ADULT AND JUVENILE FISH FACILITIES MONITORING REPORT
LOWER GRANITE DAM
2012

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INTRODUCTION

This report summarizes the operation and maintenance of the adult fish passage facility at Lower Granite Dam in 2012, including the results of inspections completed by fisheries personnel from March 1 to December 14. The report also summarizes operation and maintenance of the juvenile fish passage facilities and includes an overview of the collection, transportation, and bypass of migrating juvenile salmon and steelhead at Lower Granite Dam in 2012. More detailed information on juvenile fish collection and transportation activities at Lower Granite Dam can be found in the Walla Walla District's Juvenile Fish Transportation Program 2012 Annual Report.

ADULT FISH FACILITIES

Facility Description

Adult fish passage facilities at Lower Granite Dam consist of an adult fish ladder (adjacent to the dam on the south shore of the river), an adult fish trap located in the fish ladder, two weirgate entrances on the south shore of the river (SSE-1 & 2), a powerhouse collection system comprised of ten floating orifice gates, three north powerhouse entrance gates (NPE-1, 2, 3), a channel under the tailrace deck and spillway connecting all three entrances to the ladder, three north shore entrances (NSE-1, 2, 3), and an auxiliary water supply system. The fishway ladder itself is comprised of a series of pools and weirs and covers a horizontal distance of approximately one-quarter mile while rising a vertical distance of about 100 feet.

During standard fishway operation, the two south shore weir gate entrances are open all the time. Four of the ten floating orifice gates are left open at any one time (gates 1, 4, 7, and 10). Two of the three north powerhouse entrances are normally operated (usually entrances 1 and 2). At the north shore, only the two downstream entrances are normally open at any one time.

Auxiliary water is supplied to the fishway by means of three electric motor-driven turbine pumps that take water from the tailrace area and pump it to floor diffusers located along the tailrace collection channel. Two pumps are operated at any one time and the third pump is kept as a spare and rotated occasionally with one of the other two pumps to even the operational wear. The water supply to the fish ladder proper (approximately 75 cfs) is supplied by gravity flow from the forebay through the fishway exit and upper ladder diffuser.

Automated Fishway Control System

The Lower Granite automated adult fishway control system consists of a Dell 486 computer with a 60-IBM/N card installed and a SIXNET remote terminal unit (RTU). The Dell Optiplex GX-1 computer is located in the powerhouse control room and the RTU300 is mounted adjacent to the existing fishway system control (FSC) board. The computer is used to change the control parameters of the RTU, and provides data acquisition and storage. The RTU controls the six fishway weirgates according to set points that either control the gate at depth below tailwater or a channel to tailwater head differential. NOTE: this controller system, located in the control room, broke down early during the 2011 inspection season. A trouble report was submitted. At this time it appears unlikely this system can be repaired.

The fishway control system provides the following information to the computer: 1) channel water elevation at all three pairs of entrance weirs in feet above mean sea level (MSL), 2) elevation of all six weirgates in feet above MSL, 3) tailwater elevations at three locations in feet above MSL, 4) depth of each weirgate below tailwater in feet, 5) the difference between channel water elevation and tailwater elevation in feet, and 6) the elevation of the fish attraction water pump discharge chamber above MSL.

This control system was installed between 3 January and 28 February, 1994. The system was programmed to control SSE-1 and SSE-2 at eight feet below the south shore tailwater, NPE-1 and NPE-2 at eight feet below the north powerhouse tailwater, and NSE-1 and NSE-2 were set to maintain the north shore channel one foot above the north shore tailwater elevation. (Lack of sufficient water at the north shore prevents NSE-1 and NSE-2 from being set at seven feet below tailwater. Weir depths are sacrificed to maintain the one foot of head differential.) Gate position is sensed by existing Selsyn technology inputting to an INCON model 1255 position monitor that provides gate level accuracy to .01 foot mean sea level (MSL).

Fishway collection channel elevations near the weirgates at the south shore, north powerhouse, and north shore are measured by a Milltronics multiranger plus ultrasonic level transducers which provide a 25 foot measuring range. The ultrasonic transducers are mounted at elevation 650 MSL and thus provide an accurate level indication to elevation 625 MSL (the lowest level in the fish channel). Tailwater elevations at the north powerhouse and north shore are also monitored by ultrasonic transducers, while the south shore is monitored by Selsyn technology similar to the weirgate levels.

Operation and Maintenance

During 2012, the adult fishway system was all or partially dewatered from January 3 until February 13 for maintenance purposes. (*The adult fishway system was dewatered for the 2013 winter outage on December 18, 2012 due to the need to install new gratings and make ladder modifications for lamprey. The second, and later, dewatering event will be covered in the 2013 Report*.) The ladder portion of the fishway was dewatered on January 3. Powerhouse crews dewatered the powerhouse channel portion of the ladder on January 4. The spillway section of the ladder was not dewatered in January of 2012 due to concerns with a faulty bulkhead.

Powerhouse crews initiated dewatering of the fish ladder @2330 hours on December 31 by shutting down fish pumps two and three approximately 48 hours prior to beginning the planned operation. On January 3 bulkheads were placed in the fish ladder exit to stop the flow of water down the ladder. The drain at diffuser 14 was left closed to keep a small amount of water in the ladder until all the fish could work their way down to the junction pool. Dewatering of the adult fish ladder section only was completed on January 3. Two adult steelhead and one adult lamprey were encountered while dewatering the ladder but they moved through the system and out into the tailrace area on their own. In addition, the following fish were salvaged and released to the tailrace: 3 peamouths, 1 adult channel catfish, 1 adult sculpin.

The powerhouse section of the adult fishway channel was dewatered on January 4. The following fish were removed from the powerhouse portion of the ladder: four live adult steelhead (2 clipped, 2 unclipped), 1 live unclipped rainbow trout, 1 dead juvenile Chinook, 1 live peamouth, 2 dead adult channel catfish. All live recovered fish were trucked above the dam and released at Offield Landing.

During January – February of 2012 the spillway section of the adult fish ladder complex was not dewatered for condition assessment and fish removal. A leaky bulkhead was determined to be too dangerous to allow the normal fish salvage operation. Consequently this section was left watered up during the January – February ladder outage and not dewatered per normal operations.

Normal preventative maintenance was conducted on the adult fishway system between January 4 and February 12, 2012. In addition the following work was also accomplished: 1) replaced the grating on diffusers 3 and 7, 2) cleaned the picketed leads, 3) reattached loose sections of the fallback fence, 4) addressed the high temperature alarm problem on fish pump #1, 5) performed a remote grating inspection of diffuser 13 (since the spillway section of the ladder remained watered up), 6) adjusted the limit switches on the fish viewing window, 7) fixed the oil leak at the speed reducing motor on fish pump #2, 8) replaced the broken belt on the fish pump #2 ventilation fan, 9) removed debris from the ladder and the powerhouse channel, 10) repaired the cleaning brush on the fish viewing window.

Modifications

Modifications to the adult fish trap complex at Lower Granite, operated by NOAA-Fisheries, were completed during the winter of 2007. The modifications included: expansion of the platform area; modifying the anesthesia system to provide for an additional four holding tanks; installing a pivoting flume system to route fish to the anesthesia tanks; adding two sorting tanks behind the anesthesia tanks for the working up/sorting of hatchery fish; adding four more adult holding tanks for fall chinook broodstock collection; adding a flume system to route fish to the holding tanks; adding additional electrical outlets for PIT-tag scanning and providing an additional pipe in the forebay to add the extra water needed to operate the expanded trap facilities.

The adult fish ladder and fish trap functioned well during 2012 with no major repairs needed. The replacement of the controller valve for diffuser 14 in the adult fish ladder improved the water flow to the adult trap. Following installation in November of 2009, extensive flow tests were conducted. During the tests, it was possible to run all six adult holding tanks at the adult trap with a sufficient flow of water down to a forebay elevation of 734.2 feet. This allowed for improved holding of adult chinook again during the 2012 field season.

Operations and Maintenance

Auxiliary Water Supply:

When the adult fish ladder complex was watered up in February 2012, fish pumps one and three were initially run to supply water to the adult fish ladder diffuser system. This quickly changed when babbit material was found in the bearing oil on pump one. At that time pump one was taken off line and pump two was run in it's place. Fish pump one was brought back on line on May 9 following bearing repairs. The three fish pumps were then run in varying two pump combinations during the May through mid-October time period without further incidents. Fish pump one went out of service again on October 16. The cause was not directly pump-related but was traced to a broken fuse on a motor management relay which blew during a station service shutdown. Unfortunately, the plant did not have a replacement fuse in stock so bulkheads were switched out and pump two was brought back on line in place of pump one. A replacement fuse was eventually procured for pump one and the problem fuse replaced on November 5 making that pump available for service again. It was decided not to bring pump one back on line again during 2012. Fish pumps two and three were run from October 16 until the pumps were shut down on the morning of December 16 in preparation for early fish ladder dewatering and 2012-2013 winter maintenance activities (including extensive grating replacement and lamprey orifice installations).

Table 9. Fish pump outages at Lower Granite Dam, 2012.*

Affected Pump(s)	Dates	Reason for Outage/Comments
Pumps 1, 2 &3	1/01 - 2/12	2012 Fishway outage
Pump 1	2/24 - 5/9	Babbit material found in bearing oil
Pump 1	10/16 -11/05	Broken fuse on motor management relay
Pumps 1, 2 &3	12/16 – 12/31	2013 Early fishway outage

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

Adult Fish Trap Operations:

During the 2012 fish season, the adult fish trap at Lower Granite Dam was operated between March 8 and November 19. Unlike the 2011 season, it was necessary to take the trap out of service several times due to water temperatures exceeding 70°F. The trap was taken out of service for 24 hours starting at 0740 hours on July 18 due to water temperatures in excess of 70°F. The adult fish trap was shut down again at 0700 hours on the morning of Thursday July 26 due to high water temperatures. The trap temperature at the time of shutdown was 71.0 Degrees F. On July 30 at 0730 hours the adult fish trap was again placed in operation, as water temperatures had decreased into the 67 Degree F. range. The adult fish trap was once again shut down at 0704 hours on the morning of Sunday August 5 due to high water temperatures. The trap water temperature at the time of shutdown was 71.5 Degrees F. On August 9 at 0730 hours the adult fish trap was again placed in operation, as water temperatures had decreased into the 68 Degree F. range. On August 12 at 0700 hours the adult fish trap was shut down again because of high water temperatures in their system. Adult fish trap operations resumed on August 28 During 2012 the adult fish trap sample rate was set at a 10% sample rate for the start of the season but was increased to 15% on August 28 and remained at that rate for the duration of the season.

Numerous activities took place at the adult trap during the course of the 2012 season. One of every 25 hatchery steelhead had a scale and genetic sample taken from them. All previously PIT-tagged fish regardless of origin had a scale and genetic sample taken during the entire year. All wild steelhead without a PIT tag had one implanted, along with scale and genetic samples taken for the entire trapping season. Later in the season scale samples were taken from one out of every three hatchery Chinook. Sort by code Lemhi origin Chinook were also radio-tagged and scale and genetic samples taken during the course of the spring and summer.

Collection of adult fall Chinook for transport to Lyons Ferry Hatchery began on August 18. Due to relatively low numbers of fish, actual transport operations did not begin until August 30. Due to a very high percentage of adult females in the fall Chinook run, brood stock goals (for females) were largely met for both Lyons Ferry and Cherry Lane hatcheries by the third week in October. Consequently protocols at the adult trap were changed and only Chinook females that were wire-tagged (2 out of 3) were hauled to Lyons Ferry. In order to increase the number of male fall Chinook available for spawning, the protocols were also changed and untagged males $\geq$ 65 cm were hauled to

Lyons Ferry starting in late October. Also at that time, the Cherry Lane Hatchery began filling any fish needs by going directly to Lyons Ferry rather than Lower Granite. Trucking operations continued on an as needed basis through mid November. The final transport of adult fall Chinook to Lyons Ferry Hatchery took place on November 17.

A grand total of 12,717 fall Chinook were handled by personnel at the adult trap. Out of this total, 5,996 were hauled to the hatcheries and 6,721 were released back into the fish ladder. Lyons Ferry Hatchery received a total of 5,057 fall Chinook (1,890 adults, 3,167 jacks). The Nez Perce Hatchery at Cherry Lane received a total of 939 fall Chinook (752 adults, 187 jacks). Following the conclusion of adult fish trapping activities, the adult trap complex was dewatered for the winter on November 19.

During 2012, the following species and numbers of fish (by clipped and unclipped designation) were handled by personnel working at the Lower Granite adult fish trap complex: sockeye (15 clipped, 23 unclipped), coho (28 clipped, 382 unclipped), steelhead/spring (443 clipped, 75 hatchery non-clipped, 390 wild unclipped), steelhead/ fall (11,108 clipped, 789 hatchery non-clipped, 3,446 wild unclipped), Chinook spring/summer (5,822 clipped, 270 non-clipped coded wire tagged, 1,731 non-clipped with no wire tag), Chinook fall (1,232 clipped, 3,001 clipped coded wire tagged, 6,476 unclipped, 2,008 unclipped coded wire tagged).

Adult Fishway Inspections

Methods:

A total of 141 physical inspections of the adult fishway complex were conducted at Lower Granite between 1 March 2012 and 20 December 2012. (Note: due to the installation of new gratings and lamprey structuctures the adult fishway was dewatered earlier than normal in December 2012 – slightly reducing the number of inspections in comparison with previous years.) This averaged out to slightly over 3.3 inspections per week during the fish passage season. The routine inspections during 2012 were conducted by COE fisheries personnel stationed at Lower Granite Dam. Once per month, inspections were also conducted in conjunction with Oregon Department of Fish and Wildlife personnel stationed at Little Goose Dam. Following inspections, out of criteria readings or other problems were reported to powerhouse personnel for correction. Powerhouse operators also conducted their own inspections of the adult fishway system to help ensure proper operation.

The inspections were conducted in order to maintain the adult fishway within established operating criteria and to monitor long-term trends in operation. Inspections were not scheduled on a daily or hourly basis but rather an attempt was made to make at least three inspections per week on a no more than once per day basis. Other than avoiding inspections after lockages or other events that could impact staff gauge and weir gate readings, all inspections were made without regard to operational conditions.

Visual inspections of the adult fishway system were conducted by walking through the facility, observing fish passage conditions, and examining each criteria point. Staff gauge readings were taken at the picketed leads, viewing room pool, forebay, adult fishway exit, diffuser 14, and collection channel/tailwater areas adjacent to the entrance weirs. Weir entrance readings were also recorded on each inspection: two at the south shore entrances (SSE-1 and SSE-2), two at the north powerhouse entrances (NPE-1, NPE-2), and two at the north shore entrances (NSE-1 and NSE-2). All readings were taken to the nearest tenth of a foot.

Established operating criteria have long been used for each portion of the fishway. The difference between the elevation reading at the upstream staff gauge (picketed leads) and fish viewing room pool staff gauge should be no more than 0.3 feet. There should be no more than 0.5 feet of head between the adult fishway entrance and the forebay level. The water depth over the ladder weirs (measured at diffuser 14) should be within 1.0 to 1.3 feet. Head differentials at all fishway entrances (differential between entrance bay elevation and tailwater elevation) should be 1.0 to 2.0 feet. Weir depth readings (difference between the weirgate elevation reading and the tailwater level) should be 7.0 feet or greater at the north shore and 8.0 feet or greater at the south shore and north powerhouse.

Readings from each visual inspection were recorded on a standardized form and reviewed for out of criteria readings or other problems. Information from the fishway control system board (FSC Board) was also reviewed and used to supplement the information from visual inspections. When problems were found within the fishway, powerhouse operators were notified and asked to correct them within the limitations of the system.

Inspection Results:

Data from each physical inspection during 2012 was entered into an updated Excel program for analysis. The program evaluated criteria points on a per inspection basis and, when things were out of criteria, recorded the amount out of criteria by tenth of a foot blocks. The program also provided information on the percentage of time that an inspection point met criteria for the entire inspection year. Summary data was automatically copied into an Excel table by the program. This Excel table was later copied into a Word table (Table 1 below) for inclusion in this report and references to inspection results refer to data listed in this table.

Table 1. Summary of adult fishway inspections at Lower Granite Dam, 2012.[1]

			------Not Enough Depth------			-------Too Much Depth-------		
Criteria and 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**
South Channel	0	0.0	***	***	***	***	***	***
Water Velocities	***	***	***	***	***	***	***	***
	141							
Differentials								
Ladder Exit	140	99.3	***	***	***	1	0	0
	***	***	***	***	***	0.7	0.0	0.0
	141							
Ladder Weirs	133	94.3	5	3	0	0	0	0
	***	***	3.5	2.1	0.0	0.0	0.0	0.0
	141							
Counting Station[3]	141	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	141							
South Shore Entrance	141	100.0	0	0	0	0	0	0
	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	141							
North Powerhouse Entrance	138	97.9	1	0	2	0	0	0
	***	***	0.7	0.0	1.4	0.0	0.0	0.0
	141							
North Shore Entrance	82	58.2	25	11	23	0	0	0
	***	***	17.7	7.8	16.3	0.0	0.0	0.0
	141							
Weir Depths								
SSE-1[2]	126	89.4	0	0	0	***	***	***
	15	10.6	0.0	0.0	0.0	***	***	***
	141							
SSE-2[2]	126	89.4	0	0	0	***	***	***
	15	10.6	0.0	0.0	0.0	***	***	***
	141							
NPE-1[2]	35	24.8	0	0	0	***	***	***
	106	75.2	0.0	0.0	0.0	***	***	***
	141							
NPE-2[2]	35	24.8	0	0	0	***	***	***
	106	75.2	0.0	0.0	0.0	***	***	***
	141							
NSE-1	0	0.0	0	0	141	***	***	***
	0	0.0	0.0	0.0	100.0	***	***	***
	141							
NSE-2	46	32.6	2	6	87	***	***	***
	0	0.0	1.4	4.3	61.7	***	***	***
	141							

[1] Data are from Appendix 5.
[2] "On sill" means the weirgate is bottomed out on its sill due to low tailwater conditions and within criteria at this location.
[3] Data is listed as 100% in criteria because both "too much depth" readings were at the maximum allowable 0.3 feet (table is for >0.2 feet).

South Shore Channel Water Velocities

Velocity Meter Readings:

Present criteria stipulate that channel velocities (transportation velocity) in the junction pool area of the adult fishway at Lower Granite be 1.5 – 4.0 feet per second or greater. When the meter was installed at Lower Granite it was put in a part of the channel that had the lowest velocities to monitor the worst-case situation. Consequently, readings are lower in that area then they would be in other locations. During early 2006, modifications were made to the lower weirs in the adult fish ladder and the channel in the junction pool was also narrowed by adding a steel wall inside the existing structure. It was thought that this would help improve channel velocities. Velocities did improve somewhat but not enough to reach the criteria level.

At Lower Granite, six readings are taken from the velocity meter during each fishway inspection and recorded on the inspection form. The six readings are then averaged and the average velocity used as the reading for that inspection. During 2012, readings at the meter in the junction pool were out of criteria on all 141 inspections that were conducted by COE project biologists. Readings ranged from 0.85 fps to 1.27 fps in 2012 compared to 0.73 fps to 1.22 fps in 2011, 0.79 fps to 1.14 fps in 2010, 0.58 fps to 1.19 fps in 2009, 0.88 fps to 1.10 fps in 2008, and 0.70 fps to 0.90 fps in 2005 (prior to junction pool modifications). The average velocity reading during 2012 was 1.03 fps throughout the duration of the entire season.

Head Differentials

Ladder Exit:

There should be no more than 0.5 feet of head between the trashracks and fish ladder exit according to the Fish Passage Plan. The head differential readings for this criteria point were within criteria (0.5 feet or less) on all but one of the 141 inspections in 2012. Nearly all of the readings early in the season showed either no differential or from 0.1 – 0.2 feet of differential. Beginning near the first of May the differentials became notably higher peaking on July 6 with a head differential of 0.6 feet. This was the one reading 0.1 above criteria. This area was within criteria 99.3% of the time.

Ladder Weirs:

Water for the adult fish ladder is supplied by gravity flow from the reservoir through the ladder exit and also through a diffuser below the water control section. The amount of water added to the ladder through the diffuser depends on the elevation of the Lower Granite reservoir, with more water being added through the diffuser as the reservoir lowers. The water supply for the adult fish trap is tied into the diffuser and also

affects the amount of water available for ladder operations when the reservoir is operated at minimum operating pool (MOP).

According to the Fish Passage Plan, 1.0 to 1.3 foot of water should flow over the top of the ladder weir at diffuser 14. Readings are taken from a staff gage that measures elevation (the top of the ladder weir is at elevation 727.0 feet). Hence, the acceptable range of readings falls between 728.0 feet and 728.3 feet. This inspection point was out of criteria 8 times during 2012. There were 5 out of criteria readings that were 0.1 feet below the 1.0 foot minimum over-flow criteria level and 3 readings that were 0.2 feet below the criteria level. Court ordered spill and pool elevations near MOP accounted for the majority of out of criteria readings. This inspection point was within criteria 94.3% of the time during 2012. By contrast it was within criteria 81.1% of the time during 2011, 87.8% of the time in 2010, 85.1% during 2009 and 95.4% of the time during 2008.

Counting Station:

Gratings (picketed leads) separate the area between the staff gage above the fish viewing window and the staff gage below the fish viewing window (counting station). Criteria calls for no more than 0.3 foot of differential between the two staff gage readings. In 2012 this inspection point remained within criteria 100% of the time.

South Shore Fishway Entrance Head Differentials:

South powerhouse fishway entrance head differential readings should range from 1.0 to 2.0 feet between the channel entrance and the tailwater level at the fishway entrance. There were no out of criteria readings during the 2012 fishway inspections. This inspection point remained within criteria 100.0% of the time during 2012.

North Powerhouse Fishway Entrance Head Differentials:

North powerhouse fishway entrance head differential readings should range from 1.0 to 2.0 feet between the channel entrance and the tailwater level at the entrance. During 2012 this inspection point was out of criteria three times. There was one reading 0.1 below criteria and two reading greater than 0.2 feet below criteria. This inspection point was within criteria 97.9% of the time during 2012.

North Shore Fishway Entrance Head Differentials:

The criteria range for head differential readings at the north shore fishway entrances is also between 1.0 and 2.0 feet. Under the present situation, two fish pumps cannot supply enough water to the north shore to maintain both head differential readings and weir depths. This situation has also been exacerbated due to operation during minimum operating pool (MOP) conditions in the tailrace. Standard operational policy has been to sacrifice weir depth readings in order to maintain at least 1.0 foot of head

differential. During 2012, the head differential readings were out of criteria 59 times. There were twenty five readings 0.1 feet below criteria, eleven readings 0.2 feet below critiera, and twenty three readings greater than 0.2 below criteria. The failure of weirgate NSE-1 and the need to dog it off at a compromise level contributed to the higher than usual out of criteria readings this year. During 2012, this inspection point was within criteria 58.2% of the time.

Fishway Entrance Weir Depths

South Shore Entrances 1 and 2, Weir Depths

The south shore fishway system at Lower Granite consists of two fishway weir entrances: south shore entrance one (SSE-1) and south shore entrance two (SSE-2). Present criteria calls for a weir depth level of 8.0 feet or greater between the tailwater elevation and elevations at the south shore fishway entrance weir gates. South shore gates were considered to be "on sill" and bottomed out whenever the tailwater elevation was 633.0 feet or less. This is usually not too much of a problem at the south shore gates. During 2012 operation of the Little Goose pool during the summer months dropped the Lower Granite tailrace to 633.0 feet or lower on fifteen occasions and caused both gates to bottom out. All events in which the gates were on sill took place in July and August.

Weir gate depths are considered to be out of criteria whenever there is enough tailwater elevation to allow the weir gates to move off their sills and readings are not 8.0 feet or greater. During 2012, SSE-1 was never out of criteria (per the physical readings off the weir gate dial). During 2012, SSE-1 remained within full criteria 89.4% of the time and was on sill 10.6% of the time.

SSE-2 was never out of criteria during 2012. During 2012, SSE-2 remained within full criteria 89.4% of the time and was on sill 10.6% of the time.

North Powerhouse Entrances 1 and 2, Weir Depths

Like the south shore, criteria at the north powerhouse fishway entrances also requires weir depths of 8.0 feet or greater. The north powerhouse fishway system at Lower Granite consists of two operating fishway entrances: north powerhouse entrance one (NPE-1) and north powerhouse entrance two (NPE-2). North powerhouse gates were considered to be "on sill" whenever the adjacent tailwater elevation was 636.0 feet or less. At this level, both gates "bottom out" and rest on their respective sills. During 2012, this occurred on a near constant basis from April 2 until October 19 due to operation of the Little Goose pool at the minimum operating level most of the time. In all, both NPE-1 and NPE-2 were on sill 106 times during the season. Readings that were on sill were considered to be within criteria because nothing could be done about the minimum operating pool levels (MOP), which caused the condition.

Weir gates are considered to be out of criteria whenever there is enough tailwater elevation to allow the gates to move off their sills and readings are not 8.0 feet or greater. Neither NPE-1 or NPE-2 was out of criteria during 2012. During 2012, both gates remained within full criteria 24.8% of the time and were on sill 75.2% of the time.

North Shore Entrances 1 and 2, Weir Depths

Present criteria at the north shore fishway entrances stipulates a weir depth reading of 7.0 feet or greater at both entrances. With the exception of heavy spill conditions, there is seldom enough tailwater elevation to maintain both weir depths and head differentials. It is a standard operational practice to sacrifice weir depths in order to maintain at least 1.0 foot of head differential at the north shore. Because of these unusual operating conditions, and the emphasis on maintaining head differentials, weir depth readings are almost always below the desired level. This changed somewhat during the 2011 season and continued in 2012 and was caused by the failure of NSE-1 on May 31 2011. In order to deal with this problem, the gate at NSE-1 has been dogged off at a compromise level. NSE-2 actually met the 7 foot (or greater) depth criteria level on 46 occasions while NSE-1 never met the depth criteria. In the case of NSE-1, all out of criteria depth readings were greater than 0.2 feet below the acceptable criteria level. In the case of NSE-2 there were eight out of criteria readings within 0.2 feet below the acceptable depth level and eighty seven readings were greater than 0.2 feet below criteria. During 2012, NSE-1 met criteria 0.0% of the time and was out of criteria 100.0% of the time. NSE-2 met criteria only 32.6% of the time and was out of criteria 67.4% of the time.

Automated Versus Visual Inspection Results

Readings from the computer system (fishway system control board) were valuable in obtaining an "overall picture" of the functioning of the adult fishway and served as a supplement to the actual visual inspections. During most of the year, the readings between the actual visual inspections and the automated system were reasonably close. The Corps biologists attempted to accurately read staff gauges to the nearest 0.1 foot but discrepencies did occasionally occur. The biggest factors were frequent wave action which made accurate staff gauge readings difficult and the slight time differences between the physical reading and recording the reading off the fishway system control board. During periods of high spill and wind the automated system was particularly valuable and enabled us to monitor the north shore weir gates without becoming drenched.

Recommendations for 2012

1. Repair the damaged weirgate at NSE-1 with a new gate and control system.
2. Consider replacing all the weirgates with a new improved system as parts are difficult to obtain for the existing gates.

3. Continue monitoring of the electronic fishway readings (FSC board) to ensure that electronic fishway readings match physical conditions.
4. Replace the adult fishway control system (located in the control room) with a new system as the old one appears to irreparable.
5. Continue monitoring of the adult trap water demand to ensure that things are operating as planned (following the installation of the new diffuser 14 butterfly valve) and that enough water is available to operate the full range of adult holding tanks during the critical fall period.

JUVENILE FISH FACILITIES

Facility Description

The juvenile fish passage facilities at Lower Granite Dam consist of extended-length submersible bar screens (ESBSs) to divert fish away from turbines, vertical barrier screens, orifices to divert fish from bulkhead slots and fish screen slots, a collection channel and underground pipe to transport fish from the dam to the collection facility, an inclined screen primary dewatering system, a single-stage wet separator and fish distribution system, fish holding raceways, sampling facilities, and barge and truck loading facilities.

Each of the bulkhead slots and fish screen slots (gatewells) has 2 orifices leading into the collection channel. Bulkhead slot orifices are 10 inches in diameter and fish screen slot orifices are 8 inches in diameter. The hydraulic capacity of the collection channel and pipe do not allow all orifices to be open at once. Under normal operation, 18 bulkhead slot orifices (one per slot) and up to six fish screen slot orifices are open at any one time. Fish screen slots and Wagner Horns had closure devices installed during 1995. Cables broke on some of the Wagner Horn closures shortly after construction and allowed the devices to fall off. Replacement took place during 1996. However, not all the fish screen slot closures are 100% effective in deterring fish from moving into the slots. Consequently fish screen slot orifices are run on an alternate basis throughout the season to allow trapped fish an escape route into the collection gallery.

Depending on the amount of debris moving through the system, the bulkhead slot orifices are normally backflushed with air every three hours around the clock to clear debris during the actual fish collection season. Lights are directed at each open orifice to enhance fish attraction into the collection channel. Water and fish from the collection channel are carried underground through a 42-inch diameter gravity flow pipe to the collection facility approximately 1/4 mile downstream from the dam. Upon reaching the facility, most of the water is eliminated through an inclined screen and the remaining water and fish flow into the separator. Small fish pass through the separator bars and are collected while large fish and woody debris are returned to the river. Collected fish are then routed directly to a barge, bypassed back to the river, placed in a raceway for later transport, utilized for research, or become part of the sample.

Facility Modifications

Facility Modifications

1. Refurbished the sample diversion slide gates per PSMFC guidelines.
2. Had the problem fish counters repaired by Smith Root.
3. Replaced a small hand valve at the base of the separator.
4. Repaired a large crack on the turn to the "A" sample gate.
5. Built a pipe extension to the river to allow juvenile lamprey to pass from the upstream raceways into the river.
6. Built new lamprey-friendly tailscreens for all the raceways.
7. Repaired the seals on the sample holding tank anesthetizing bins.
8. Refurbished all the oxygen probes for the Point Four and YSI systems.
9. Cleaned up the counter tunnel wire connections in the separator control room.
10. Completed extensive fish barge PMs.
11. Checked/repaired damaged mesh in raceway tailscreens.
12. Rebuilt snorkel seals on the raceway loading boom and replaced the flexible hose.

River Conditions

Flows in the Snake River during the 2012 season were somewhat of a mix. Flows were the highest in the last five years during March and April. Flows were average during May and below average from June through October. Flows for entire the juvenile fish collection period running from March 26 through October 31 averaged 62.4 kcfs. Flows exceeded the Biological Opinion target of 100 kcfs on 49 dates during 2012 but never quite reached the 200 kcfs mark. River flows for the last few days of March were between 75.5 and 100.8 kcfs – well above the norm. Flows in April averaged 119.4 kcfs and ranged between 91.4 kcfs and 191.0 kcfs. The peak flow of the season was 191.0 kcfs and occurred on April 28. In May, river flows averaged 107.1 kcfs and ranged between 75.6 kcfs and 138.9 kcfs. River flows in June averaged 90.3 kcfs and ranging between 65.7 kcfs and 128.2 kcfs. River flows in July averaged 46.5 kcfs and ranged between 33.8 and 63.0 kcfs. August flows averaged 27.3 kcfs and ranged from 22.8 kcfs to 38.5 kcfs. River flows were only slightly lower in September averaging 22.8 kcfs and ranging from 16.7 to 31.1 kcfs. The season's low flow occurred on October 21 at 15.6 kcfs. Daily flows in October averaged 19.4 kcfs and ranged up to 31.2 kcfs. The flow on October 31, the last day of the collection season, was 31.2 kcfs.

Operations and Maintenance

Bypass and Transport Operations

The juvenile fish bypass gallery was watered up on March 21 at 0800 hours. Fish were bypassed through the 72-inch pipe at the base of the separator (primary bypass) until 0730 hours on March 22 when water was routed over the separator bars due to relatively high numbers of juvenile lamprey and small Chinook becoming stranded on the inclined screen. Fish thus routed over the separator bars were diverted out the long bypass pipe to mid-river. On March 25, formal fish sampling (only) activities began. With the exception of sample fish, and fish collected for research barging operations, all fish were bypassed back to the river until May 1.

Fish barging operations from Lower Granite followed the general pattern of recent years with a few research barge trips taking place prior to the initiation of general fish transportation. Fish were collected 2-3 days before the actual transport date in order to allow marking crews time to mark and handle the fish. The first research barge departed Lower Granite on April 12. Subsequent research barges departed Lower Granite on April 19 and April 26. When fish were not being collected for research, all fish other than sample fish were returned to the river by way of secondary bypass (bypass through the outfall pipe to the river). Fish were collected for numerous other studies after general collection began but this had no effect on the general operation of the facility. After normal collection activities began, these fish were handled as part of the regular collection and diverted to the upstream raceways for marking operations. Collection ended at 0700 hours October 31.

An estimated 5,812,430 juvenile salmonids were collected at Lower Granite Dam during the 2012 operating season. The 2012 species collection included: 1,731,454 clipped yearling chinook, 962,141 unclipped yearling chinook, 256,860 clipped subyearling fall chinook, 430,048 unclipped subyearling chinook, 1,746,004 clipped steelhead, 607,404 unclipped steelhead, 552 clipped sockeye/kokanee, 30,289 unclipped sockeye/kokanee and 47,678 coho. More unclipped yearling Chinook, clipped subyearling Chinook, and unclipped steelhead were collected in 2012 than in 2011. All other species categories' declined. Unclipped yearling Chinook had the highest number of fish collected in the last five years while clipped sockeye had the lowest.

Peak collection dates during 2012 were quite a bit different than the long-term average (Table 3). The peak collection day of April 26 (362,200) is the second earliest in the last five years and was also the peak day for several species. Clipped yearling Chinook (135,000) peaked on April 26 which is the earliest peak date in the last five years. Unclipped yearling Chinook collection (69,400) peaked on April 26 and tied with 2009 as the earliest peak collection day in the last five years. Clipped (119,000) and unclipped steelhead (37,400) collection peaked on April 26, second only to the April 24 peak collection day in 2009 per the five year average. Clipped subyearling fall Chinook collection (15,000) peaked on June 4, the second earliest peak collection day in the last five years. Unclipped subyearling fall Chinook collection (20,800) peaked on June 5, tied for the second latest peak collection day. Clipped sockeye collection (200) peaked on May 9, the earliest peak collection day in the last five years and also easily the lowest number

collected in the last five years. Unclipped sockeye collection (5,200) peaked on May 18, the second earliest peak collection day in the last five years. Coho collection (6,300) peaked on May 18, the third latest day in the last five years. The April 26 peak collection date for many species was immediately prior to the peak water flow date of April 28.

The COE and NMFS transported fish by barge from Lower Granite for research purposes only on April 12, April 19 and April 26. Fish collection activities for general transport began at 0700 hours on May 1. The first day of general fish barge transport was May 2. Fish were barged every day from May 2 to May 28. On May 30 every other day barging began and continued through August 16. Every other day trucking began on August 18 and continued until October 31. All truck trips were made with the 300 gallon pickup mounted tank except for the last trip of the season on October 31 when collection increased and the 3500 gallon tanker truck was used to transport the smolts. Due to a manpower shortage at the Little Goose Fish Facility, Lower Granite personnel transported Little Goose's fish from September 5 through October 7 and again on October 31. Because of large numbers of predacious birds around the Bonneville release site, Lower Granite trucked fish to Dalton Point from October 15 through the duration of the season.

During 2012 both the 4000 and 2000 series fish barges were direct-loaded at Little Goose Dam from May 5 to May 26. Due to regional concerns over juvenile fish migration times, fish barging operations did not begin at Little Goose until May 4 and not until May 6 at Lower Monumental. Fish barging operations at McNary do not begin until river conditions are "no longer spring like". In 2012 fish barging operations did not take place at McNary Dam. Fish barging operations at all other sites continued until mid August. The last barge for all sites left Lower Granite on August 18.

An estimated 2,674,880 juvenile salmonids (46.0% of fish collected) were transported from Lower Granite in 2012 (Table 2). This is proportionately lower than in 2011 when 61.4% of the fish were transported and much lower than 2010 when 93.1% of the collected fish were transported. During 2012 high flow levels helped moved many fish past the dam prior to the initiation of general transport operations. The numbers of fish and the percentages transported of each species group in 2012 were: 706,149 clipped yearling Chinook (40.8%), 283,003 unclipped yearling Chinook (29.4%), 255,959 clipped subyearling fall Chinook (99.6%), 411,347 unclipped subyearling fall Chinook (95.7%), 625,853 clipped steelhead (35.8%), 323,799 unclipped steelhead (53.3%), 552 clipped sockeye (100.0%), 28,742 unclipped sockeye/kokanee (94.9%) and 39,476 coho (82.8%).

It has long been the policy at Lower Granite to try and load as many fish as possible directly onto fish barges to avoid raceway loading/holding. Direct loading of smolts onto waiting fish barges (rather than into raceways) is felt to be highly beneficial to the fish by eliminating secondary handling and related stress factors. An estimated 12.4% of the smolts (approximately 329,210 smolts out of 2,659,998 smolts barged from Lower Granite) were direct loaded onto fish barges at Lower Granite during the 2012 season. By contrast During 2011, an estimated 43.4% of the smolts barged from Lower

Granite (1,674,590 smolts out of 3,859,265 smolts barged) were direct loaded into barges at Lower Granite. This is nearly the same as in 2010 but somewhat better than most recent years. During 2010, 1,499,663 smolts were direct loaded out of 3,378,007 smolts barged (44.4%). Direct load percentages for other years were: 2009 (32.5%), 2008 (38.8%), and 2007 (24.5%).

The low direct load percentage during 2012 was caused by a number of factors. As in previous years, one factor limiting direct loading of barges was the need to divert large numbers of smolts to the upstream raceways to accommodate research marking operations during the peak of the juvenile outmigration. However, the biggest factor in 2012 for the personnel actually handling the fish was the constant threat of debris clogs in the direct load line to the barge. It is now mandatory to report even minor blockages and related fish kills to the region. Following two "incidents" it was decided to load raceways rather than risk continuing problems due to relatively high debris levels. Direct loading of fish barges at Lower Granite took place from May 6 until May 16. Other factors which limited direct barge loading were a late start to general transport operations and occasional late arrival times of returning fish barges.

An estimated 2,674,880 (99.4%) of the total juvenile salmonids transported from Lower Granite Dam were transported by barge compared to 3,859,265 (99.6%) in 2011, 3,378,007 (99.5%) in 2010, 4,111,943 (99.8%) in 2009, and 4,235,017 (99.6%) in 2008 (Table 2). The number of fish barged and the percentages of the total transported by species group in 2012 were: 706,147 clipped yearling Chinook (almost 100%), 282,894 unclipped yearling Chinook (99.9%), 255,814 clipped subyearling Chinook (99.9%), 396,998 unclipped subyearling Chinook (96.5%), 625,847 clipped steelhead (almost 100%), 323,764 unclipped steelhead (almost 100%), 552 clipped sockeye/kokanee (100%), 28,535 unclipped sockeye/kokanee (99.3%) and 39,447 coho (99.9%).

As per previous years, fish collected at Little Goose Dam and Lower Monumental Dam were also loaded onto fish barges that originated from Lower Granite Dam during the 2012 season. This year no fish were barged from McNary Dam. The total number of fish barged from other sites during the 2012 season was: Little Goose Dam (2,529,526) and Lower Monumental Dam (1,223,329).

As in recent seasons, no early season fish trucking activities took place during 2012. Late season trucking operations at Lower Granite began on August 18 and continued every other day through October 31. Due to low fish numbers, trucking operations resumed using the pickup-mounted midi-tanker. Approximately 14,882 juvenile salmonids, 0.5% of the fish transported from Lower Granite in 2012, were transported by truck (Table 2). The number of fish trucked and the percentage of the total transported by species group were: 2 clipped yearling Chinook (< 0.1%), 109 unclipped yearling Chinook (<0.1%), 145 clipped subyearling Chinook (0.1%), 14,349 unclipped subyearling Chinook (3.5%), 6 clipped steelhead (<0.1%), 35 unclipped steelhead (<0.1%), 0 clipped sockeye/kokanee, 207 unclipped sockeye/kokanee (0.7%), and 29 coho (<0.1%).

In addition, another 1,289 juveniles were transported by truck when Lower Granite combined fish trucking operations to help Little Goose from September 5 to October 7 and again on October 31, the final day of the season. The pickup-mounted midi-tanker was used for nearly all the truck fish transport trips during 2012. It was not until the final trip of the season (October 31) that the large semi truck was used. On that date the combined estimated weight of transported fish for both Lower Granite and Little Goose was nearly 362.8 pounds – more than twice the capacity of the midi-tanker.

The physical operation of the transport barges and transport trucks went reasonably well during the 2012 season. As in 2011 there were no operational problems that prevented the normal transportation and release of fish at the designated release points. Nevertheless, as is to be expected of any large-scale operation involving considerable equipment over a lengthy period of time, there were a few minor operational problems. Perhaps the problem of most concern was a noticeable leak somewhere in the hull or plumbing mechanism of fish barge 8107. The biological technicians pumped out the front void of this barge on several occasions after noticing that the barge was riding slightly bow heavy. This leak will hopefully be evaluated and repaired during the 2012-2013 winter maintenance season. Another problem that surfaced was some minor air leaks on the cylinders that lift the fish barge plungers on barges 8106 and 8107 (the JFF maintenance crew replaced seals in several cylinders). The pump alarm on engine #2 on barge 8105 also developed problems and triggered false alarms several times during the season. Other problems that surfaced were minor problems with the oxygen sensors on the P4 system, small fuel and antifreeze leaks (quickly repaired), minor exhaust leaks, a broken fuse housing for a bow light, and a stuck valve on the plumbing on barge 2127.

As a matter of concern, the rubber fish release plungers on the 4000 and 8000 series fish barges are wearing out and beginning to deteriorate from sunlight and exposure to extreme summer heat. An examination of the plungers by fish facility personnel showed there was some cracking and leaching of material on quite a few of them. An order has been placed for six replacement plungers. It is unknown how long the barges will operate with questionable plungers but we are attempting to procure enough to be backed up through the 2013 field season and out into the reasonably near future. In addition, a new plunger is being developed in engineering. Hopefully, it will be less subject to heat deterioration and instead of replacing an entire plunger only a bottom rubber seal would be replaced.

In recent years the oxygen monitoring systems on the fish barges have often caused as many problems (usually minor) as any of the mechanical systems. Problems are typically of a single hold nature and involve a probe in a particular hold not reading correctly or giving fluctuating readings. This is usually solved by renovating the probe and changing out the electrolyte. In other cases it has been necessary to install another probe or chase down an electrical system problem. The touch pad monitors on some of the barges are also aging and thought should be given to replacing the current system with a new system (including new monitors) to ensure reliability. In addition various parts for the present system are not available - leaving us liable should a system go down. The portable YSI oxygen/temperature monitoring systems (used as a backup

system the barges) have proven invaluable over the years and allowed for monitoring of oxygen and temperature levels whenever there were problems with the main Point Four system.

There were very few problems with the Lower Granite fish trucks during the 2012 season. NOAA-Fisheries late season transport evaluation study put quite a few fish back into the river that would have normally been transported and kept transport numbers low enough to use the 1-ton pickup and midi-tanker tank for nearly the entire season. The maintenance staff had no problems with either the 1-ton pickup or the 300 gallon mini-tanker. Care was taken to add enough river ice to keep the tank temperature at an acceptable level for the trip to Bonneville and in general very little tempering was required at the release site. The semi truck was not used until the last trip of the season and operated without incident for that solo trip. That said, in previous years the refrigeration system on the large tanker truck has presented problems for the drivers. The system runs but frequently the drivers have not been able to measure any significant cooling during pre-season truck testing.

Bypass

The fish facility was placed in primary bypass mode (fish are diverted directly back to the river) on March 21. At 0800 hours on March 22 the facility was taken off primary bypass and put into secondary bypass (fish routed over the separator and through the long outfall pipe to mid-river) due to lamprey and early yearling Chinook and steelhead being stranded on the inclined screen. Collection for sampling began at 0700 hours on March 25. All fish, except those collected and transported for research purposes, were bypassed to the river until 0700 hours on May 1 when collection for general transportation operations began. Smolts were bypassed for approximately 15 minutes on June 6 to clean the separator screen and for 40 minutes on September 26 to check for debris. During these cleaning events no estimate was made of the number of fish bypassed because the fish are bypassed before encountering the sampling system (Primary Bypass). The facility was placed into secondary bypass on October 31 at 0655 hours so fish could be routed through the PIT-tag interrogation system. Fish were routed through the secondary bypass until the morning of December 20 when the juvenile fish system was dewatered for the winter.

In 2012, 3,133,048 smolts were bypassed from the LGR Juvenile Fish Facility compared to 2,429,798 in 2011, 247,129 in 2010, 2,465,023 in 2009 and 815,565 in 2008 (Table 2). The number and percentage of smolts bypassed by species group included: 1,024,069 clipped yearling Chinook (59.1%), 678,689 unclipped yearling Chinook (70.5%), 57 clipped subyearling fall Chinook (<0.1%), 17,163 unclipped subyearling fall Chinook (4.0%), 1,119,949 clipped steelhead (64.1%), 283,526 unclipped steelhead (46.7%), 1,430 unclipped sockeye/kokanee (4.7%) and 8,165 coho (17.1%). An estimated 3,088,372 juvenile salmonids, 53.1% of the total collection were bypassed from March 26 to May 1, before the start of the general transport season. By contrast, during 2011 27.1% of the total collection (1,709,591 smolts) was bypassed from March

26 to May 1. This is the first year that more fish were bypassed than transported from LGR.

As part of five research studies, 66,885 smolts were bypassed from LGR. The National Marine Fisheries Service (NMFS) Survival Study PIT-tagged and bypassed 57,052 smolts: 16,761 unclipped yearling Chinook, 20,133 clipped steelhead and 20,158 unclipped steelhead. The NMFS Fall Chinook Late Season Transportation Study bypassed 57 clipped and 5,685 unclipped subyearling fall Chinook. The USGS, USFWS, Pacific Northwest National Laboratory (PNNL) and NMFS "Investigating passage of ESA-listed fall Chinook salmon at Lower Granite Dam during winter when the fish bypass system is not operated" study bypassed 43 non-target smolts and 46 target previously PIT-tagged holdover subyearling fall Chinook from the SBC tanks. The Idaho Fish and Game Genetic Stock Index study bypassed 1,818 unclipped, untagged yearling chinook and 473 unclipped and untagged steelhead. The USFWS and USGS study to evaluate early life history, migratory behavior and survival of fall Chinook salmon in the Snake River bypassed 355 target, previously PIT-tagged subyearling fall Chinook, 38 non-target bycatch and 50 fish were bypassed without being examined or identified to species due to high water temperatures, from the SBC tanks. The NMFS study to monitor the behavior and survival of wild spring/summer Chinook salmon in the Snake River basin bypassed 726 target, previously PIT-tagged unclipped yearling Chinook, 496 non-target fish were handled and bypassed and 46 non-target, previously PIT-tagged fish were bypassed from the SBC tanks.

Turbine Operations

During 2012, turbine units 1-6 were unavailable for service 15,007.4 hours out of a possible 52,704 operational hours. This computes to an overall availability factor of 71.5%. This is on par with 2011 when the availability factor was 71.9%. The 2012 availability factor on a per unit basis was: turbine unit 1 (63.8%), turbine unit 2 (88.6%), turbine unit 3 (69.1%), turbine unit 4 (49.6%), turbine unit 5 (68.7%), and turbine unit 6 (89.4%). Turbine unit 1 was unavailable for service a total of 3,178.5 hours for various reasons. The two biggest outage factors were annual maintenance (which carried over from December 2011 and required 1,544 hours during 2012) and welding repair work to correct the angle of the fixed blades. The welding repair work (coupled with annual maintenance) was performed from July 9 until September 5 and required 1,394 hours. Turbine unit 2 was unavailable for service 1,002.6 hours. The biggest outage factor was annual maintenance in November and December which required 651 hours. Turbine unit 3 was unavailable for service a total of 2,722.8 hours. The biggest outage factor was annual maintenance/BPA fiber optic line installation which carried over from August 1, 2011 and was completed on March 28 and required 2,138 hours during 2012. The second main reason for this units' unavailability was annual maintenance. This work was performed from October 9 until November 2 and required 576 hours. Turbine unit 4 was unavailable for service for a large part of the year with a total of 4,428.4 hours. The main cause was cavitation repair conducted from April 3 through October 9 which required

4,380 hours. Turbine unit 5 was unavailable for service a total of 2,745 hours. The main cause was cavitation repair conducted from September 17 through the duration of the year which required 2,520 hours. Turbine unit 6 was unavailable for service a total of 930.1 hours. The biggest outage factor was annual maintenance and T2/Doble testing activities in September which required 410 hours. In general, turbine unit availability was highest during the months of April – May and lowest during August – November.

Turbine unit unavailability caused by fish-related work was fairly typical during 2012. Nearly all fish-related outages were due to fish screen installation and removal activities and video inspections of the VBSs and ESBSs. Per the Ombil database system there were approximately 80.7 hours of direct fish-related turbine unit outages during 2012. By comparison during 2011 and 2010 there were a recorded 39.6 hours, and 95.7 hours of outages, respectively. During 2012, there were also approximately 29.5 hours of unit outages related to trash raking activities in February and March which were not included in the fish-related outages. Per Ombil, the following outage hours were directly related to fish work in 2012: Unit 1 (18.5 hours), unit 2 (11.7 hours), unit 3 (11 hours), unit 4 (13 hours), unit 5 (7.2 hours) and unit 6 (19.3 hours).

Forebay Debris/Trashracks

Forebay debris removal and trash rack raking operations were completed by February 27, 2012. During most of the season forebay debris levels were moderate and debris drifted back and forth with the wind. Descaling became quite severe in the JFF lab samples (up to 10.7% of the sample fish) during mid September. The shift operators checked the gatewell draw down and the differential was within the established range. Trash racks were racked on Unit 1 on September 19 and three loads of material (approximately 30 cubic yards) was removed. Trash racks on Units 2 and 3 were then raked on September 24 and little debris was removed. Due to continuing descaling issues, the project raked the trashracks on turbine unit 2 on the morning of October 2. (The 2A trashrack had not been raked earlier due to the inability to clean it with turbine Unit 1 in operation.) Some fine material was then removed from trashrack 2A. Some very large logs were also removed from the bottom of the 2B trashrack. No further raking of trashracks took place during the remainder of the fish season. Descaling slowly subsided and other factors (such as damaged ESBSs) may have been a factor in the high descaling rate.

Extended-Length Submersible Bar Screens (ESBSs)

All operating turbine units were equipped with ESBSs during the 2012 fish passage season. Winter maintenance of the screens by the powerhouse mechanics was ongoing in late February and early March. A physical inspection of the screens was conducted by fish facility personnel in mid March - just prior to installation. No significant problems of any kind were detected. Installation of fish screens in all

operating units (Units 1,2,4,5,6) was completed by March 21. Unit #3 was dewatered at that time but brought on line on March 28 following ESBS installations.

Every attempt was made to conduct video inspections of the ESBSs during the course of the fish season as outlined in the Fish Passage Plan. While it is possible to get a good view of the VBSs with the existing video equipment, it is more difficult to get an accurate assessment of the ESBSs due to the limited amount of screen area detectable on the camera. Video inspections were attempted in late April and again in mid May but were cancelled due to turbidity issues. The units were operationally rotated off line and video inspections were finally conducted on all units on June 22-23. No problems were detected with any screen on those inspections. Per the Fish Passage Plan, it is not necessary to conduct video inspections during July. Video inspections during August and late October also revealed no problems of any kind with the ESBSs.

Operation of the ESBSs appeared to be relatively trouble-free during the 2012 season until September and early October. During routine examination of the fish screens in September and October it was determined that screens were bent in several units. Damaged fish screens were eventually found in slots 1C, 2B, and 5C. The bent screen in Unit 1 was found when it was forced out of service on October 10 due to an inoperable ESBS. Lower Granite in the process of acquiring replacement fish screens from John Day. Modifications may need to be done to these screens to make them work at Lower Granite.

The ESBS scrub brushes can be individually set to clean the screens at the following interval times: 15 minutes, 1 hour, 2 hours, and 4 hours. During most of 2012 the brush cleaning times on all ESBSs were set for one cycle every four hours when the unit was operating. After problems were detected with the ESBSs in September and October, the cycle time was increased to once every hour. After the problem fish screens were detected and taken off line, the cycle time on the undamaged screens was changed back to once every four hours. All operating screens remained at a cycle time of once every four hours for the duration of the season. The last of the ESBSs were raised and dogged off for the winter maintenance season on December 19.

Vertical Barrier Screens (VBSs)

New New vertical barrier screens (VBSs) were installed in all turbine units during 1996. These screens have panels of plastic mesh on the front and 25% open area perforated plate on the back. In April of 2005, three experimental VBSs were installed in unit 4 and these screens remained in place during the entire 2012 fish season. Minor problems have been detected on VBS inspections in recent years but a tight schedule for the maintenance crew has made correcting these problems difficult As in 2011, during 2012 VBSs were inspected with an underwater video camera per FPP guidelines in conjunction with inspections of the ESBSs. The 2012 October inspections revealed that VBSs in units 2, 4, and 6 had minor issues with missing rivets or loose straps. The mechanical crew's tight winter schedule makes getting these issues addressed difficult.

The VBSs seem to be structurally sound. Hopefully repair work to replace the missing straps and rivets will be accomplished as soon as time permits.

Gatewells

Gatewells were inspected during adult fishway inspections throughout the 2012 season for debris buildup, oil, dead fish, unusual concentrations of live fish, or anything else out of the ordinary. As in previous years, extended length bar screens and modified vertical barrier screens noticeably increased the turbulence in the gatewells. This caused debris to tumble around in the gatewells and exit through the orifices, rather than accumulate on the gatewell surfaces. Another factor in the lack of gatewell surface debris buildup was that gatewell drawdown with ESBSs was greater than with the earlier 20 foot traveling screens, putting the orifice closer to the surface, especially under minimum operating pool conditions. As was the case from 1998 - 2011, constant debris movement through the orifices prevented the need for extensive gatewell cleaning during 2012.

Some larger debris was removed from individual gatewell surfaces with a small dipping basket when it appeared that it might cause problems with movement through the collection gallery orifices. This operation first took place during initial water-up in late March and continued throughout the season as circumstances warranted. Gatewell dipping took place only when the units were shut down for maintenance or were off line due to lack of water for generation. During nearly all of the 2012 collection season, surface debris coverage on the gatewells easily averaged less than 1%.

Orifices and Collection Channel

The Lower Granite juvenile collection channel was watered up on March 21, 2012 to accommodate fish screen installations. Bulkhead (downstream) slot orifices were operated in the usual manner during 2012 with at least one orifice per gatewell slot opened to divert fish into the collection channel. Upstream (fish screen slot orifices) were operated to provide additional water and fish guidance as hydraulic conditions allowed. During 2007, the upstream gatewells (fish screen slots) were dipped to see if any fish were present (gatewells and Wagner Horns were sealed in the mid 1990s). Very few fish were found with the exception of fish screen slot 5B where approximately 50 steelhead and 50 Chinook were removed. Consequently, an orifice from slot 5B was always left open during the entire 2012 fish collection season to ensure fish moved out of it safely. Orifices from the other fish screen slots were operated when hydraulic conditions in the gallery permitted.

The air backflush orifice cleaning system worked reasonably well during 2012 and there were no significant maintenance issues of any kind. Due to the variability of the debris moving through the system, fish facility personnel maintained a rigorous schedule of backflushing orifices every three hours around the clock from late March

through the cessation of fish collection activities on the last of October. After that time, orifice flushing activities were slightly reduced but still maintained on a regular basis to ensure no orifices were plugged and impeding fish passage. This operation continued until the last of the fish screens were pulled. The collection gallery orifices were closed, and the channel dewatered on the morning of December 20.

Primary Dewatering Structure

Lower Granite's primary dewatering structure consists of an inclined screen of stainless steel mesh, supported by heavy bar screen, just upstream from the porosity control perforated plate for the separator. There is no mechanical cleaning device on this screen. It is cleaned with a long handled brush or scraper at periods ranging from every hour to once or twice per day dependent on the amount of debris moving through the system. Debris buildup is usually not a problem. Exceptions are during periods of high wind when tumbleweed and other plant materials are blown into the river or during periods of high river flow when an excessive amount of small woody debris, such as wood chips or pine needles, is in the river. Debris spills can also dislodge fine material which can pass into the juvenile fish system and cause problems. In addition small invertebrates in the river can also plug the screen and make cleaning very difficult. During late May and early June 2012, debris levels were high at times resulting in the need to clean the screen on an hourly basis to prevent clogging.

When the inclined screen on the separator system becomes severely clogged with debris, it is necessary to go into primary bypass mode by closing the dewatering valve below the screen and opening the 72-inch bypass valve. This takes pressure off the top of the inclined screen and allows debris to either float off or be easily brushed off. Typically it takes about 20 - 30 minutes of time to go through the entire cleaning procedure during which time fish are bypassed back to the river through the pipe at the base of the separator (primary bypass).

Unlike 2011 when debris blockages on the separator inclined screen resulted in having to go to primary bypass mode to clean the screen on 15 occasions, during 2012 it was necessary to dewater the inclined screen on only two occasions. The first event took place on June 6 when debris impingement on the screen became bad enough to prevent normal control of the separator. The second event took place on September 26 and was related to investigating a descaling issue and not for debris impingement.

It is likely that the fish facility would have had to go into primary bypass mode to clean the inclined screen numerous times during late May and early June due to debris blockages had it not been for a tool developed by the JFF maintenance crew. A long handled brush with high pressure air jets was developed during 2011 to help clear the debris from the screen. In practice the separator technician hooked the hose on the brush into the facility air supply. The brush was then pushed as far back on the inclined screen as possible and slowly pulled forward. The high pressure air pushed through the screen material and then bubbled back up freeing the debris immediately in front of the brush.

By slowly pulling the brush forward it was possible to clean the debris off a portion of the screen one section at a time. Had it not been for this development, it is highly likely the screen would have had to be dewatered and cleaned on a more frequent basis during 2012.

A problem that did not occur during 2012 that caused management problems in 2011 was a sudden influx of the aquatic plant Elodea moving through the system and clogging the inclined screen. This was something that had not previously been encountered to any extent at this site. Bushels of this plant were removed off the inclined screen and from raceways during early to mid July of 2011. Fish facility personnel attempted to chase down the cause of this influx of material (thinking that perhaps someone upstream might have been cleaning vegetation from around docks) but were unsuccessful in finding the source. Hopefully this was a onetime event but assuming this plant is established in the river system it seems likely similar problems will occur in the future.

Separator

The separator at Lower Granite is a single stage separator and currently has no provision for size separation of juvenile fish. The separator functioned well during the 2012 season with the exception of the few periods of time when high levels of debris became an issue. It was necessary to check the separator exits more frequently than normal during the late May to mid-July time frame due to debris blockages. Descaling of juvenile fish became quite severe during September 2012. The separator was partially dewatered on September 26 from 1455 to 1535 hours in order to remove the bars and see if debris in the bin might be a factor in the high descaling rate. The inspection revealed that the separator bin was almost entirely clear with less than half a five gallon bucket of shells and small sticks removed.

Late in the 2011 collection season the 42-inch valve electric controller failed due to a bad circuit card. It was necessary to manually operate the valve for the last portion of the 2011 season. This card was replaced prior to startup operations in 2012 and both the 42-inch and the 72-inch valve functioned well during the 2012 season.

As in recent seasons the separator was also operated in the standard mode (water over the bars) to monitor for late season PIT-tagged juveniles passing through the system in November and December of 2012. (Unlike some other sites, Lower Granite does not have a full flow bypass with PIT-tag detection for juvenile fish. PIT-tag detection of juveniles normally ceases with the end of separation activities on the last of October.) No sampling or handling of juvenile fish took place during the extended separator operations. They were simply routed through the separator and out the long bypass pipe back to the river (secondary bypass) until the morning of December 20 when the juvenile collection system was dewatered for the season. The JFF maintenance crew kept electric/diesel heaters available for use at the separator and other exposed pipe areas. Separator personnel started the heaters whenever overnight temperatures dropped to the point that

pipes could potentially freeze. As was the case in 2011, temperatures remained mild enough during November and December of 2012 that we were able to operate the system in the secondary bypass mode (PIT-tag monitoring mode) continuously and avoid going into primary bypass to keep from breaking pipes. It was necessary to operate the diesel heaters on only one or two nights.

As has been the case during recent years, during 2012 small Chinook jacks caused some problems by falling through the separator bars and ending up in the sample. This is especially problematic because the jacks tend to thrash around quite a bit while being anesthetized and can potentially injure the much smaller juvenile fish in the anesthetizing bins. In addition, jacks could potentially be caught by anglers soon after release and should not be consumed early on due to the possible latent effects of MS-222. In order to prevent jacks from entering the sample, an additional set of separator bars with a smaller spacing were place on top of the existing separator bars on the morning of October 1. These bars were removed after the end of fish collection and sampling activities when the system had been switched back to secondary bypass mode. The new bars measure 1 inch in diameter, are constructed of rigid wall aluminum tubing, and are spaced approximately 1 1/16 to 1 1/8 inches apart. They are built in three full length panels and secured in place overlaying the existing separator bars.

Sample System/PIT Tag System

The sample system at Lower Granite consists of two slide gates located in the bottom of the separator exit flumes a few feet downstream of the separator, a large slide gate which separates PIT-tagged fish from sample fish, a PIT-tag tank and routing system to a holding tank or the river, a sample tank with four operational 4-inch counter tunnel exits, an enclosed pipe that carries fish from the sample tank to a sample holding tank which is divided into two equal halves (each with two pre-anesthetizing chambers). The two primary slide gates, which are controlled by a touch pad calibrated to within 0.001%, also act as PIT-tag diversion gates. The system has the capability to send PIT-tagged fish that exit the separator during a sample either to the sample or to the river. Most of the time, the system is set so the sample overrides the PIT-tag diversion system, sending PIT-tagged fish to the sample instead of being diverted back to the river. During 2012 this occurred from startup on March 25 until 0700 hours on August 2 when the system was switched over to “divert during sample mode”. (In this mode the sample is over-ridden to allow PIT-tagged fish to be diverted while a sample is in progress.) The system was operated in divert during sample mode until the end of normal separator operations on October 31.

At the start of the season on March 25 the sample gates were set to divert 10% of the fish to the sample while the remaining fish were diverted back to the river through the bypass outfall pipe. Samples were taken four to six times per hour during the course of the season until August 16 when the system was switched to a 100% sample rate due to lower fish number and also in order to help facilitate truck loading operations. The sample rate remained at 100% for the duration of the season on the morning of October

31. Weekly sample rates ranged from 0.500% to 50.000% prior to the 100% sample period. During the course of the season, the sample system only needed minor adjustments in air pressure and gate timing by Pacific States Marine Fisheries Commission personnel.

A new slide gate system with PIT-tag detection capabilities was added to the flume leading to the upstream raceways and bypass outfall pipe during the 2007 winter outage period. This system was installed by NOAA-Fisheries and PSMFC personnel between March 12 and March 21, 2007. The system now has four modes: 1) bypass marking, 2) bypass, 3) general collection, and 4) marking. When the system is in bypass marking mode all fish are diverted to the raceways for marking purposes except sort by code fish which are bypassed back to the river. When the system is in bypass mode all fish are diverted through the bypass outfall pipe (secondary bypass) to the river. When the system is in general collection mode, fish are diverted down the flume to the east raceways for normal collection and marking activities. And finally when the system is set for marking mode, previously PIT-tagged fish (sort by code) are diverted to raceway 10 through an additional pipe to avoid being handled again. Untagged fish are routed down the flume for normal marking activities. This system continued to work well during 2012.

Barge/Truck Loading Operations

It has long been the policy at Lower Granite to try and load as many fish as possible directly onto fish barges to avoid raceway loading/holding. Direct loading of smolts onto waiting fish barges (rather than into raceways) is felt to be highly beneficial to the fish by eliminating secondary handling and related stress factors. An estimated 12.4% of the smolts (approximately 329,210 smolts out of 2,659,998 smolts barged from Lower Granite) were direct loaded onto fish barges at Lower Granite during the 2012 season. By contrast During 2011, an estimated 43.4% of the smolts barged from Lower Granite (1,674,590 smolts out of 3,859,265 smolts barged) were direct loaded into barges at Lower Granite. This is nearly the same as in 2010 but somewhat better than most recent years. During 2010, 1,499,663 smolts were direct loaded out of 3,378,007 smolts barged (44.4%). Direct load percentages for other years were: 2009 (32.5%), 2008 (38.8%), and 2007 (24.5%).

The low direct load percentage during 2012 was caused by a number of factors. As in previous years, one factor limiting direct loading of barges was the need to divert large numbers of smolts to the upstream raceways to accommodate research marking operations during the peak of the juvenile outmigration. However, the biggest factor in 2012 for the personnel actually handling the fish was the constant threat of debris clogs in the direct load line to the barge. It is now mandatory to report even minor blockages and related fish kills to the region. Following two “incidents” it was decided to direct load raceways rather than risk continuing problems due to relatively high debris levels. Direct loading of fish barges at Lower Granite took place from May 6 until May 16. Other

factors which limited direct barge loading were a late start to general transport operations and occasional late arrival times of returning fish barges.

Truck loading operations at Lower Granite went relatively well. As per recent years, there was no early season trucking during 2012. Trucking operations began immediately after fish barging ended and ran from August 18 until October 31. NOAA-Fisheries late season transport evaluation reduced the number of fish transported and allowed the facility to use the pickup-mounted midi tanker system for nearly all the season. Fish were diverted from the lab directly onto the waiting midi-tanker reducing fish handling operations. The Lower Granite semi was only used on the very last day of the season during 2012 when fish numbers (combined with those of Little Goose) were too high to use the midi-tanker.

Avian Predation

Control Measures

Injuries associated with predators include wounds inflicted by other fish, birds, and lamprey. Predator wounds were observed on 1.0% of the smolts examined in the detailed subsample compared to 0.8% in 2011, 0.8% in 2010, 1.0% in 2009 and 1.0% in 2008. Predator marks were highest on clipped steelhead, clipped yearling Chinook and unclipped steelhead. Predator marks caused by birds, characterized by a distinct V-shaped descaling pattern on both sides of a fish were the most common predator mark (70.7%) compared to 26.6% caused by fish and 2.7% caused by lamprey. Atypical of previous years, clipped yearling Chinook had the second highest occurrence of bird bites with clipped and unclipped steelhead having the first and third highest incidences respectively. Normally, the larger clipped and unclipped steelhead smolts have the most bird bites.

Bird wires in the Lower Granite Dam tailrace area were replaced by USDA Wildlife Services personnel during March, 2004 (immediately prior to the beginning of the 2004 fish season). To help ensure the wires were less susceptible to damage by watercraft, braces were built on the powerhouse tailrace deck during 2006 to raise the wires higher above the water. Six anchor points were built and the extended braces were installed on the tailrace deck by Corps of Engineers personnel. This system continued to work well during 2011. Several bird wires were replaced by USDA-APHIS personnel in September 2010. Two bird wires failed late in 2012 they will be replaced before the 2013 collection season.

Avian predation control measures at Lower Granite and Little Goose dams in 2012 were similar to those conducted during 2004-2011. The actual hazing period was reduced somewhat in 2011 to the April 1 to June 30 time period. This was done to allow for additional hazing efforts during the period of time the most juvenile fish were being spilled over the dam. Hazing took place 16 hours per day (essentially dawn to dusk)

between April 24 and June 4. This appeared to be highly effective and stopped the problem we have had during previous years of gulls returning to feed after the control agent left for the day. An individual agent was assigned to Lower Granite Dam during the work week and was able to devote his entire time to controlling avian predation at this site. Additional agents filled in during the April 24 to June 4 time period to allow for 16 hour per day coverage on weekdays and weekends. The control measures utilized included: 15 mm pyrotechnics, long-range rockets, fused rope salutes, and propane canons.

Gull Counts

Gull counts initially began at Lower Granite Dam during 1999 and continued each succeeding year including 2012. Utilizing binoculars, technicians assigned to the separator were instructed to count all gulls visible in the tailrace area (an area immediately below the dam to a defined point approximately one half mile downstream). Counts were made twice daily; at approximately one half hour after sunrise and then again at approximately one half hour before sunset. Daily count data was recorded on forms and entered into an Excel spreadsheet for later evaluation. General gull counting began on March 25 and continued through October 31. In addition, counts were extended through December 15 to take advantage of the additional monitoring opportunity due to late season separator operations. During the general March 25 to October 31 counting period a total of 1,360 gull sightings were recorded. This is considerably less than in 2011 when 2,122 gull sightings were recorded. During 2012 more gulls were seen on morning counts (749) than on evening counts (646). The highest count day for gulls during 2012 was on April 12 when a total of 66 were counted on the combined morning and evening counts. This is very near the April 3 peak passage date for clipped steelhead and just prior to the (slightly delayed) beginning of hazing activities on April 6.

During the extended November 1 through December 15 counting period, an additional 316 gulls were observed. A total of 238 were observed on the morning counts and 78 on the afternoon counts. This is much more than in 2011 when only 32 late season gulls were counted. Observers noted that most gulls were seen just downstream of the bird deterrent wires and also noted that juvenile lamprey/shad were being preyed upon. It is not clear why late season 2012 was so much more active than 2011. As in 2011 specific cormorant counts were not conducted at Lower Granite during 2012.

Recommendations

1. Install a generator to power the fish facility during electrical outages.
2. Dependent on the initiation of the Phase 1 fish facility upgrade, refurbish the existing separator inclined screen with bar screen material; add an airburst cleaning system under the inclined screen; beef up the existing screen support system (it is rusted and could possibly fail in the not too distant future).
3. Replace the aging Point Four oxygen monitoring systems on the 4000 and 8000 series

fish barges.

4. As needed, replace the cracked barge fish hold plungers with new plungers.
5. Tune up the Cummins barge engines (per company specs this should be done every 1,000 hours).
6. Paint the holds on fish barge 4382 in FY 2013.
7. Pour concrete to serve as ballast in fish barges 4394 and 4382 as soon as funding becomes available.
8. Paint the hulls on all the fish barges as soon as funding becomes available.
9. Refurbish the concrete on the raceway interiors with a new sac-rub finish (pending a new JFF).
10. Replace the aging lab chiller system with an improved system.
11. Install or remove push knees (as needed) on the barges and explore a new bumper system to use in place of the present cable and tire system.
12. Repair concrete erosion damage in the upwell structure as soon as possible (rebar is showing).

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