWG-7 and LWG-8. Average season flow through spillways was 34.5 kcfs with a maximum daily average of 80.8 kcfs May 23 and a minimum daily average of 4.5 kcfs August 21. Adult steelhead overshoot spill through the RSW occurred from 0500-0900 hours on Sundays, Tuesdays, and Thursdays March 1 to March 30 and from September 1 to November 15. River temperatures collected as part of the daily condition sample averaged 59.2° F for the season and ranged from 43.0° F March 30 and April 1 to 68.0° F July 4 and July 5.

ADULT FISH FACILITY

Facility Description

Adult fish passage facilities at Lower Granite Dam consist of one south shore adult fish ladder. The upper fish ladder extends from the forebay to tailwater. The fish ladder includes the forebay temperature control system with pumps to supply cooling water, one fish ladder exit, slotted weirs control section, upper diffuser, overflow weirs with orifices, and a fish counting station with picketed leads. Auxiliary water is supplied from the forebay through diffuser 14 to maintain flow over the upper ladder weirs. Lower Granite fish trap is located at the turnpool area just upstream from the fish count station. The lower ladder contains a powerhouse collection channel, three electric auxiliary water supply (AWS) pumps, collection channel diffusers, a transport channel under the spillway, and ladder entrances. There are six main fish ladder entrances: two north shore entrances (NSE-1 and NSE-2), two north powerhouse entrances (NPE-1 and NPE-2), and two south shore entrances (SSE-1 and SSE-2). The powerhouse collection channel has ten floating orifice gates (FOGs) with gates 1, 4, 7, and 10 operating.

AWS pumps draw water from the tailrace that is distributed through the lower ladder and collection channel diffusers to provide attraction flow.

Facility Modifications

1. Replaced supply valves for adult trap anesthetic and sample tanks.
2. Repaired fall out fence.
3. Filled/repaired fish ladder expansion joints.
4. Replaced adult fish trap brail barrier grating.
5. Built cover for NSE gate operators.
6. Reconfigured fish ladder exit temperature control supply.
7. Upgraded forebay, tailwater, and fish ladder temperature monitoring system.
8. Refurbished the first FOG as part of a repair rotation.

Operations and Maintenance

Fish Ladder and Collection Channel

The adult fish ladder was in service throughout 2023 apart from the winter maintenance season from January 3-February 15. During the winter annual outage, the upper fish ladder is dewatered for maintenance activities including debris removal, diffuser grate and structural support inspections, picketed lead, staff gauge, and fish counting window cleaning, maintenance of count station window cleaning mechanisms, and packing of leaks in expansion joints. A minimum of 24 hours prior to dewatering, the auxiliary water is shut off to discourage newly arriving fish from starting up the ladder. A bulkhead is then placed in the fish ladder exit, any exit pool fish are removed and released to the forebay, and the upper ladder is partially dewatered. Diffuser 14 is gradually closed to allow fish to move through the orifices to the tailrace. The drain for diffuser 14 is closed to maintain a minimal amount of water in the ladder while remaining fish are flushed down the ladder. Biologists and maintenance personnel descend the ladder through orifices to remove debris, inspect the ladder, and move remaining fish to the tailrace. There were 4 unclipped adult steelhead trout, 1 clipped steelhead trout, 2 unclipped juvenile steelhead trout, and 1 smallmouth bass observed in the exit or upper ladder during the dewatering January 3. The adults were released at Offield Landing and the juveniles were released at Illia Landing. All diffuser grating passed inspection.

The lower ladder is typically dewatered to a depth of one foot providing a holding pool for fish. Once the target depth is obtained, maintenance personnel and biologists inspect entrance weirs, diffuser grates, fallback fence, and exposed diffuser gate operating equipment. Staff gauges are then cleaned, and debris is removed. Water is lowered to 0.4 foot for visual inspection of grating and fish recovery. When dewatering for repair is necessary; fish are crowded to the entrance pools, netted, and placed in fish only transport containers. Fish in the containers are raised from the collection channel with the crane and transported to the tailrace or forebay for release. Salmonids recovered from the powerhouse section of the collection channel January 5 included 13 unclipped adult steelhead trout, 12 clipped adult steelhead trout, 2 juvenile unclipped Chinook salmon, and 13 juvenile unclipped steelhead trout. Incidental species included 20 suckers, 7 peamouth, 2 shad, 1 Walleye, 1 sculpin, 6 juvenile lamprey, and 4 Smallmouth Bass. No problems were observed during the inspection of the north powerhouse channel.

Auxiliary Water Supply

AWS fish pumps were out of service (OOS) from January 3 to February 17 for annual maintenance. Annual maintenance consists of general mechanical and electrical inspection and repairs. AWS pump 1 and 2 were returned to service February 17. AWS pump 3 remained offline for lower guide bearing replacement and was returned to service April 27. AWS pumps 1 and 2 remained in service through May 22 when AWS pump 3 was brought online and AWS pump 2 was removed from service to replace the RTD card within the control panel. On August 16, AWS pump 2 was brought online and AWS pump 3 was taken out of service for seal repair. AWS pumps 1 and 2 remained in service through the end of the season. Significant pump outages are summarized in Table 1.

Table 1. Fish pump outages at Lower Granite Dam, 2022*

Affected Pump(s)	Dates	Reason for Outage/Comments
1 and 2	Jan 1 – Feb 17	Annual maintenance
3	Jan 1 – Apr 27	Annual maintenance/lower guide bearing
2	May 22-June 1	Replace RTD card in control panel
3	Aug 16 – Aug 23	Repair leaking seal

*Only outages involving two or more calendar days are included.

Adult Fish Passage and Fish Counts

Lower Granite adult fish ladder was operated in fish passage plan compliance March 1 through December 31. During the season there were brief interruptions in auxiliary water supply pump (AWS) operation related to non-routine maintenance and powerhouse outages as part of Doble testing and 500kV line outages. Visual and video fish counts occurred throughout the adult fish passage season (Table 2). Adult salmonid, shad, and lamprey counts can be found at DART Adult Passage Daily Counts for All Species | Columbia Basin Research (cbr.washington.edu).

Table 2. Lower Granite Dam Adult Fish Counting Schedule March 2022 – Feb 2022.

Count Period	Counting Method and Hours *
March 1–31	Day Video 0400–2000 hours (PST)
April 1 – October 31	Day Visual 0500–2100 hours (PDT)
June 15 – September 30	Night Video 2100–0500 hours (PDT)
November 1 – December 30	Day Video 0400–2000 hours (PST)

*PST = Pacific Standard Time; PDT = Pacific Daylight Time, in effect during daylight saving time 3/14/21–11/7/21.

There has been concerns raised about the increase in Walleye abundance observed during recent years in the adult fish ladder. Fish count personnel assisted the project biologist in quantifying Walleye passing the adult fish ladder starting during the 2021 adult passage season. In 2023, there were 8,338 Walleye counted from April thru October (Table 3). This was an increase from the 5,064 Walleye counted during the same timeframe in 2022. Walleye counts were conducted as outlined in the fish count schedule above.

Table 3. Walleye Counts at Lower Granite Adult Fish Count Station in 2023

Year	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2021	---	60	58	19	19	92	464	1165	---	---	1,877
2022	---	68	252	399	783	464	1526	1572	---	---	5,064
2023	---	70	732	1508	1368	939	1386	2335	---	---	8,338

Fish Ladder Temperature Control

Electronic temperature probes were used to monitor fish ladder water temperatures at the ladder exit, diffuser 14, turn pool, and the junction pool throughout the fish passage season. Real-time fish ladder temperature data along with that for four additional Project temperature monitoring stations can be found online at: http://www.nwd-wc.usace.army.mil/dd/nww/fl_temps/www/index.html. The permanent fish ladder temperature control system has been operational since 2016. Forebay fish ladder auxiliary water supply pumps 1 and 2 were modified to intake cooler water from an elevation of 667.0 feet (66.0 feet below MOP) and supply the spray bar in front of the fish ladder exit. Gravity flow then distributes the cooler water from the forebay down the ladder. The system also includes a chimney structure that drafts cold water from an elevation of 667.0 feet into diffuser 14 intake. Water from diffuser 14 cools the ladder as it flows down the overflow sections of the ladder and is the main supply for the adult fish trap. Forebay ladder temperature control system pumps operated June 5 through September 30.

During the 2021-2022 maintenance season the orientation of the fish ladder temperature control pumps was reconfigured. Pump 1 was returned to its historical position to provide direct supply into the fish ladder exit channel and pump 2 remained tied into the exit shower ("Laughery's Shower"). In 2023, Pump 2 was operated from June 5 through September 30. Pump 1 was only operated August 16 through August 24 due to concerns that it was causing a temperature differential between the ladder exit and the forebay. Fish ladder water temperatures did not impact adult fish trapping operations this season.

Adult Fishway Inspections

Methods

The automated fishway control system consists of a computer in the control room that interfaces with process level controllers that receive information from remote terminal units. The terminal units are fed by sensors detecting entrance weir gate positions, collection channel and tailwater elevations, and upper diffuser pool levels. Lower Granite automated fishway control system programing continues to be adjusted as needed to maintain fish ladder operational compliance. The system's digital touch screen displays located in the control room and the third floor of the powerhouse with gates remotely operated from the control room. The control system "biologist snapshot" of fish ladder operation is printed concurrent with ladder inspections to compare physical readings and identify calibration issues. Collection channel temperatures and velocities are measured with sensors in the south powerhouse and the north shore channels as part of the automatic system. Powerhouse electricians manually calibrate fish ladder gates to ensure the control system program operates in criteria parameters following winter maintenance. During the 2023 fish passage season, the fish ladder control system was unable to consistently maintain

depth over the weirs and channel/tailwater head differential at the north shore during spill operations at MOP elevation. NSE depth over the weir criteria was sacrificed to achieve channel/tailwater head differentials.

Operating criteria involve normal and special operating conditions. Normally NSE-1 and NSE-2 are operated to meet criteria of at least 7 feet (depth criteria) or be on sill if less than 7 feet (sill criteria), NPE-1, NPE-2, SSE-1, and SSE2 weir gates are operated to meet criteria of at least 8 feet or be on sill if less than 8 feet (sill criteria), and four floating orifice gates (1, 4, 7, and 10) are operated in the powerhouse collection channel. Normal operating criteria for the rest of the ladder include maximums of 0.5-foot head at the exit, maximum 0.3 feet head at the picketed leads, 1.0-1.3 feet of water depth over the ladder weirs, 1.5-4.0 feet per second collection channel velocity, and 1.0-2.0 feet of head differential at all fishway entrances. Special operating conditions are used if normal criteria cannot be met. The fish ladder control system continued to have issues maintaining depth over the weirs and operating gates within the same depth range based on tailwater elevation at induvial entrances.

Adult fishway inspections consist of observing facility operating conditions and recording visual readings from staff gauges, weir gate selsyns, and electronic meters. Inspections by fisheries staff are normally conducted three or more times per reporting week with day and times randomized. An average of 3.7 inspections per week were performed (164 inspections /44 weeks) in 2023. Depths and head differentials that were out of criteria, as well as other problems, were reported to maintenance staff and/or powerhouse shift operators for correction. Anchor (SMP contractor) biologists performed a minimum of two ladder inspections each week while on Project. Lower Granite biologist staff typically performed 2 to 3 inspections per week. Inspections were also conducted by Oregon Department of Fish and Wildlife personnel once a month.

Inspection Results

Visual readings of staff gauges and weir gate depths were recorded and compared with automated control system readings to check for calibration problems. High variability between wave crests and troughs created by spill reduced the accuracy of biologists' staff gauge readings in the tailrace. The automatic fish ladder control system was upgraded to the Automation Direct PLC and HMI Configuration Software (C-More Programming Software) in 2016. The control system program is unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during spill operations. Calibrations to the automatic control system were made throughout the passage season. Entrance gates found out of criteria during ladder inspections due to fish ladder control system problems were manually adjusted to depth or sill criteria and left in manual mode until electricians completed diagnostics and made calibrations. Electricians continue to troubleshoot control system internal functioning errors in the program. Data from fishway inspections were entered into an Excel spreadsheet (Appendix 1). The average compliance of all criteria points in 2023 was 74.3% compared to 79.5% in 2022. The fish ladder control system programming issues were the most common reason for out-of-criteria readings. LWG electrical team is working with the Project Biologist to find a permanent solution to this ongoing problem. A summary of fish ladder performance and variability is provided in Table 2.

Ladder Exits

Ladder exit head differentials were in criteria on 100% of the inspections.

Ladder Weirs

The depths over the fish ladder weirs were within criteria on 100% of the inspections.

Counting Stations

The head differential across the counting station picketed leads was in criteria on 100% of inspections.

Entrance Head Differentials

SSE-1 & 2 head differentials were in criteria on 93.3% of inspections. Out of criteria readings included 6 at 0.01-0.1 feet below criteria, 4 at 0.11-0.2 feet below criteria, and 1 at >0.2 feet below criteria.

NPE-1 & 2 head differentials were in criteria on 58.5% of inspections. Out of criteria readings included 26 at 0.01-0.1 feet below criteria, 13 at 0.11-0.2 feet below criteria, and 29 at >0.2 feet below criteria.

NSE-1 & 2 head differentials were in criteria on 43.9% of inspections compared to 59.5% in 2022. Head differential readings were out of criteria (criteria 1.0-2.0 feet) on 92 inspections in 2023. Out-of-criteria readings included 21 at 0.1 feet below criteria, 20 at 0.2 feet below criteria, 51 greater than 0.2 feet below criteria, 1 at 0.11-0.2 feet above criteria, and 2 at >0.2 feet above criteria. NSE channel/tailwater head differentials were likely out of criteria due to the fish ladder control system being unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during current spill volumes and at MOP.

Entrance Gate Depths

SSE-1 weir gate was in depth or sill criteria on 56.1% of inspections (55.5% depth, 0.6% sill) compared to 70.5% in 2022. Out of criteria readings included 23 at 7.9 feet, 13 at 7.8 feet, and 37 at 7.7 feet or less. SSE-1 and SSE-2 reading at the gate have consistently been reading higher than the electronic reading on the fish ladder control system due to calibration issues with the FSC tailwater elevation sensor at the SSE.

SSE-2 weir gate was in criteria on 61.0% of inspections (61.0% depth, 0.0 % sill) compared to 71.2% in 2022. Out of criteria readings included 9 at 7.9 feet, 16 at 7.8 feet, and 39 at 7.7 feet or less. SSE-1 and SSE-2 reading at the gate have consistently been reading higher than the electronic reading on the fish ladder control system due to calibration issues with the FSC tailwater elevation sensor at the SSE.

NPE-1 weir gate was in depth or sill criteria on 95.1% of inspections (46.3% depth, 48.8% sill) compared to 98.2% in 2022. Out of criteria readings included 6 at 7.9 feet, 1 at 7.8 feet, and 1 at 7.7 feet or less.

NPE-2 weir gate was in depth criteria or sill on 96.4% of inspections (47.0% depth, 49.4% sill) compared to 97.6% in 2022. Out of criteria readings included 5 at 7.9 feet and 1 at 7.8 feet.

NSE-1 weir gate was in depth or sill criteria on 81.7% of inspections (81.7% depth, 0.0 % sill) compared to 82.8% in 2022. Out of criteria readings included 12 at 6.9 feet, 6 at 6.8 feet, and 12 at 6.7 feet or less. The fish ladder control system was unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during spill operations. Depth over the weirs at the north shore entrance was maintained well but the channel/tailwater head differential could not be maintained.

NSE-2 weir gate was in depth or sill criteria on 82.3% of inspections (82.3% depth, 0.0 % sill) compared to 82.8% in 2022. Out of criteria readings included 13 at 6.9 feet, 5 at 6.8 feet, and 11 at 6.7 feet or less. The fish ladder control system continued to be unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during spill operations at MOP elevation. Depth over the weirs at the north shore entrance was maintained well but the channel/tailwater head differential could not be maintained.

Collection Channel Velocity

Velocities were in criteria on 96.3% of inspections (criteria: 1.5-4.0 ft/s) compared to 99.4% in 2022. The collection channel velocity meter was upgraded to a Teladyne Signature Flowmeter as part of the fish ladder control system. The sensor also provides water temperature and is located in the powerhouse collection channel between the transition pool and unit 1. A Signature Laser Sensor was also installed above the north shore collection channel that measures channel elevation and surface velocity.

Adult Fish Trap Operations

Lower Granite adult fish trap was operated March 1 to November 15 by NOAA Fisheries and Idaho Department of Fish and Game (IDFG). Sample rates were adjusted with adult passage to meet collection and research needs. The adult ladder temperature control system sustained adult trap temperatures below 70°F for trapping operations for the season. The maximum adult trap water temperature during 2023 was 69.2°F on September 16.

The adult trap total collection for the season was 39,341 fish, including 357 Sockeye Salmon, 3,149 Coho Salmon, 13,563 steelhead, 11,326 spring/summer Chinook Salmon, 10,944 fall Chinook Salmon, and 2 Bull Trout. There was 10 adult lamprey incidentally trapped this season.

IDFG assisted NOAA in sampling throughout the trapping season. Sampling included scale collection, genetic sample, sex determination, fork length, adipose fin clipped/unclipped, and evaluating non-adipose clipped hatchery fish run proportion. Unclipped adult steelhead were PIT tagged to estimate headwater tributary escapement.

Research

Sampling of Steelhead, Chinook salmon, and Sockeye salmon by the Idaho Department of Fish and Game (IDFG) and NOAA Fisheries for Biological data collection:
The goal is to collect fish scales, genetics tissue, sex and length, wild/hatchery composition, and non-adipose clipped hatchery fish assessment of 5-20% of adult steelhead, spring/summer Chinook salmon, and Sockeye salmon ascending the ladder. Natural origin adult steelhead and spring/summer Chinook salmon will be PIT tagged to estimate headwater tributary escapement. Sockeye salmon may be PIT tagged in the future to estimate metrics regarding conversion rates. Some steelhead and spring/summer Chinook salmon may be radio-tagged or spaghetti-tagged. This information provides status information used in several forums.

Steelhead collection totaled 13,563 (9,668 clipped, 3,895 unclipped) with 3,802 having genetic and scale samples taken, and 1,988 having genetic samples only taken. Of the 13,563 fish sampled, 3,653 were PIT tagged. There were 540 recaptured PIT-tagged steelhead and 5 Floy-tagged recaptured.

Spring/Summer Chinook salmon collection totaled 11,326 (8,658 clipped, 2,668 unclipped) with 2,617 having genetic and scale samples taken, and 2,159 having only genetic samples taken. Of the 11,326 fish sampled, 2,478 were PIT tagged. There were 397 recaptured PIT-tagged fish. Fall Chinook salmon broodstock collection began August 18. Of the 10,944 fall Chinook salmon handled at the adult trap, 3,103 were transported (genetic samples taken) and 7,841 were released.

WDFW Broodstock Collection and Transport:
Washington Department of Fish and Wildlife (WDFW) fall Chinook salmon broodstock transport to Lyons Ferry Hatchery began August 20 and ended October 5 when collection goals were met. WDFW transported 2,125 adult fall Chinook salmon.

Nez Perce Tribe Broodstock Collection and Transport:
Collection for transport to Cherry Lane/Dworshak hatcheries began August 18 and ended October 6 when broodstock goals were met. Nez Perce Tribe transported 978 adult fall Chinook salmon.

PIT Tagging Adult Coho Salmon for NPT:
All adult Coho salmon sampled that did not have a tag were PIT-tagged this season. There were 3,149 adult Coho salmon sampled, 52 were previously PIT-tagged and 3,095 were PIT-tagged at the LWG adult trap this season. Broodstock collection of Coho salmon for the Nez Perce Tribe did not occur this season.

IDFG Genetic Sampling and Collection of adult Sockeye salmon:
Genetic samples were taken from 356 of the 357 adult Sockeye salmon collected in the trap. There were 16 PIT-tagged recaptured adult Sockeye salmon. Emergency trap and transport of adult Sockeye salmon for IDFG was not conducted this season. All Sockeye salmon collected were returned to the fish ladder.

PIT Tagging and Genetic Sample Collection from Bull Trout for USFWS:
Bull trout were collected as part of the normal adult trap daily sample and using the adult sort by code system to recapture previously PIT-tagged fish. Two untagged bull trout were PIT tagged,

fin clipped for genetic analysis, and had morphometric data collected. Fin clips were sent to USFWS to determine the fish's origin. No previously PIT-tagged bull trout were collected in the adult trap. All fish were be released back into the adult fish ladder.

IDFG Investigation into the biological characteristics of walleye captured at LWG Fish Trap: The objective is to PIT-tag each fish and release them back into the tailrace to examine the rate that they re-ascend the ladder to understand potential of walleye to establish upstream of Lower Granite. There were 157 adult walleyes trapped and PIT-tagged this season. This is the high for walleye collection at LWG adult trap and more than double the 73 that were trapped during 2022.

For additional information on data collected at Lower Granite adult trap contact Darren Ogden (NOAA; darren.ogden@noaa.gov) or Gordon Axel (NOAA; Gordon.axel@noaa.gov).

Recommendations

1. Replace fish ladder turnpool gate with hoist operated picketed lead system.
2. Replace adult trap braille/recovery pool gate.
3. Replace all entrance weir gates and operating systems.
4. Replace fish ladder automatic control system to permanently address continuing issues.
5. Replace and relocate staff gauges that are difficult to read.
6. Replace and relocate the north powerhouse velocity meter.
7. Relocate SSE fish ladder tailwater elevation sensor to a location that represent the actual tailrace elevation not the anomaly at that location.
8. Relocate velocity sensor currently ran through conduit on the collection channel floor.
9. Add a PIT tag array at the adult trap return gate.

Table 4. Summary of adult fishway inspections at Lower Granite Dam, 2023 [1]

LOWER GRANITE			Not Enough Depth			Too Much Depth		
Criteria & Locations	No. In Criteria / No. On Sill / No. of Inspections	% In Criteria / % On Sill	No. / % Within 0.01-0.1 Foot	No. / % Within 0.11-0.2 Foot	No. / % >0.2 Foot	No. / % Within 0.01-0.1 Foot	No. / % Within 0.11-0.2 Foot	No. / % >0.2 Foot
Channel Velocities	158 *** 164	96.3 ***	*** ***	*** ***	*** ***	*** ***	*** ***	*** ***
Differentials								
Ladder Exit	164 *** 164	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
Ladder Weirs	164 *** 164	100.0 ***	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Counting Station	164 *** 164	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
South Shore	153 *** 164	93.3 ***	6 3.7	4 2.4	1 0.6	0 0.0	0 0.0	0 0.0
North Powerhouse	96 *** 164	58.5 ***	26 15.9	13 7.9	29 17.7	0 0.0	0 0.0	0 0.0
North Shore	72 *** 164	43.9 ***	21 12.8	20 12.2	51 831.1	0 0.0	1 0.6	2 1.2
Weir Depths								
SSE-1	91 1 164	55.5 0.6	23 14.0	13 7.9	37 22.6	*** ***	*** ***	*** ***
SSE-2	100 0 164	61.0 0.0	9 5.5	16 9.8	39 23.8	*** ***	*** ***	*** ***
NPE-1	76 80 164	46.3 48.8	6 3.7	1 0.6	1 0.6	*** ***	*** ***	*** ***
NPE-2	77 81 164	47.0 49.4	5 3.0	1 0.6	0 0.0	*** ***	*** ***	*** ***
NSE-1	134 0 164	81.7 0.0	12 7.3	6 3.7	12 7.3	*** ***	*** ***	*** ***
NSE-2	135 0 164	82.3 0.0	13 7.9	5 3.0	11 6.7	*** ***	*** ***	*** ***

[1] Data from Appendix 1.
[2] "On sill" means the weir gate is resting on its sill and meets "on sill" criteria at this location.

SYNOPSIS OF JUVENILE FISH FACILITY OPERATION

Facility Description

Juvenile fish facilities at Lower Granite Dam consist of extended-length submersible bar screens (ESBSs), vertical barrier screens, ten and fourteen inch orifices, a collection channel, a primary dewaterer, emergency and primary bypass, fish separator, fish distribution system that includes PIT tag bypass and sort by code, sampling system with lab, holding facilities distribution, and barge and truck loading.

ESBS's guide fish in the forebay away from the turbine units into one of the 18 gatewell slots that contain two orifices for diverting fish into the collection channel. South orifices are 14-inches and north orifices are 10-inches in diameter. The collection channel typically operates with the 14-inch orifices open in each gatewell slot of operating units. Lights are directed at each open orifice to enhance fish passage into the collection channel. Fish in the collection channel are transported into an above ground flume and are either bypassed to the river via the outfall pipe or directed to the collection facility juvenile separator. Once in the separator, adult and larger non-target fish are released to the river and juvenile fish pass below separator bars and enter the distribution system. Collected fish are then routed directly to a barge, bypassed back to the river, held in a raceway for later transport, utilized for research, or become part of the sample.

Facility Modifications

The following modifications were made to the JFF prior to or during the 2023 fish collection season:

1. Installed dissolved oxygen and total dissolved gas monitoring systems on 2000 series barges.
2. Completed upgrades to the total dissolved gas monitoring systems on the 4000 and 8000 series barges to include GPS and data logging.
3. Completed VBS replacement in gatewell slots 3A, 3B, 3C, 5A and 6A.
4. Repainted the deck and above deck structures on barges 8105 and 8106.
5. Replace forward bits on barge 4382.
6. Installed Vaki Pipeline Counter into the sample PVC line to test its suitability for replacing the current outdated counter system.
7. Repainted the separator.
8. Installed oxygen cylinder storage cage on new concrete pad outside facility lean-to.
9. Replaced workshop air conditioning system.
10. Installed new air conditioning system into the PIT computer system room.
11. Installed additional lighting for the separator A and B exit dewatering inspection.
12. Replaced the 10" flex hose section of the barge loading boom.
13. Installed new release valve for sample recovery tank.
14. Improvements to the secondary bypass gate to simplify emergency power outage procedures.
15. Installed new pump in the wet lab to dispose of anesthetic water.

Operation and Maintenance

Turbine Operations

Efforts were made to operate all turbine units within one percent of the peak efficiency from April 1 to October 31. Deviations were infrequent and brief or required by BPA. Table 17 contains unit outages during 2023.

Table 5. Lower Granite turbine unit outages, 2023.

Unit	Date OOS	Reason out of service
Units 1-6	Jan 9-19	BPA Switchyard modifications
Units 1-6	Feb 27-Mar 1	Trash rack raking
Units 1-6	Mar 20-Mar 23	ESBS Installation
Unit 5	Feb 6	T02 Doble Testing
Units 1-6	Nov 13-Nov 15	ESBS Removal
Units 1-4	Nov 30, 2023-Feb 8, 2024	T1 Gasket Rehabilitation
Unit 5 & 6	Nov 30-Dec 22	Daily line outage for T1 Gasket Rehabilitation
Unit 1	Apr 23	ESBS/VBS Inspection
	May 22	ESBS/VBS Inspection
	Jun 25	ESBS/VBS Inspection
	Aug 27	ESBS/VBS Inspection
	Oct 23	ESBS/VBS Inspection
	Nov 20, 2023-Feb 8, 2024	Annual Maintenance
Unit 2	Apr 23	ESBS/VBS Inspection
	May 22	ESBS/VBS Inspection
	Jun 25	ESBS/VBS Inspection
	Aug 27	ESBS/VBS Inspection
	Aug 28-Sept 14	Annual Maintenance and VBS Repair
	Oct 22	ESBS/VBS Inspection
Unit 3	Mar 26-Mar 27	Differential Issues
	Apr 23	ESBS/VBS Inspection
	May 22	ESBS/VBS Inspection
	Jun 25	ESBS/VBS Inspection
	Aug 27	ESBS/VBS Inspection
	Oct 2-Oct 18	Annual Maintenance and VBS Replacement
	Oct 22	ESBS/VBS Inspection
Unit 4	Nov 21, 2022-Jan 24, 2023	Thrust Bearing & Bearing Indication Upgrades
	Apr 23	ESBS/VBS Inspection
	May 2	Adjust Wicket Gate Packing
	May 21	ESBS/VBS Inspection
	Jun 26	ESBS/VBS Inspection
	Aug 28	ESBS/VBS Inspection
	Oct 22	ESBS/VBS Inspection
Unit 5	Jan 25	VBS Inspection
	Feb 6-Mar 16	Bearing Indication Upgrade
	Apr 23	ESBS/VBS Inspection
	May 21	ESBS/VBS Inspection

Unit	Date OOS	Reason out of service
	Jun 26	ESBS/VBS Inspection
	July 10-July 27	Annual Maintenance
	Aug 27	ESBS/VBS Inspection
	Oct 22	ESBS/VBS Inspection
Unit 6	Apr 23	ESBS/VBS Inspection
	May 21	ESBS/VBS Inspection
	Jun 26	ESBS/VBS Inspection
	July 31-Aug 17	Annual Maintenance
	Aug 28	ESBS/VBS Inspection
	Oct 22	ESBS/VBS Inspection

Debris/Trash Racks

Trashracks were raked February 27-March 1. Trashrack raking was not required during the fish passage season.

Extended-length Submersible Bar Screens (ESBSs)

ESBSs were inspected and tested prior to installation on March 20-23. Brush cleaning cycle was set to operate automatically every two hours this season.

Vertical Barrier Screens (VBSs)

VBSs were video inspected in conjunction with ESBSs during the 2023 fish passage season. Detailed inspections were performed during the June ESBS inspection. VBS screen panel mesh has the potential to deteriorate and become brittle over time. VBS panels for screens that pass underwater camera inspection but showed potential for deterioration continue to be replaced/repaired during unit annual outages or during winter maintenance as time permits.

Gatewells

Gatewells were normally less than 1% covered with debris and did not exceed the 50% debris surface coverage criterion. Turbulence in gatewells with ESBSs causes debris to tumble around and exit through the orifices rather than accumulate on the gatewell surfaces. Surface debris was removed from individual gatewells with a hand dipping basket during initial water-up in late March and continued throughout the season. Occasional oil sheens were dealt with by floating oil absorbent pads in the affected gatewells.

Orifices/Collection Channel

The orifice gallery was watered up March 15. Orifice operation was determined by collection channel flow and forebay elevation. When the forebay is raised above MOP, 10” orifices in gatewells of non-priority units (typically units 4 & 5) are used to maintain acceptable flow to the PDW. Orifices were inspected as often as every three hours and back-flushed with air as needed to remove debris March 1-May 25. Orifices were inspected and back flushed twice a shift May

25-November 1 when river debris loads were minimal. Orifice operation programming issues continue to be a problem. The facility was operated by two biological technicians to monitor the orifice gallery and the operation of the bypass system during the spring freshet. Orifice lights were checked during daily and nightly inspections.

Primary Dewaterer

The primary bypass system was watered up in bypass mode March 15. Primary dewaterer floor screen brushes, side screen brushes, and the pneumatic screen cleaners were intermittently operated in auto and manual mode by powerhouse operators and JFF staff due to mechanical and programing issues with the system. Operational changes in response to programming, mechanical, and structural issues with the PDW continue as needed.

Wet Separator/Distribution and Sampling Systems

Water levels in the separator varied with the forebay elevation and PDW operations requiring adjustment in porosity control valves and separator exit gates. Biological technicians adjusted porosity dewatering valves and exit gate positions in response to separator water elevation changes related to PDW weir operation. Separator exit gates were adjusted to improve PIT tag detection efficiencies as coordinated with PSMFC technicians. There were minimal debris obstructions.

Barge Loading Operations

Barge loading operations occurred from April 24 through June 15. The barge loading boom was forced out of service due to a hydraulic pump failure on June 15, shortening the barging season at Lower Granite by two trips. While the loading boom was in service, loading from the raceways went smoothly. Direct loading did not occur.

Truck Loading Operations

Truck transport started as scheduled August 1 and continued with the last truck departing November 1.

Recommendations

1. Complete Phase 1a modifications and resolve programming issues.
2. Look into redesigning mechanical screen cleaner.
3. Operate the PDW flume outflow between 35-40 cfs to reduce delays in system.
4. Continue rebuilding motors on the 2000 series barges.
5. Replace barge bumper cable and tire system with bumpers.
6. Paint hulls on 8000 series barges.
7. Install ballast material in barges 4394 and 4382 voids to eliminate use of river water.
8. Improve/modify sample holding tank anesthetic chamber separation door operation.
9. Ensure all researchers working at LGW are accountable for anesthetic waste disposal in compliance with the EPA Clean Water Act.
10. Modify PDW side screen cleaners for reliability and ability to operate system in auto mode.

11. Replace electrical cables, control, and hoist for upstream raceway fish crowder.
12. Construction for roof over upstream raceways.
13. Replace upstream and downstream raceway release manifolds.
14. Replace PVC sample line with a 12-inch flume.
15. Replace sample PIT array with new upgraded flume PIT array.
16. Install inline Vaki Pipeline Counter into the PVC sample line to test system as an alternative method to enumerate fish.
17. Replace PDW floor brushes.

APPENDIX