ADULT AND JUVENILE FISH FACILITY MONITORING REPORT
ICE HARBOR DAM
2011

Mark F. Plummer
Project Fishery Biologist
Stephen Jeffers
Biological Science Technician
Ice Harbor Dam
U.S. Army Corps of Engineers

INTRODUCTION

This report summarizes the operation and maintenance of the adult and juvenile fish passage facilities at Ice Harbor Dam in 2011. The juvenile fish sampling program and results are given in greater detail in the 2011 Juvenile Fish Transportation Program Annual Report.

RIVER CONDITIONS

Peak river flow at Ice Harbor Dam occurred June 9 reaching 215.7 kcfs. River flows continually exceeded 100 kcfs May 11 – July 11. Spill for juvenile fish passage began April 1 and continued through August 31. Water temperatures taken at and during the juvenile sample season (April 11 – July 7) ranged from 46 degrees Fahrenheit in early April to 59 degrees Fahrenheit July 7.

ADULT FISH FACILITY

Facility Description

The adult fish passage facilities at Ice Harbor are comprised of separate north and south shore systems. The north shore facilities include a fish ladder with a counting station, an adult fish collection channel, and a three-pump auxiliary water supply system. The collection system includes two downstream entrances near the navigation lock wall at the base of the dam, and one side entrance into the spillway basin. The downstream entrance nearest the navigation lock wall is normally open for fish passage, and the other two entrances are closed. Three electric pumps supply the auxiliary water for fish attraction flow. Two of the three pumps operate continuously during normal operation. The third pump serves as a backup in the case of a pump failure.

The south shore facilities are comprised of a fish ladder with a counting station, two south shore entrances, a powerhouse collection system, and a pumped auxiliary water supply system. The powerhouse collection system includes two downstream entrances and one side entrance into the spillway basin at the north end of the powerhouse, twelve floating orifices, and a common fish transportation channel. The fishway entrances used during normal operation include: one south shore entrance nearest the powerhouse, one downstream north powerhouse entrance, and four operating floating orifices. Eight electric pumps are available to supply the auxiliary water for fish

attraction. In addition, excess water from the juvenile fish bypass system (approximately 200-270 CFS depending on forebay head) is added to the south shore fish pump discharge chamber from April 1 through December 15.

Operations and Maintenance

The juvenile collection channel was dewatered for annual maintenance. Repairs to caulking, juvenile collection channel netting, damaged Plexiglas orifice covers, and screen cleaner brush replacement were accomplished during the winter outage. Prior to start up 2011, the drive pulley and size of the drive wire were changed. We are experiencing fewer problems with the cable travel system that moves the screen cleaner up and downstream. The primary dewatering screen was inspected along with the supporting structure underneath. A zebra mussel inspection was performed, none were found. The concrete in the juvenile collection channel concrete is continuing to deteriorate in places. No other problems were found during the juvenile collection channel inspection. The south shore fish ladder was unwatered to tailwater elevation January 18, 2011 and returned to service March 2, 2011. A small section of concrete (approximately 2 feet x 1 foot x 3 inches deep) is missing from the bottom one of the weir sections of the south fish ladder. On February 14, 2011 the lower south shore fish ladder and powerhouse collection channel were inspected by underwater video camera (ROV). The diffuser grating found in the SW end of junction pool 1 was lifted approximately 6" above the adjoining grating. The water was very turbid (clarity at 3.3 feet), making visibility difficult. An Army dive team was called in to make the repairs. The south adult fish ladder was returned to service after the start of the adult fish passage season due to the repairs. No other problems were found during the south shore fish ladder inspection. The north shore adult fish ladder was dewatered to tailwater elevation for annual inspection and maintenance January 3 - 14, 2011. The upper north fish ladder was inspected January 3. The lower north fish ladder was inspected by underwater video (ROV) January 4. On January 5, rebar was removed from the north shore adult fish ladder and on January 6 the Power Diffuser Weir (PDW) was inspected. No other problems were found. Maintenance work performed on both ladders and juvenile collection channel included: debris removal, picketed lead and staff gage cleaning, adult fish counting/viewing window cleaning (NFL was done January 5, 2011, SFL was done January 20, 2011), and maintenance of auxiliary water supply pumps.

Areas that were dewatered in 2011 season that required fish removal are listed below.

January 3	Upper North Fish Ladder
January 18	Upper South Fish Ladder
February 2	South Fish Ladder Diffuser 12 Grating
February 12	Navigation Lock Lateral Repairs
December 21	Juvenile Fish Collection Channel

The total estimated number of fish handled during unwatering events in the 2011 season was 106. The species composition of the fish handled was 81 adult steelhead, 10 smallmouth bass, 9

adult Chinook salmon, 2 catfish, 2 sucker, and 2 carp. There were also several hundred juvenile shad handled.

Modifications

Adult Fish Trap Operation

The adult fish trap was not operated in 2011.

Auxiliary Water Supply System

All three fish pumps on the north shore and eight on the south shore were available for operation in 2011 with the exceptions listed below. 5 of the 8 south fish pumps were operated maintaining criteria in the south adult fishway. The north shore two pump operation makes the third north fish pump a backup. This allows normal two pump operation in the event one pump needs to be placed out of service. Each north shore fish pump operates at 350 CFS and each south shore fish pump operates at 300 CFS. In addition, approximately 270 CFS is added to the south adult fish pump chamber from excess water in the juvenile collection channel.

South fish pump 1 is out of service due to vibration.	September 10, 2010 – August 23, 2011
South fish pump 3 is out of service due to gearbox problems.	March 16, 2011 – May 17, 2011
South fish pumps 2,4,5,6, and 7 out of service due to tailwater at 353'@1615 05-16 to 1115 05-17	May 16, 2011 - May 17, 2011
South fish pump 8 out of service due to tailwater at 353'@1615 05-16 to 1335 05-17	May 16, 2011 - May 17, 2011
South fish pump 7 out of service to fix oil leak @1340 05-17 to 0810 05-25	May 17, 2011 – May 25, 2011
South fish pumps 2,3,4,5,6, and 8 out of service due to tailwater at 353'@2315 05-24 to 0300 05-25, SFP 3 on at 0700	May 24, 2011 – May 25, 2011
South fish pump 5 out of service to fix oil leak @0827 05-25 to 1430 05-25	May 25, 2011 – May 25, 2011
South fish pump 6 out of service to fix oil leak @1450 05-25 to 1340 05-26	May 25, 2011 – May 26, 2011
South fish pump 6 out of service to fix oil leak @0730 05-31 to 1350 06-01	May 31, 2011 – June 01, 2011
South fish pump 4 out of service to fix oil leak @1510 06-01 to 1300 06-02	June 01, 2011 – June 02, 2011
North fish pump 1 forced OOS 1345 06-02 due to line #2 tripped by bird unannunciated and RTS 1045 06-03	June 02, 2011 – June 03, 2011

South fish pump 2 out of service to fix oil leak @0825 06-07 to 1459 06-07	June 07, 2011 – June 07, 2011
South fish pump 8 out of service to fix oil leak @0800 06-08 to 1430 06-08	June 08, 2011 – June 08, 2011
South fish pumps 2,3,4,5,6, and 7 out of service due to tailwater at 354.6'@ 2325 06-08 to 0845 06-09	June 08, 2011 – June 09, 2011
South fish pumps 2,3,4,5,7, and 8 out of service to try to raise CFEW #2 for maintenance @ 1211 06-13 to 1501 06-13	June 13, 2011 – June 13, 2011
North fish pumps 1 and 2 turned off @ 1220 07-07 to 1340 07-07 and diffuser #1 closed @ 1230 07-07 to 1335 07-07 for camera inspection of NFEW #1	July 7, 2011 – July 7, 2011
South fish pump 3 on stand-by due to motor vibrating excessively @ 0604 07-13. It was placed out of service @ 0949 07-20 to 1408 07-20 to uncouple the motor for repairs.	July 20, 2011 – July 20, 2011
North fish pump 1 tripped off at 0605 and was restarted at 0626 on 07-23.	July 23, 2011 – July 23, 2011
North fish pumps 1 and 2 turned off @ 1215 to 1425 08-05 to install NFEW #2 bulkhead	August 5, 2011 – August 5, 2011
North fish pump 1 tripped off at 0350 and NFP 3 was started at 0405 on 08-12.	August 12, 2011 – August 12, 2011
North fish pump 1 turned off at 0716 to 0832 on 08-16 to change its oil filter.	August 16, 2011 – August 16, 2011
South fish pump 1 returned to service and turned on for testing at 0815 on 08-22	August 22, 2011 – August 22, 2011
South fish pump 3 out of service for repairs to the gearbox at 1120 on 08-22	August 22, 2011 –
South fish pump 4 was shut down from 1338 to 1404 08-25 due to the gearbox reaching high temperatures.	August 25, 2011 – August 25, 2011
South fish pump 6 was shut down from 1405 to 1408 08-25 due to the gearbox reaching high temperatures.	August 25, 2011 – August 25, 2011
The north shore fish pumps were turned off September 6, 7, and 8 from approximately 1100 hours to1600 hours to reduce flow at the north shore fish entrances to facilitate repairs.	September 6, 7, and 8, 2011 – September 6, 7, and 8, 2011.
The north shore fish pumps were turned off September 12 from 1220 to 1325 to reduce flow at the north shore fish entrances to facilitate repairs.	September 12, 2011 – September 12, 2011

North shore fish pump 1 tripped under voltage and was restarted at 1735.	October 30, 2011 – October 30, 2011
North shore fish pump 1 was turned off at 1307 and NFP #3 turned on. At 1415 NFP #2 tripped and was restarted at 1425.	October 31, 2011 – October 31, 2011
North shore fish pump 3 was turned off at 0951 and NFP #1 turned on at 0952.	November 1, 2011 – November 1, 2011

Adult Fishway Inspections

Visual inspections

The Corps project fishery personnel conducted visual inspections of the adult fishways during the fish passage season March through December. In addition, the powerhouse operators conducted daily inspections of the fishways. Fishery personnel averaged 5 inspections each week with 139 inspections completed from March 1 through December 30. The inspections were conducted by visually inspecting various areas of the fishways and recording readings on a data form from staff gages, fishway entrance hoists motor selysns, and if needed tape measures. The data was subsequently transferred to a computer spreadsheet (Appendix 2). In addition, an estimate of the amount of debris that accumulated near the fish ladder exits and in the gate wells was made during each visual inspection. When the fishway was out of criteria, the powerhouse operator was informed to make adjustments to the fishway control system or arrange for repairs if needed.

Automated Fishway Control System

In the 2011 Fish Season, Ice Harbor sensed water levels with a sonar based level sensing system manufactured by Milltronics using the Multi Ranger model. This signal was sent to a Programmable Logic Control Center (PLC) that processed the signals from the Multi Ranger then displayed the reading on a screen in the Control room and if needed sent a signal to raise or lower one of the three weirs in services. The automated fishway control system consists of a PLC which interfaces with process level controllers. The remote terminal units control the fishway weir gates according to set points that either controls the gate at a depth below tailwater or a channel to tailwater head differential. A printout from the printer in the control room contains the following information: date; time (hour, minutes, and seconds); channel temperature; channel and tailwater elevation in feet above mean sea level (MSL) for the north shore, north powerhouse and south shore; elevation in feet above MSL for the fishway entrances; water depth at the fishway entrances; channel/tailwater differential; and set points for the fishway entrances and the channel/tailwater differential.

The readings from the automated fishway control system printout were recorded and compared to the visual inspection results to ensure that the fishways were operated within criteria. The automated control system was calibrated bi-monthly to ensure its accuracy. The time difference between reading the staff gage and collecting the computer printout in the control room may have been as much as 120 minutes. The time difference between the automated and visual readings may give different inspection results due to operational changes, such as spill, switching units, and other water elevation fluctuations.

Inspection Results

Overall fishway performance (percent in criteria) was improved in 2011 when compared to that of 2010. Water elevations readings at the staff gages during spill can vary as much as 1 foot on either side of the average elevation. This condition significantly contributes to incorrect visual readings falsely indicating an out of criteria event. Another contributor to out of criteria events is the location of the staff gages in relationship to the water level sensing equipment. Some staff gages are located several feet from the target area to be regulated. This condition makes accurate calibration impossible due to the relationship between the sensing equipment and the staff gage not being linear. The Project is pushing ahead with correcting this problem by the current upgrade to sonar water level detecting devices and moving the staff gages to the proper positions. This effort is ongoing.

South Shore Entrance (SFE): The 2011 SFE weir gate percent in criteria ($\geq$ 8 feet or on sill) was 94.2%, an increase of 12.8 % from that of 2010 at 81.4%. The 2011 SFE percent in criteria due to on sill events was 20.5%, a decrease of 17.1% from that of 2010 at 37.6%. Most of the out of criteria occurrences can be attributed to unit operation changes, spill, and difficulty in reading staff gages due to fluctuations in water elevation, lower tailwater conditions, and discharges from the navigation lock.

North Powerhouse Entrance (NFE): The 2011 NFE weir gate percent in criteria ($\geq$ 8 feet or on sill) was 93.0%, an increase of 14.9% from that of 2010 at 78.1%. The 2011 NFE weir gate percent in criteria due to on sill events was 21.8%, a decrease of 14.9% from that of 2010 at 37.1%. When the SFE and the NFE fish entrances cannot be maintained at 8 feet depth or on sill simultaneously, criteria is sacrificed at the NFE to maintain criteria at the SFE the most used entrance.

North Shore Entrance (NSE): The 2011 NSE weir gate percent in criteria ($\geq$ 8 feet or on sill) was 92.3%, an increase of 6.3% from that of 2010 at 86.0%. The 2011 NSE weir gate percent in criteria due to on sill events was 22.4%, a decrease of 28.2% from that of 2010 at 50.6%. The majority of the out of criteria conditions at this entrance are due to the inability to lower the entrance weir to 8 feet depth while maintaining the channel/tailwater differential.

Fish Collection Channel/Tailwater Head Differential: The channel/tailwater head differential was in criteria on most inspections in 2011 (criteria = 1 - 2 feet). The percent in criteria at the SFE, NFE, and NSE was 92.3%, 96.8%, and 82.1% respectively.

ICE HARBOR Criteria and Locations	No. in Criteria/ No. on Sill/ No. of Inspections	% In Criteria/ % On Sill	No./% Within 0.01-0.1 Foot	Not Enough Depth No./% Within 0.11-0.2 Foot	No./% >0.2 Foot	No./% Within 0.01-0.1 Foot	Too Much Depth No./% Within 0.11-0.2 Foot	No./% >0.2 Foot
Channel Velocities	85	54.5	***	***	***	***	***	***
	***	***	***	***	***	***	***	***
	156							
Differentials								
South Fish Ladder								
Ladder Exit	154	98.7	***	***	***	0	0	2
	***	***	***	***	***	0.0	0.0	1.3
	156							
Ladder Weirs	154	98.7	0	0	2	0	0	0
	***	***	0.0	0.0	1.3	0.0	0.0	0.0
	156							
Counting Station	156	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	156							
North Fish Ladder								
Ladder Exit	156	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	156							
Ladder Weirs	153	98.1	1	0	0	2	0	0
	***	***	0.6	0.0	0.0	1.3	0.0	0.0
	156							
Counting Station	156	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	156							
Collection Channels								
South Shore	144	92.3	0	0	2	1	4	1
	***	***	0.0	0.0	1.3	0.6	2.6	0.6
	156							
North Powerhouse	151	96.8	0	0	3	0	0	1
	***	***	0.0	0.0	1.9	0.0	0.0	0.6
	156							
North Shore	128	82.1	2	4	17	0	2	1
	***	***	1.3	2.6	10.9	0.0	1.3	0.6
	156							
Weir Depths								
SFE 1	115	73.7	0	4	5	***	***	***
	32	20.5	0.0	2.6	3.2	***	***	***
	156							
NFE 2	111	71.2	0	2	9	***	***	***
	34	21.8	0.0	1.3	5.8	***	***	***
	156							
NSE 1	109	69.9	0	0	12	***	***	***
	35	22.4	0.0	0.0	7.7	***	***	***
	156							

*** Data from Appendix 2**

Recommendations

1. Continue to repair south ladder mud valves in the entrance channel and auxiliary water supply conduit to facilitate dewatering.
2. Modify the top of the downstream navigation lock gate so it will not strand fish.
3. Rehabilitate fish entrance weirs and hoisting equipment.
4. Relocate staff gages and radar units so the staff gage fishway control system reading and the automated fishway control system readings will be closer to the same depth.
5. Initiate a contract to repair leaks and missing concrete areas in the fish ladders.
6. Install a handrail along the outside edge of north and south fish ladders.
7. Replace the north and south fishway exit wooden log booms.
8. Replace adult fishways and adult collection channel grating.

JUVENILE FISH PASSAGE FACILITY

Facility Description

The juvenile fish passage facility at Ice Harbor Dam consists of standard length submersible traveling screens (STS's), vertical barrier screens (VBS's), 12 inch orifices (36 orifices), a collection channel and dewatering structure, fish sampling facilities, evaluation separator facilities, and a transportation flume/pipe to the tailrace downstream from the Project.

The fish collection channel has about 300 cfs flow and was operated with 20 orifices open. All but 30 cfs flow is removed at the primary dewatering structure. The remaining 30 cfs flow and fish are routed through a transport pipe and flume to the fish sampling facility or to the tailwater.

Facility Modifications

Additional avian deterrent wires were installed on handrails and downstream of the spillway. Plans to modify the existing anesthetic recirculation system to discharge the MS222 solution onto the ground were completed and the system will be functional for the 2012 sample season.

Operations and Maintenance

Bypass Operations

Bypass operations began March 23, 2011 and continued through December 21, 2011.

Turbine Operations

Efforts were made to operate all turbine units within one percent of the best efficiency from March 15 to November 30. Deviations occurred but were infrequent and brief.

Debris/Trash Racks

Main units 1, 2, 3, 5, and 6 trash racks were raked March 28 - 29. Approximately 25 cubic yards of debris were removed. Turbine units 1 and 2 trash racks held the most debris. Turbine unit 4 trash rack raking occurred April 11, no debris was found. No additional trash rack raking was required during the season.

Submersible Traveling Screens

The STS' installation began with turbine unit 1 on March 29. The STS picking beam became stuck in gatewell slot 1B during STS installation. It was removed March 31 which allowed STS installation to proceed. The remaining in service STS' were installed April 1. Unit 4 STS installation was delayed until April 28 due to the unit was out of service and not operating. STS' were inspected monthly beginning April 19 with the exception of May 24. That inspection was delayed due to Little Goose Dam going to 100 percent spill because of transformer problems. Ice Harbor was requested not to take a unit OOS for STS inspections thereby increasing dissolved gas levels in the river. The inspection was rescheduled to May 31 but was unable to be performed due to the high turbidity of the water. On the September 20, 2011inspection, the STS in gatewell 3A had a rip on its south edge. It was repaired and returned to service September 22. STS' inspections ended November 16. Turbine units STS were raised December 13, 19, and 20.

Vertical Barrier Screens

Project personnel inspected the vertical barrier screens (VBS's) while conducting STS inspections. Each VBS was inspected independently once each month during STS inspections. No problems were found with the VBS screens this season.

Gatewells

Gatewell debris was moderate at Ice Harbor Dam in 2011 and never approached the 50% coverage criteria point for mandatory cleaning. Slots were dipped for debris removal prior to installing the STS screens. In addition, on June 29, 2 yards of debris were removed from gatewell slots 1A and 1C. The total volume of debris removed for the season was less than 5 cubic yards. On September 15 at 1600 hours, oil was observed in gatewell 5-C slot. The juvenile fish orifice was closed until the gatewell could be cleared. The orifice was re-opened September 16 at 0826 hours after the oil was removed.

Orifices/Collection Channel

During the 2011 season, the collection channel was operated with 20 open orifices. Orifices were routinely cycled and back flushed by powerhouse operators and fish facility personnel. During periods of higher fish and debris loads (April 1 through July 31), the orifices were back flushed and cycled once per shift. Orifice lights were checked daily and replaced when required. On April 12,

orifice 6AN was found plugged with debris and upon unplugging one dead juvenile salmonid of unknown origin was found.

Primary Dewatering Structure

The primary dewatering screen cleaner brush performed well this season. Prior to bypass start up 2011, the drive pulley and size of the drive wire were changed. We are experiencing fewer problems with the cable travel system that moves the screen cleaner up and downstream.

Sampling System

The sampling system functioned well this season. No problems were associated with sampling. An anesthetic recirculation system was designed and installed during the 2009 winter maintenance period. On April 11, the first day of sampling, approximately one hundred silver lampreys were observed going into the separator while collecting target fish. When sampling was completed, only 4 lamprey were sampled. It is thought that the missing lamprey escaped the sample tank by going into the North sample tank compartment and flushed down the drain into the river.

Avian Predation

Avian predation on juvenile salmon and steelhead were observed at Ice Harbor Dam in 2011. Fish eating birds observed included: Cormorant, Gull, Blue Heron, White Pelican, Bald Eagle, Tern, Grebe, Kingfisher, Mergansers and Osprey.

Several actions have been taken to reduce predation. The Corps has contracted for the services of an animal control specialist from the United States Department of Agriculture's Animal and Plant Health Inspection Service (APHIS). This program was expanded this season to include another APHIS agent making a 24 hour 7 day a week bird hazing program. The animal control specialist hazed birds by using pyrotechnics from April to June. Hazing took place in three locations: tailrace near bird wires, tailrace downstream of bird wires to the power line crossing, and forebay near the entrance to the juvenile bypass. Hazing from a boat was also introduced and found to be very effective.

APHIS installed 3 additional avian (bird) wires in the west end over the tailrace area below the powerhouse within the boat restriction zone (BRZ) prior to the juvenile fish season. These wires have been very effective by keeping the birds further downstream decreasing predation in the wired area. Needle strips (Nixalite) and other deterrent devices are installed around the Project to prevent birds from perching. Fish Facility personnel installed single strand bird wires above the navigation lock wing wall hand rails both upstream and downstream to prevent cormorant and gull loafing in these areas. A water cannon is affixed to the juvenile fish outfall pipe to discourage birds from holding in the bypass discharge area.

Recommendations

1. Install a water line in the primary dewaterer to provide flush water to the transportation flume.

2. Modify the juvenile collection channel to allow fish that are handled during dewatering to be put into the bypass pipe and returned to the river.

3. Pave the road and provide curbing that would direct any water runoff away from the juvenile facility and the hillside.

4. Install a hopper in the main bypass pipe below the sampling stations. This would permit
unwatering event rescued fish to be returned to the tailrace via the bypass pipe.

5. Install a crowding mechanism in the juvenile collection channel that would encourage adult fish to exit.

6. Replace the outfall pipe water cannon black iron pipe with stainless steel to prevent corrosion. In addition, replace the pump and water gun.

7. Install handrail along the north and south adult fishway ladders.

8. Install a debris bubbler system under the entire incline screen located in the juvenile fish collection channel.

9. Install a disposal system for the MS-222 used in the recirculation sample tank.

10. Reposition/replace the orifice fish attraction lights in the juvenile fish collection channel.