

**ADULT FISHWAY INSPECTIONS  
ON THE COLUMBIA AND SNAKE RIVERS**

**1999 ANNUAL REPORT**

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**COLUMBIA BASIN FISH AND WILDLIFE AUTHORITY**

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# **FISHWAY INSPECTIONS AT COLUMBIA AND SNAKE RIVER DAMS, 1999**

## **INTRODUCTION**

Fish agency personnel inspected fish passage facilities at 13 hydroelectric dams located on the Snake and Columbia rivers. These projects were inspected monthly to assure that fish facilities were being operated according to established criteria documented in the Corps of Engineer (COE) Fish Passage Plan (FPP), or in the Detailed Fishery Operating Plan (DFOP) for the Public Utility District (PUD) projects in the MidColumbia. The Fish Passage Center (FPC) coordinated the fishway inspection program for the State and Federal fish agencies. The FPC continued to coordinate special fish facility operations with fish and wildlife agencies and tribes. This report summarizes results obtained from the individual project inspections during the 1999 fish passage season.

The inspection program normally spans from April through October at most projects with the lower dams completing inspections in March and November. These months are timed to coincide when most adult and juvenile fish are passing the mainstem dams. The fish facilities are inspected 7 or 8 times during the season by the State or Federal inspector. The FPC coordinator makes site visits with the inspectors on several occasions during the year, generally early and late in the fish passage season. The monthly project inspections were coordinated with the salmon managers as well as the operating agencies, i.e., the COE and PUD through monthly updates or forums such as the Fish Passage Operations and Maintenance Committee (FPOM). The main goal of a fishway inspection is to assess passage conditions at the time of the inspection and assure that facilities are operating according to established criteria. Out-of-criteria conditions are coordinated with the projects for resolution, as soon as possible. The agency representative is responsible for coordinating these immediate problems to project personnel. The monthly update and this final Report by the FPC operations coordinator will serve to alert the operating agency of problems that were noted during the inspections, and that in some cases require resolution.

Prior to the 1999 fish passage season, fish agency and tribal personnel met with the PUD staff to discuss inspections from the previous season (1998) and to review modifications that were made at adult or juvenile fish facilities at the five MidColumbia dams. From these sessions we were

better able to understand what fish passage conditions one might expect for the upcoming season. These annual forums provide excellent opportunity to discuss and assess fish conditions at the PUD projects.

## **BACKGROUND**

Adult fish passage facilities were incorporated into thirteen mainstem Columbia and Snake River dams as early as 1933 and to the new powerhouse at Bonneville Dam in 1981. Fish passage was blocked in the Columbia

River at Grand Coulee Dam in 1938 and in the Snake River at Brownlee Dam in 1958. Fish passage criteria have been developed through the years to achieve known hydraulic conditions within a fishway that should reduce potential migration delays and mortality of upstream migrating adult fish at mainstem dams.

The COE and PUD were to operate their fish facilities within the standards set forth in the agreed upon Fish Passage Plan at COE projects or according to the standards set forth to meet the NMFS Biological Opinion at the PUD projects. The updated criteria spell out what the project should do when a major equipment failure or other problem occurs that would prevent operation of the fish facilities within best ranges. The operating agencies are responsible for maintenance of the fish facilities and for operating them at the agreed upon criteria year round, with special or annual maintenance accomplished during the winter maintenance period. Planned fishway outages occur mainly when adult fish passage is minimal, such as the winter season. Outages during the fish passage season require special coordination between the operating entities and the fishery agencies and tribes.

Through the fish passage season, project personnel daily inspect adult fish facilities. Most adult fishways operate in an automatic mode and require no manual adjustments unless the equipment malfunctions. The project operators normally will put a fishway back in criteria as a discrepancy is found.

Key items recorded during an inspection include:

- *Weir gate depths at the main fishway entrances,*
- *hydraulic head differentials at the entrances and along the channels,*
- *depth of water over the fish ladder weirs,*
- *collection or transportation channel velocities,*
- *head differentials across trashracks and picketed leads,*

- *powerhouse operations including number of fish turbines operating and at what Mw or Q,*
- *number of spill bays operating and quantity of spill, and other measurements, and*
- *a comment section to list special conditions or out-of-criteria areas.*
- *Inspections of juvenile fish facilities are normally completed while on site as well.*

The fishway inspectors usually schedule their monthly inspections with the project prior to the inspection date, however, the inspections can be made unannounced. The inspectors check into a project to announce that they will be completing an inspection. The inspectors are responsible for contacting project operations personnel to review the inspection and coordinate problems that require correction. A completed copy of the inspection report can be left at the project or later sent to the COE project operations biologist or PUD personnel. The FPC fishway coordinator receives a copy of the inspection, reviews it, and then follows up on problem areas that were noted with the COE project or district fish biologists.

The Fish Passage Center has been coordinating fishway inspections at the mainstem Columbia and Snake River projects since 1984. The 1999 season was a continuation of the long-term inspection program that the State and Federal fish agencies have endorsed since the 1960's. Funding for the inspection program comes from Idaho Department of Fish and Game (IDFG), Oregon Department of Fish and Wildlife (ODFW) Washington Department of Fish and Wildlife (WDFW), National Marine Fisheries Service (NMFS), and the United States Fish and Wildlife Service (USFWS).

## **GENERAL RESULTS**

Inspections of fish facilities were completed on a monthly basis in 1999 at Columbia and Snake River dams having adult fishways. Most projects operated their fish facilities close to accepted criteria during the adult fish migration season. Monthly inspection reports were summarized and distributed to the Salmon Managers and COE and PUD operations biologists or operations personnel. Other pertinent adult passage information was disseminated weekly or biweekly in FPC reports.

Key factors that affected fishway operations at the mainstem dams during the 1999 fish passage season are listed below:

- Medium to high flows and spills were prevalent during the spring and summer months in the Snake and Columbia rivers in 1999.

- Debris loads brought down the river due to the spring/early summer freshet caused some problems related to operating fish facilities, but did not appear to be as great a factor as originally expected based on the amount of snowpack in the mountains.
- The Snake River projects were operated at Minimum Operating Pool (MOP) plus 1-ft during the spring and summer months to improve juvenile fish passage conditions. The additional 1-ft was required to assist passage of navigation barges up and downstream through the lock channel. During part of the passage season, some fishway entrances at the Snake River dams were operated at reduced weir depths due to the gates resting on sills (no additional depth can be achieved).
- Mechanical failures on essential fishway equipment such as fish pumps, fish turbines, or other auxiliary water equipment were minimal during the 1999 fish passage season; however, some adult fish facilities are aging to the point where reliability of the systems might be compromised if modifications are not completed in upcoming years.
- Priest Rapids and Wanapum dams have completed switchover to fixed open main entrance gates and they appeared to operate satisfactorily through the year.

### **SUMMARY BY PROJECT**

State and Federal Fish agency personnel who completed fish facilities inspections throughout the fish passage season were as follows for the 1999 season.

<b>AGENCY</b>	<b>INSPECTOR</b>	<b>DAMS INSPECTED</b>
NMFS	Bryan Nordlund	Priest Rapids & Wanapum
NMFS	Ed Meyer	Bonneville
NMFS	Larry Swenson	McNary
ODFW	Doug Case	The Dalles & John Day
ODFW	Shawn Rapp	Little Goose & Lower Granite
WDFW	Steve Richards	Ice Harbor & Lower Monumental
WDFW	Stewart Mitchell	Wells
WDFW	Denise McCarver	Rock Island & Rocky Reach
WDFW	Glen Liner	Rock Island & Rocky Reach

Results from their inspections are summarized by project below. Dates of inspections and problem areas are noted as well as special activities that occurred during the year. Criteria used to evaluate a fishway's operation are found in the FPP and DFOP for each project.

## **BONNEVILLE DAM**

Bonneville Dam has two powerhouses: the old powerhouse (ph1) built in the late 1930s and located on the Oregon shore or south shore of the Columbia River, and the new powerhouse (ph2) completed in the early 1980s and located on the Washington shore or north shore of the Columbia River. The old powerhouse contains ten main turbine units while the new powerhouse has eight main turbine units and two smaller fish turbines that supplies auxiliary water to the WA shore fishway. Between the two powerhouses is the spillway (part of the old construction) that incorporates 18 spillbays to pass excess or designated flow past the project. The adult fishways consist of gravity-flow water provided to the auxiliary water system that supplies attraction flow water to the main fishway entrances at ph1 and the spillway entrances. At ph2, the two fish turbines supply about 5,000 cfs of water to the auxiliary water system that distributes flow to the four main entrances and the orifice gates along the powerhouse collection channel.

Ed Meyer, NMFS, completed six inspections, Larry Basham of the FPC completed two inspections of the adult and juvenile fish facilities at Bonneville Dam during 1999. The fish facilities were inspected from April (two inspections) through October (Table 1). Generally the routine followed by the inspector included:

1. The inspector met with the project biologist(s) prior to inspecting the fishway to determine existing problem areas with the fish facilities or related equipment, and what corrective actions were being taken by the project to remedy the problems, and in some cases, the project biologist accompanied the NMFS or FPC inspector;
2. Completing the on-site inspection; this included taking computer readings at the powerhouse control room and from the B-Branch and Cascades Island fishway computers, and comparing those readings to the on-site readings taken from staff gages or other sensors. The new powerhouse has a control panel with readings from the entrance gates, etc. that are compared to the direct site readings.
3. Normally, after the inspection, out-of-criteria problems noted by the inspector were discussed with the project biologist(s) for possible resolution; and
4. A copy of the report was sent to the project biologist and FPC after it was completed.

### **Powerhouse 1 Fishway**

The auxiliary water supply to the fishway is gravity flow water supplied from the forebay. Normally the auxiliary water source is ample to meet criteria through high and low flow tailwater elevations. The old powerhouse main entrances are operated in pairs, i.e., Gate 2 and Gate 64, or Gate 1 and Gate 65 depending on tailwater elevation. Five orifice gates or 5 sluice gates operate along the powerhouse collection channel depending on tailwater elevation.

Weir Gate 2 located at the south end of the powerhouse had head differentials that ranged between 0.8 ft and 1.5 ft. The gate depths ranged from a low of 5.9 ft to a high reading of 15.3 ft for the season, with the readings less than 8 ft on 2 of the 9 inspections. According to the FPP, the gates at the south end of the powerhouse are set to maintain head differential along the channel and in doing so, keep the velocity at a satisfactory rate in the channel. The criterion on gate depth was changed to include a minimum depth of 6ft at the entrance in addition to the minimum head differential reading of 1.0 ft. On the inspection when the head differential was only 0.8 ft, the depth was 15 ft so sufficient water was flowing out the entrance; however, the head will relate more to velocity through the gate. Basically, the computer-controlled equipment should have corrected for the low tailwater elevation and brought the head differential back into line. From a view that 8 ft weir depth is superior to 6 ft depth, the project could have operated Gate 2 at 8 ft or greater during the 1999 inspections.

Weir Gates 64 and 65 are located on the north end of the powerhouse. Normally one gate operates to meet the gate depth criteria depending on the tailwater elevation. Gate 64 operated on 7 of the 9 inspections with Gate 65 operating during the high flow period when tailwater elevations exceeded 26-ft (May and June). The gate depths at the A-Branch entrances ranged from 8.2 ft to 11.7 ft with head differentials through the season ranging from 1.2 ft to 2.0 ft. The gate depths exceeded 8.0 ft and the head differential was between 1.0-2.0 ft on all occasions during the 1999 fishway inspection season.

Channel velocities along the powerhouse collection channel ranged from 1.5 fps to 2.8 fps through the season. Note the velocity gage at gate 62 was not working for most of the season and records from the south end of the channel were taken. Readings fell within the criteria range of 1.5 to 4.0 fps for the 1999 season.

**South Spillway or B-branch Fishway** and the **North Spillway or Cascades Island Fishway** are part of the original fishway system with detailed writeup in the Bonneville Dam section of the FPP. Gravity flow water is supplied from the forebay, through the diffusion system into the lower end of the fish ladder. Both fishways have similar main entrances (designwise) with side and downstream entrances that operate as continuously open free-flowing vertical slots. Adjacent to each entrance is a spill bay (1 or 18) that is operated at a minimum of 4 inches open and passes about 1 kcfs of water. Each main entrance requires a head differential of between 1.0 to 2.0 ft with a targeted head differential of 1.5 ft.



During 1999, the B-branch entrance operated within a range of 1.4 to 2.0 ft, while the Cascades Island entrance operated within a range of 1.4 to 1.9 ft. Head differentials for the Bbranch and Cascades Island entrances were within criteria range during the entire fish passage season. The supply valves worked satisfactorily at each branch. On occasion, a diffuser valve was reported operating out of sequence.

**Fish Ladder:** Depth of water measured over the Bradford Island fish ladder weirs ranged from 0.9 to 1.5 ft. The readings should be between 1.1 to 1.25 ft to equate to about 1.3 ft of water down the individual A and B-branch fish ladders. The fish ladder exit at Bradford Island was reported clear of debris on all inspections during the 1999 fish passage season. The exit from the fish ladder was reported with some debris and required cleaning(FV1-1). The depth of water measured over the Cascades Island fish ladder weirs ranged between 1.0 ft to 1.3 ft as well and fell within the normal range for depth of water over the fish ladder weir crests. The main problems noted during the season were 1. Strong upwelling in the ladder from FG35 and FG3-7 and 2. Diffusers in the lower end of Bradford Island ladder were open that should have been closed; this resulted in excess flow over the top of the weirs and overflow section. The flow was immediately adjusted by the project biologist during the July inspection.

### **Powerhouse 2 Fishway**

Fish turbines F1 and F2 were operated during the fish passage season and supplied about 5,000 cfs of water to the main entrances and orifice gates along the powerhouse collection channel. During the evenings (approximately midnight to 3 a.m.) the fish units were simultaneously shut down (as necessary) to float debris off the trashracks and reduce the head differential across the racks. This action was completed to keep the head differential across the trashracks in an acceptable range. Note that shutting down the fish turbines would not change the fish ladder operation only the attraction flows from the main entrance gates for the 3-h time period.

The head differentials measured at the four main entrances ranged between 1.0 ft and 1.9 ft for the April through October inspections. The gate depths ranged between 10.1 ft and 14.6 ft for the season. Most readings were 13.0 ft or greater with exception of the October inspection when tailwater elevations prevented the gate from going deeper; the gate was on sill (elevation 1.0 ft). The project can normally keep gate depths within criteria range (about 13.0 ft submerged) under all tailwater elevations above elevation 4. It appeared that one problem was with consistency with the controller, i.e., the panel readings were well off from the on site readings made by the inspector. The 4/21, 5/27, and August inspections are examples of the depths being over 1 ft different between the north end and south end of the channel.

Although the velocity meter located in the north end of the WA shore powerhouse collection channel worked only sporadically, the readings ranged between 1.1 and 2.4 fps. The velocities were on the low end of the spectrum (minimum velocity should be 1.5 fps).

**Fish Ladder:** The exit from the fish ladder as well as the serpentine section of the fish ladder was reported clear of debris during most of 1999 with exception of one inspection. The depth of water measured over the fish ladder weirs was operated close to criteria (1.0-1.5 ft) during the inspection season at the WA fish ladder.

**Overall,** fish passage at Bonneville Dam during 1999 should have been improved from the 1998 season as:

- The project increased the requirement for weir depth at the south end of ph1 with a minimum requirement of 6.0 ft weir submergence along with the normal head criteria to achieve the proper velocities through the ph1 channel. This requirement was placed into the 1999 FPP to assure that better adult passage conditions occur during low tailwater conditions at the project. No extreme low gate depths occurred in 1999 as in 1998.
- The fish turbines at the WA fishway worked throughout the whole fish passage season in 1999.
- The flows did not present any inordinate amount of debris and the fishways were fairly clear of debris for most of the year. The most debris was reported in August and that was mainly grasses and other weeds.

Areas that still require improvement are:

- The project should modify their fishway control panel at ph2 and assure that the controlling system is calibrated with the on-site readings as well as in the Control Room of the dam. The system should be run on auto as much as possible rather than manual.
- The project should place a gage in/on the south shore weirs at ph1 so that an on-site elevation reading can be taken and then compared to the computer reading to assure the gates are calibrated correctly.
- We noted on a couple of inspections that the diffusers in the lower end of the Bradford Island fish ladder were supplying far too much water. The project should attempt to upgrade as many of the old diffusers and valves as possible during the upcoming winter maintenance season.

**Table 1. Pertinent Data for Fish Facility Inspections in 1999 at BONNEVILLE DAM.**

<b>CRITERIA ITEMS</b>	<b>DATE OF INSPECTION</b>								
	<u>7-Apr</u>	<u>21-Apr</u>	<u>27-May</u>	<u>21-Jun</u>	<u>22-Jul</u>	<u>13-Aug</u>	<u>24-Sep</u>	<u>12-Oct</u>	
<b><u>Bradford Island Fishway</u></b>									
<b><u>Bradford Island Entrances</u></b>									
Criteria: (Head Differ. = 1.0-2.0 ft); (Weir Depth + 8 ft or >); (Depth over ladder weirs = 1-1.3 ft); (Velocity + 1.5-4.0 ft)									
Head at A-Branch entrance	ft	1.8	1.6	1.9	2.0	1.4	1.6	1.2	1.4
Depth over Gate 64/65	ft	8.4	11.7	10.0	8.7	8.4	8.3	8.5	8.2
Head at South ph entrance	ft	1.1	1.3	0.8	1.2	1.5	1.5	1.2	1.0
Depth over Gate 1/2	ft	9.0	12.0	15.3	8.8	13.2	10.0	5.9	6.2
Channel Velocity	fps	2.6	2.6	1.8-2.8	2.4	2.8	2.6	2.1	2.5
Depth over ladder weir (1.0-1.3ft)	ft	1.0	1.0	1.4	1.5	1.2	1.4	1.2	0.9
Exit clean (Yes or No)		yes	no	yes	yes	yes	yes	yes	yes
<b><u>B-Branch Entrance</u></b>									
Head at B Branch entrance	ft	2.0	1.6	1.4	1.5	1.5	1.4	1.5	1.4
Staff gages clean		yes	yes	yes	yes	yes	yes	yes	yes
<b><u>Cascades Island Entrance</u></b>									
Head at main entrance	ft	1.8	1.6	1.6	1.9	1.9	1.9	1.4	1.6
Depth over ladder weir	ft	1.0	1.0	1.3	1.3	1.3	1.2	1.3	1.2
<b><u>Washington Shore Fishway</u></b>									
<b><u>WA Shore Entrance:</u></b>									
Depth over entrance weir (Criteria = 13.0 ft or >)									
NUE	ft	13.7	13.0	12.6	14.0	14.4	14.6	13.7	10.7
NDE	ft	13.7	13.2	12.6	14.0	14.3	14.6	13.7	10.6
SUE	ft	13.8	14.0	14.0	13.8	13.6	13.3	14.3	10.3
SDE	ft	14.1	13.9	13.5	14.0	13.6	13.5	13.5	10.1
Head at entrance (Criteria = 1.0-2.0 ft)									
NUE	ft	1.3	1.3	1.9	1.5	1.7	1.5	1.4	1.6
NDE	ft	1.1	1.6	1.8	1.5	1.7	1.4	1.5	1.3
SUE	ft	1.5	1.5	1.4	1.3	1.4	1.3	1.0	1.0
SDE	ft	1.1	1.4	1.3	1.1	1.7	1.2	1.0	1.0
Depth over ladder weir	ft	1.0	1.1	1.1	1.0	1.2	1.1	1.5	1.0
Channel Velocity (Elect. Meter)		1.8	1.6	2.4	1.7	1.6	1.1	1.4	00S
Ladder exit clean		yes	yes	yes	yes	yes	no	yes	yes
Staff gages clean		yes	yes	yes	no	yes	yes	yes	no
<b>Comment # (if applicable)</b>			1	2		3	4	5	

**Comments:**

1. New juvenile bypass system on-line for season; lot of screen cleaner problems; adult fishways satisfactory.
2. The inspector noted a strong upwell and water surface differential from diffusers FG-3 and FG3-7 making poor hydraulics in the lower end of the fish ladder.
3. The lower end of the Bradford I. Fish ladder was way too high; adustment were made to the diffusers controlling flow.
4. The inspector noted debris in the ladder exits, gatewells, and orifices on this inspection that required cleaning.
5. Through the inspection season, generally 2 of the 3 velocity meters were working correctly.

## THE DALLES DAM

The Dalles Dam was completed in 1957 with 22 main turbine units and two smaller turbines and is operated by the COE. The two smaller turbines, Units F1 and F-2 were part of the original construction and supply water to the Oregon fishway. The spillway is located between the powerhouse and North shore fishway and incorporates 20 spillbays to pass excess or designated flow past the project. The spill basin is shallow and no flipflaps were required to dissipate the flow.

Approximately 5,000 cfs of water is distributed from these small turbines to the East, West, and South fishway entrances as well as to the orifice gates along the powerhouse collection channel. In the early 1990s, Wasco County PUD installed a small turbine on the old auxiliary water supply on the WA shore fishway. This turbine normally supplies about 800cfs through the diffusers to the operating entrance, usually Gate N-1.

Doug Case, Oregon Department of Fish & Wildlife (ODFW) inspector for the 1999 fish passage season, completed eight fishway inspections beginning on March 31 and ending on October 21. Results of the inspections are discussed below and listed in Table 2.

### East Fishway Inspections

The East fishway entrance gates (E-2 and E-3) were submerged 8.0 feet or greater on 7 of the 8 inspections (range was 7.7 ft to 10.7 ft). The head differentials ranged from 1.3 ft to 1.9 ft. East entrance gate E-1 operated for part of the season due to high tailwater elevations that occurred in late May and early June. Prior to this year, the weir was not routinely operated and the weir gate set at elevation 81; however, the project began keeping Gate E-1 lowered at a minimal level to reduce the excessive head differential that occurred at that entrance. During the last three inspections, the gate depth at E-1 ranged between 1.9 ft to 4.6 ft. Normally, the East fishway entrances were found operating in satisfactory criteria range during the inspections completed in 1999.

The channel velocity was taken via a continuous recording unit at the eastern end of the powerhouse collection channel and then estimated by the inspector at the mid-point and western end of the channel. Water velocity in the collection channel ranged between 0.61.0 fps at the eastern end and increased to approximately 2.03.0 fps at the western end. The orifice gates located along the collection channel worked satisfactorily during the 1999 fish passage season. We did not see any orifice gates over-topped with water in 1999 as was common during the high tailwater elevations that were present in 1997.

The West fishway entrances (W-1 and W-2) were submerged 8.0 feet or greater on all inspections during 1999. The gate depths ranged from 8.0 ft to 12.0 ft. Head differential readings ranged between 0.9 ft (1 occasion) and 1.6 ft. Through the season, the average depth was 9.4 ft for each gate, well above the minimum depth of 8.0 ft.

**Table 2. Pertinent Data for Fish Facility Inspections in 1999 at THE DALLES DAM.**

<b>CRITERIA ITEMS</b>	<b>DATE OF INSPECTION</b>								
	<b>31-Mar</b>	<b>21-Apr</b>	<b>11-May</b>	<b>8-Jun</b>	<b>8-Jul</b>	<b>18-Aug</b>	<b>28-Sep</b>	<b>21-Oct</b>	
<b><u>SOUTH SHORE FISHWAY</u></b>									
<b><i>East Entrance:</i></b>									
Depth over entrance weir									
E-1 (gate set at elev. 83.5 ft)	ft	1.4	0.0	0.0	1.5	0.0	3.7	1.9	4.6
E-2 (crit. = 8 ft or >)	ft	8.1	8.1	10.5	9.5	8.7	8.6	8.4	9.4
E-3 (crit. = 8 ft or >)	ft	8.1	8.5	10.7	10.7	9.2	8.5	9.0	7.7
Head at main entrance (crit. = 1-2 ft)	ft	1.4	1.7	1.6	1.3	1.9	1.5	1.7	1.3
Depth over ladr. weir (crit. = 1-1.3 ft)	ft	1.0	1.0	1.0	1.3	1.4	1.4	1.2	1.2
Channel Velocity (crit. = 1.5 - 4.0 fps)	fps	~1.0-2.0	1.0-2.0	0.6-3.0	1.0-3.0	1.1-2.0	0.8-2.0	1.0-2.0	1.0-2.0
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes	no	yes
Selsyns operating (yes or no)		yes	yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	no	no	no	yes	no	yes
<b><i>West Entrance:</i></b>									
Depth over entrance weir									
W-1 (crit. = 8 ft or >)	ft	8.5	8.6	8.6	9.1	8	8.5	8.7	8.9
W-2 (crit. = 8 ft or >)	ft	9.1	9.5	10.5	12	11.5	10.2	8.8	10
Head at main entrance (crit. = 1-2 ft)	ft	1.6	1.4	1.2	1.1	1.3	1.2	1.3	0.9
<b><i>South Entrance:</i></b>									
Depth over entrance weir									
S-1 (Crit. = 8 ft or >)	ft	8.6	10.7	10.3	9.6	9.6	8.6	7.1	9.0
S-2 (Crit. = 8 ft or >)	ft	8.8	10.7	10.6	9.4	9.6	8.8	6.6	9.2
Head at main entrance (Crit. = 1-2 ft)	ft	1.4	1.0	0.8	1.5	1.3	1.0	1.4	0.7
<b><u>NORTH SHORE FISHWAY</u></b>									
<b><i>North Shore Entrance:</i></b>									
Depth over entrance weir									
N-1 (crit. = 8 ft or >)	ft	8.6	9.7	8.4	8.4	8.5	8.7	8.7	8.8
Head at main entrance (Crit. = 1-2 ft)	ft	1.4	1.0	1.2	1.5	1.5	1.4	1.3	1.2
Depth over ladr. weir (Crit. = 1-1.3 ft)	ft	0.9	1.0	1.0	1.2	1.2	1.2	1.2	1.1
Ladder exit clean		yes	yes	yes	yes	yes	yes	yes	yes
Selsyns operating		yes	yes	yes	yes	yes	yes	yes	yes
Picket leads clean		no	yes	yes	no	no	no	no	yes
Spill Pattern w/i Criteria (yes or no)		yes	yes	yes	yes	yes	yes	n/sp	n/sp
Comment Number (if applicable)		1	2	3			4	5	6

**Comments (see next page)**

1. The velocity was about 0.4 fps at Unit 22/21 and 1.0 fps by Unit 19/20 and speeds up to about 2.0 fps by west end.
2. Spill gate #9 OOS and remained open at 5 ft during the spill season.
3. Gate N-1 was inoperable - project was waiting for cables & parts; Gate N-1 put in service on July inspection.
4. Weir #155 was stuck in the down position with broken cables; a twisted metal bracket was noted on south side of the weir about 1 ft above the water level.
5. The project was having some control problems with the South entrance gate system and that resulted in lower reads.
6. The project needed to calibrate their south shore weirs; FPC gate showed head to be 1.2 ft rather than 0.7 ft.

The South fishway entrances (S-1 and S-2) were normally operated close to criteria regarding gate depth, with 8.0 ft average depth or greater recorded through the passage season except for the September inspection. Gate depths ranged from 6.6 ft to 10.7 ft. Head differential ranged from 0.7 ft to 1.5 ft for the season. The low reading of 0.7 ft using the Selsyns gage was believed to be in error as the FPC water level sensor showed the same reading to be 1.2 ft, well above the out of criterion reading obtained from the Selsyns gage. We asked the COE to calibrate the gage so that proper elevations could be obtained.

**Fish Ladder:** The picketed leads located at the OR fish counting station and also the exit trash racks were reported with some amount of debris on 4 of 8 inspections. **This continues to be one area that the project should increase frequency of checking and cleaning at the dam.** The depth of water over the fish ladder weirs ranged between 1.0 and 1.4 ft during the season and was acceptable during the 1999 inspection season. A main reason for the excessive buildup or head differential between the upstream and the downstream picket lead was the fact that Weir #155 was inoperable and was stuck in the down position. This made it more difficult to control flow through the upper part of the fish ladder. The Weir was broken, i.e., the cabling and bracket (twisted), and this would not allow the weir to move in the slot. A concern was that adult fish could potentially hit this bracket as they swam over the weir crest.

### **North Shore Fishway Inspections**

At the WA fishway, the North entrance gate, N-1 was operated throughout most of the fish passage season. The cabling was damaged on Gate N-1 in May and N-2 operated until cabling and parts allowed the project to fix Gate N-1 in July. The gate depths at the WA fishway ranged between 8.4 and 9.7 feet for the season with the head differential ranging between 1.0 and 1.5 ft. The COE completed restoring the damaged areas in the plunge pool section of the fishway during the 1998-99 winter maintenance period.\*\*\*\*\* The WA fishway operated satisfactorily throughout the fish migration with exception of the days when the Gates failed due to the cabling and other reasons.

**Fish Ladder:** The ladder exit was reported clear of debris during all 8 inspections. The picketed leads were reported with some buildup of debris during 5 of the 8 inspections. The main problem is linked to sticks and other debris building on the picketed leads. The depth of water recorded over the ladder weirs also showed the fish ladder in proper criteria with a range of 0.9 to 1.2 ft for the season. The staff gage located near the PUD water supply was calibrated toward the end of the inspection year and this helped determine head loss across the PUD trashrack.

**Overall,** the fish facility inspections showed The Dalles Project operating fairly close to acceptable criteria through much of the fish passage season especially relating to gate depth and head differential. Some areas of concern are listed.

- Water velocities measured at the eastern end of the powerhouse collection channel were less than recommended, but until radio telemetry results are analyzed; it is unknown what extent the reduced velocity might be a problem. Same question as in 1996/98 Annual Reports.
- The North Shore entrance, i.e., the gate or cable became severely damaged again in 1999, and there was no backup gate available for use to begin the season. In May, Gate N-1 was taken off line for the same reason as the previous year. This mechanical or design problem should be dealt with during the winter maintenance period and a better design employed to reduce continued problems with the Gates.
- The Tribal shad fishery at the exit of the OR fish ladder was minimal in terms of number of fish harvested as well as days fished this year and should have had little effect on adult fish passage at that site.
- The weir depths of the West main entrances W-1 and W-2 were at times several feet different at each location, e.g., 8.6 ft / 10.5 ft, 9.1 ft / 12.0 ft, etc. During the season, the average depth of the two gates was satisfactory, but we question why there was such a difference between the gate settings. The project should work to calibrate or automate the gates such that they travel close together in gate depth.
- Weir Gate #155 should be repaired during the winter maintenance period as there was potential for serious damage to fish if they contacted the metal brackets at the edge of the Weir.

## JOHN DAY DAM

John Day Dam is a COE operated project that went on-line for power production in 1968 with 16 main turbine units and a spillway equipped with 20 spillbays. The major change to the project has been the addition of flippers into the spillbays. This has allowed the project to spill additional flow without greatly increasing dissolved gas levels at the project.

Three turbine driven pumps are incorporated into the OR water supply for the adult fishway. This water is supplied through the diffuser system where it exits out 1 main entrance on the south shore, two main entrances at the north end of the powerhouse, and 10 floating orifice gates along the collection channel. The project is able to operate two of the three pumps to meet criteria levels of operating the main entrances as well as the floating orifice gates along the powerhouse collection channel. Six electric pumps are operable on the WA shore to supply water to the diffusers located at the lower end of the fish ladder; however, a maximum of only 4 pumps (normally 3 pumps) can operate at any one time at the north shore. The pumps supply flow to two main entrances at the north end of the spillway. The project is still exploring means to fully use the system and meet operating at a range of 8-ft or greater during all times of the year if possible. In 1999, the criteria for the gates required 6 ft gate depth and 1.0 ft minimum head differential.

Doug Case, ODFW completed eight monthly inspections of the fish facilities from March 31 through October 21 at the John Day project. Table 3 lists the criteria items and the inspection dates for the John Day project.

### **South (Oregon Shore) Fishway Inspections**

The south shore fishway operated gate SE-1 throughout the season. The head differential measured at the main entrance was between 1.0 to 2.0 ft on every inspection (range = 1.0 to 1.4 ft) with the weir depth ranging between 8.0 ft and 8.8 ft. The gate depth was 8.0 ft or greater on all 8 inspections. Throughout the 1999 season, entrance conditions at Gate SE-1 should have provided satisfactory fish passage during these eight inspections.

In 1999, the north powerhouse entrance gates, NE-1 and NE-2, were operated within the criteria ranges for weir depth (8 ft or greater) and head differential (1.0 to 2.0 ft) on all inspections except the final one where the head differential was 0.9 ft rather than 1.0 ft. The gate depths ranged from 8.1 ft to 9.1 ft with head differentials that ranged from 0.9 ft to 1.7 ft. Sufficient



flow was supplied to the NPEs even during the final inspection as the Gates were submerged 9.0 ft average and just required balancing of the depth and head to meet criteria.

The powerhouse collection channel velocity was estimated to range from 2.0 to 3.0 fps (south to north) during the eight inspections. The electronic velocity meter that was installed in the collection channel in Unit #3 did not work during the entire season. Visual estimates of the velocities in the channel gave estimates that fell within acceptable criteria range.

**Fish Ladder:** The exit from the fish ladder as well as the picketed lead at the counting station was clear of debris. Through the season, staff gages were reported as clean. As noted in all previous seasons, fish are still jumping in the upper section of the fish ladder during the late fall. The COE field unit continues to monitor that section of the fish ladder and some modifications will be made to the ladders in winter maintenance 1999-2000. The depth of water measured over the ladder weirs ranged between 0.9 ft and 1.3 ft for the season and was within the criteria range of 1.0 ft  $\pm$  0.1 ft during the non shad period and 1.3 ft  $\pm$  0.1 ft during the shad passage season.

### **North Shore Fishway Inspections**

The criteria settings for the north shore fishway entrances were changed prior to the 1995 season and remained in effect for the 1999 season. The two entrance gates, N-1 and N-2, are to be maintained at a minimum depth of 6.0ft below tailwater with a head differential of 1.0 to 2.0 ft. The minimum 6.0-ft gate depth criterion was met on three of the eight inspections; the depths ranged from 3.8 ft to 8.2 ft. The head differentials were below acceptable criteria range on three inspections with the range from 0.5 to 1.3 ft. For the season, the gate depth and head differential readings resulted in the entrances being less than criteria on 6 of the 8 inspections.

**Fish Ladder:** The exit from the ladder was reported clear of debris on all inspections. The picketed leads were noted with sticks and other debris on only 1 of the 8 inspections. The picketed leads had 0.2 ft differential on the final 3 inspections indicating that debris was building up on the racks. Depth of water over the fish ladder weirs ranged from 1.0 ft to 1.3 ft.

**Table 3. Pertinent Data for Fish Facility Inspections in 1999 at JOHN DAY DAM.**

<b>CRITERIA ITEMS</b>	<b>DATE OF INSPECTION</b>								
	<b>31-Mar</b>	<b>21-Apr</b>	<b>11-May</b>	<b>8-Jun</b>	<b>8-Jul</b>	<b>18-Aug</b>	<b>28-Sep</b>	<b>21-Oct</b>	
<b>SOUTH SHORE FISHWAY</b>									
<b>South Shore Entrance:</b>									
Depth over entrance weir									
SE-1 (Crit. = 8 ft or >)	ft	8.0	8.0	8.5	8.3	8.4	8.5	8.6	8.8
Head at SE-1 (Crit. = 1-2 ft)	ft	1.1	1.4	1.2	1.3	1.2	1.1	1.0	1.0
Dep. over ladr. weir (Crit.=1.0 +/-0.1) ft [normal] & 1.3 ft shad season)	ft	1.1	0.9	0.9	0.9	1.2	1.3	1.0	1.1
Channel Veloc (Criteria = 1.5 - 4.0 fps)	fps	~2.0	2.0-3.0	~2.0	~2.0	~2.0	~2.0	2.0	2.0-3.0
Ladder exit clean (Yes or No)		yes	yes	yes	yes	yes	yes	yes	yes
Staff gages clean (Yes or No)		yes	yes	yes	yes	yes	yes	yes	yes
Picket Leads Clean (Yes or No)		yes	yes	yes	yes	yes	yes	yes	yes
<b>North Powerhouse Entrance:</b>									
Depth over entrance weir									
NE-1 (Crit. = 8 ft or >)	ft	8.6	8.9	8.9	8.4	8.3	8.2	8.7	9.1
NE-2 (Crit. = 8 ft or >)	ft	8.9	8.8	8.7	8.1	8.7	8.2	8.5	8.9
Head at NE-1&2 (Crit. = 1-2 ft)	ft	1.3	1.6	1.6	1.7	1.2	1.3	1.0	0.9
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	yes	yes	no
<b>NORTH SHORE FISHWAY</b>									
<b>North Shore Entrance:</b>									
Depth over entrance weir									
N-1 (Crit. = 6 ft or >)	ft	OOS	6.0	7.5	5.0	3.9	8.2	6.3	6.0
N-2 (Crit. = 6 ft or >)	ft	OOS	6.2	7.4	4.9	3.8	8.2	4.0	5.8
Head at N-1&2 (Crit. = 1-2 ft)	ft	NA	1.1	0.6	1.5	2.2	0.5	1.3	1.1
Depth over Idr weir (Crit.=1.0 +/-0.1)	ft	1.1	1.1	1.1	1.0	1.3	1.3	1.0	1.0
Ladder exit clean		yes	yes	yes	yes	yes	yes	yes	yes
Staff gages clean		yes	yes	yes	yes	yes	yes	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	no	yes
Comment number (if applicable)		1		2	3	3	4		

**Comments:**

1. North Shore fish pumps were OOS due to rewiring the breakers, etc.
2. LED reads for n. shore fway control were 1.0 ft off for tailwater elevation; note the low head differential (0.6 ft).
3. LED reads for n. shore fway control were 1.0 ft off for tailwater elevation; note June was great for head way low for depth.
4. Head differential way low at N Shore entrances; continued problem with control of Entrance depth and Head.

**Overall**, the main entrances at the south fishway were operated very close to criteria during the 1999 fish passage season. Areas of concern based on observations from the inspections are listed.

- Fish jumping/leaping (mainly steelhead) in the exit section of the fish ladders at John Day Dam still occurs. Hydraulic conditions need to be improved to keep fish moving through the upper section of the north and south fish ladders (Continuing Recommendation through many years).
- The passage of adult fish through the north shore counting station has been and continues to be a problem with a high percentage of fish falling back through the counting window (especially late summer and fall run fish). A modification of the counting station is required. During the past few seasons, there has been a large differential between The Dalles Dam and John Day Dam and it appears McNary. Continued researching of the problem should be done to come to the reason why the differential exists.
- The north shore auxiliary water supply should be changed to allow more flow through the supply conduit. The John Day Project completed wiring to reduce overloading of the fish pumps. It was thought that this fix would allow the pumps supply sufficient flow to achieve an 8-ft or greater weir depth with 1.0 ft or greater head differential at the north shore entrances. It has not solved the problem, see results of this year's inspection results on the north shore.
- This was the second year of checking the new juvenile bypass system during the inspection program. A new inspection form was developed to incorporate operation of the juvenile bypass system.

## **MCNARY DAM**

McNary hydroelectric project was completed in 1953 and is a COE operated facility. The project incorporates 14 main turbine units and 22 spillbays. The end 3 spillbays per side do not have fliplips.

The OR and WA shore fish ladders use full overflow weirs along with the submerged orifices in each weir so overall the ladders carry at least double the Q as the newer fish ladders built at other COE dams. On the OR fishway, three large electric fish pumps drawing water from the tailrace of the dam plus about 1,000 cfs of gravity flow from the forebay supply water to the main entrance gates located at each end of the powerhouse. Along the powerhouse collection channel, 12 floating orifice gates supply about 60 cfs each to the tailwater to attract adult fish to the

channel. Initially, the project operated 30 of these gates along the powerhouse, but this total was reduced to the present 12 in the mid-1980s. One other major change on the WA shore fishway was completed in the 1990s. The water supply for the WA fishway was changed from the pressurized system to a non pressurized one. Wasco/Klickitat PUDs installed a small turbine on the water supply from the forebay that produces electricity for the PUD and also supplies flow (about 1,600 to 1,700 cfs) to meet gate depth and head differential requirements for the two main entrance gates.

Larry Swenson, NMFS, inspected the fish facilities at McNary Dam on eight separate occasions between April and November 1999. Results of the inspections are discussed below with Table 4 listing data collected for the inspections. The project has been able to print a copy of the computer-generated Status Report of the fishway readings for a number of years. These were obtained by the inspector at the beginning of the inspection and compared with the field data taken at the main entrances. The site readings and the computer-generated report of the fishway readings were normally close during the inspections and did not require calibration, i.e., the readings were less than 0.3 ft different.

The project can normally meet criteria operating with two of the three pumps at the OR fishway. When three pumps operate, the angle open is normally near 24 degrees while the blade angle is increased to 31-32 degrees when two pumps operate. In addition to the pumped and gravity-flow water, about 350-400 cfs of water from the juvenile bypass system is added to the north end of the powerhouse near the NPEs.

Spill was present from April through August with the higher levels recorded in May and June. Normally, the spill patterns were satisfactorily followed, using the daytime pattern for adult fish passage.

**South Shore (Oregon) Fishway Inspections:** During 1999, the main entrances at the south shore (SFEW-1 & 2) were reported within the criteria range of 9 ft or greater gate depth and 1.0 ft to 2.0-ft head differential on all inspections. The gate depths ranged from 9.0 ft to 9.2 ft with head differentials ranging from 1.0 ft to 1.5ft. The north powerhouse entrances (NFEW-1 & 2) were also reported within the required criteria as gate depths ranged from 9.1 ft to 9.4ft. Head differentials ranged from 1.3 ft to 1.5 ft.

The channel velocities were estimated between 1.5 to 2.0 fps at the southern end of the channel and increased to near 2.4 to 3 fps at the northern end of the channel. The southern end was

recorded via an electronic meter installed downstream of the junction pool and upstream of ph turbine unit #1. The surface velocity was estimated at the northern end of the channel by timing a wood chip or floating object a given distance along the channel.

**Fish Ladder:** The picketed leads located at the OR fish ladder count station were reported clear of debris during the inspections; debris was building up at the exit from the fish ladder on the August and September inspections that required cleaning. The depth of water reported over the OR fish ladder weirs ranged between 1.1 ft to 1.3 ft for the season and was within acceptable range during the season.

### **North Shore (Washington) Fishway Inspections**

The WA shore fishway entrances, WFE-2 and WFE-3, operated with gate depths ranging from 8.9 ft to 10.6 ft, and with head differentials ranging between 1.2 ft and 1.6 ft. The gate depths and head differentials were operated within acceptable criteria range through the season, i.e., greater than 8.0 ft gate depth and head differential between 1.0 ft to 2.0 ft. The computer generated report gave close correlation with the on-site readings.

**Table 4. Pertinent Data for Fish Facility Inspections in 1999 at MCNARY DAM.**

<b>CRITERIA ITEMS</b>	<b>DATE OF INSPECTION</b>									
	<b>22-Apr</b>	<b>19-May</b>	<b>16-Jun</b>	<b>20-Jul</b>	<b>18-Aug</b>	<b>17-Sep</b>	<b>20-Oct</b>	<b>18-Nov</b>		
<b>SOUTH SHORE FISHWAY</b>										
<b>South Shore Entrance:</b>										
Depth over entrance weir (Criteria: 9 ft or > gate depth at SFEW-1,2 & NFEW-1,2)										
SFEW-1	ft	9.2	9.1	9.2	9.0	9.1	9.0	9.2	9.2	
SFEW-2	ft	9.2	9.1	9.2	9.0	9.1	9.0	9.2	9.2	
Head at SFEW-1,2 (Crit.= 1-2 ft)	ft	1.0	1.1	1.1	1.1	1.2	1.5	1.2	1.1	
Dep. over ladr. weir(Crit.=1-1.3')	ft	1.1	1.1	1.1	1.1	1.1	1.3	1.1	1.2	
Channel velocity (Crit.= 1.5-4.0 fps)	fps	2.0-3.0	2.0-3.0	1.5-2.7	2.6-3.0	2.6-3.0	3.3-2.9	2.6-2.8	1.7-2.7	
Ladder exit clean		yes	yes	yes	yes	no	no	yes	yes	
Picket leads clean		yes	yes	yes	yes	yes	yes	yes	out	
<b>North Powerhouse Entrance:</b>										
Depth over entrance weir										
NFEW-2	ft	9.2	9.1	9.4	9.1	9.3	9.3	9.1	9.2	
NFEW-3	ft	9.2	9.1	9.4	9.1	9.3	9.3	9.1	9.2	
Head at NFEW-2&3 (Crit. = 1-2ft)	ft	1.3	1.4	1.5	1.4	1.4	1.3	1.4	1.5	
<b>WA.SHORE FISHWAY</b>										
<b>North Shore Entrance:</b>										
Depth over entrance weir										
WFE-2 (Crit. = 8 ft or >)	ft	10.6	9.7	10.0	8.9	9.9	9.1	9.8	9.8	
WFE-3 (Crit. = 8 ft or >)	ft	10.5	9.7	10.0	8.9	9.9	9.1	9.8	9.8	
Head at WFE-2&3 (Crit. = 1-2 ft)	ft	1.4	1.3	1.4	1.5	1.2	1.6	1.1	1.4	
Dep. over ladr. weir (Crit. = 1-1.3 ft)	ft	1.0	1.1	1.0	0.9	1.0	1.0	0.9	1.0	
Ladder exit clean		yes	no	yes	yes	yes	yes	yes	yes	
Picket leads clean		yes	no	yes	yes	yes	yes	yes	out	
Comment number (if applicable)		1					2			

**Comments:**

1. A two-pump operation was used during most of the fish passage season.  
Grebes were observed in the gatewells and juvenile bypass channel on several inspections during the season.  
Project biologist was contacted on each occasion.
2. Several orifice gates were overtopped with water during the inspection; project personnel freed them.

**Fish Ladder:** The fishway exit was reported with some debris (tumbleweeds or other grasses) on one inspection. The picketed lead section located at the counting station in the WA fish ladder was also reported with debris during the same (May) inspection. The depth of water recorded over the ladder weirs was reported at 0.9 ft on 2 of the inspections with the depth ranging from 0.9 to 1.1 ft. The project normally cleared the leads on Monday and Thursday of each week.

**Overall,** the adult fishways normally operated close to the criteria established for the WA and OR fish passage facilities. The main entrances were operated in acceptable criteria during the adult fish passage season. Some problem areas that exist are:

- The orifice gates along the powerhouse collection channel can be found overtopped or stuck in position when tailwater changes occur. This problem should be corrected.

The inspections made of the **juvenile fish passage system** showed some continued problem areas that were present during the inspection season.

- Debris continues to be especially hard on the juvenile equipment, i.e., vertical barrier screens, extended bar screens, de-watering screens, and any screen material at the juvenile bypass facility. The project should continue to make improvements to the screening system.
- During most of the 1999 inspections, Western Grebes were reported in the gatewells and on occasion in the bypass channel. A more aggressive attempt to keep the Grebes away from the gatewells and bypass channel should be taken, as they are very effective predators on the juvenile fish in these enclosed areas.

## **PRIEST RAPIDS DAM**

Priest Rapids Dam was completed in 1959 with ten main turbine units and 22 spillbays. The project is owned and operated by Grant County PUD. The adult fish facilities consist of two fishways located on the Left and Right bank of the Columbia River. Five electric pumps pump water from the tailrace of the dam and gravity-flow water is pulled from the forebay of the project into a large chamber. This water is channeled through a diffusion system (mostly floor diffusers) into the collection channel and lower end of the fish ladder at both shores of the project.

Main entrance gates on the Left Bank fishway are located at the eastern end (shore entrance) and the western end of the powerhouse. Nine orifice gates operate along the powerhouse collection

channel. One main entrance gate is operated at the Right Bank fishway. In 1999, the project completed modification of and installed new slotted gates into the main fishway entrances. The Gates were changed from overflow weir-type gates to the slotted or fixed-open gates.

As in previous years, fish agency and tribal personnel met with Grant PUD personnel prior to the 1999 fish passage season for the purpose of reviewing the previous year's fishway operations, planned operations for the upcoming passage season, and changes that might affect fishway inspections for the year. This meeting continues to be beneficial as it helps set the stage for the upcoming fish passage season.

Bryan Nordlund, NMFS, completed 7 inspections of the adult fish facilities during the 1999 season beginning April 5 and ending on October 7 (Table 5). The inspector was normally accompanied by an operator and a fish biologist or tech from Grant PUD. Priest Rapids Dam has a computer controlled fishway system that allows a computer printout of the settings on an instantaneous basis if desired. A copy of the computer-generated readings was normally compared to the site readings to assure if any calibration was necessary or if tailwater elevations or project operations were made during the inspection.

**Left Bank Fishway:** At the Left Bank fishway, Gate LEW-3 was operated to meet depth criteria only on the initial inspection. Gate LEW2/3 required that the weir be submerged 8.5 ft  $\pm$  0.5 ft below tailwater elevation with the head differential at 1.2 ft target (range of 1.0 ft to 2.0 ft). The project operated Gate LEW-3 at 8.3 ft depth with 1.1 ft head differential during the April inspection. The Gate modification was completed at entrance LEW-2 prior to the May inspection and was operated to meet head differential only. The head differential ranged from 0.9 ft to 1.7 ft during the May through October inspections. The project met the head differential on 6 of the 7 inspections, with the targeted head met on two of the seven inspections. The Gate was operating below the minimum head differential of 1.0 ft on the final inspection (0.9 ft recorded).

Project personnel installed gate LEW-4 prior to the April inspection. The head differential was targeted at 1.5 ft for that entrance. The head differential was greater than 1.0 ft on 6 of the 7 inspections with the target "head" of 1.5 ft met on 1 of the 7 inspections. The low reading for the season was on 16 June when 0.8 ft was reported with the high reading of 1.9 ft during the September inspection.



Also, the fallout fence that had been installed in the west end of the collection channel near Gate LEW-2 was removed during the 1999 winter maintenance period. The fish agencies and tribes agreed this to removal of the fallout fence. Channel velocity was visually estimated and ranged between a low of near 1.0 fps to a high estimate of 2.0 fps. At times, the velocities in the channel were minimal between the junction pool and through the channel to near Unit 10.

**Fish Ladder:** At the Left Bank fish ladder, the depth of water over the ladder weirs ranged between 1.0 ft to 1.1 ft for the season; all satisfactory readings. The exit from the fish ladder was clear of debris on all occasions as well as the picketed leads at the counting station.

### **Right Bank Fishway**

The Right Bank fishway entrance obtains its auxiliary water from the Left Bank water supply system via a large conduit that allows water to flow through diffuser gratings into the lower end of the right bank fish ladder. Gate REW-1 was operated during the 1999 fish passage season. The main gate is required to operate within the following range: 1.0 to 2.0 ft for head differential with the target "head" being 1.25 ft. Gate REW-1 had head differentials ranging from 1.1 to 1.5 ft for the season. All readings were above the 1.0 ft minimum range with the target "head" of 1.25 ft met on all but the August inspection.

**Fish Ladder:** The depth of water reported over the fish ladder weirs was 1.0 ft on all seven inspections. The picketed leads at the counting station were clear of debris on all inspections with the ladder exit clean on each inspection except for August and September when grasses and other floating debris were reported at the exit.

**Overall,** the adult fish passage facilities had major changes from the proceeding years with the installation of the new entrance gates. For the most part, the changeover was smooth and should benefit the project in the long run regarding maintenance and other problems that are reduced with fixed-open gates. Potential areas of concern relating to project operation are listed:

- The radio telemetry report should be further analyzed and reviewed for continued operation of the orifice gates as presently operated along the channel. It may be that fewer orifice gates can be operated at the project (Same response as in 1998 Report).
- Severe fluctuations of flow, hence tailwater elevations resulted in staff gages being nearly impossible to read. During these times, computer readings were used at several locations.

**Table 5. Pertinent Data for Fish Facility Inspections in 1999 at PRIEST RAPIDS DAM.**

<b>CRITERIA ITEMS</b>	<b>DATE OF INSPECTION</b>							
	<b>5-Apr</b>	<b>11-May</b>	<b>16-Jun</b>	<b>21-Jul</b>	<b>11-Aug</b>	<b>13-Sep</b>	<b>7-Oct</b>	
<b>LEFT BANK FISHWAY</b>								
<b><i>Left Bank Entrance:</i></b>								
<b><u>Depth over entrance weir</u></b>								
LEW-2 (Criteria = 8.5' +/- 0.5')	ft	8.3	NA	NA	NA	NA	NA	NA
<b><u>Head at main entrance</u></b>								
LEW-2 (Criteria = 1.2 ft target)	ft	1.1	1.1	1.3	1.1	1.1	1.7	0.9
LEW-4 (Criteria = 1.5 ft target)	ft	1.2	1.1	0.8	1.1	1.2	1.9	1.0
Depth over ladr. weir (Crit. = 1-1.2 ft)	ft	1.0	1.0	1.1	1.1	1.0	1.0	1.1
Channel velocity (Criteria = 1.5-4 fps)	fps	~1.0	~1.5	~1.25	~2.0	~1.5	1.5	1.3
Ladder exit clean (Criteria = yes or no)		yes	yes	yes	yes	yes	yes	yes
Staff gages clean (Criteria = yes or no)		yes	yes	yes	yes	yes	no	yes
Picket leads clean (Criteria = yes or no)		yes	yes	yes	yes	yes	yes	yes
<b>RIGHT BANK FISHWAY</b>								
<b><i>Right Bank Entrance:</i></b>								
<b><u>Depth over entrance weir</u></b>								
Head at REW-1 (Criteria = 1-2 ft)	ft	1.2	1.2	1.3	1.4	1.1	1.5	1.3
Depth over ladr. weir (Crit. = 1-1.2 ft)	ft	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Ladder exit clean (Criteria = yes or no)		yes	yes	yes	yes	Fair	Fair	yes
Staff gages clean (Criteria = yes or no)		yes	yes	yes	yes	yes	no	yes
Picket leads clean (Criteria = yes or no)		yes	yes	yes	yes	yes	yes	yes
Comment number (if applicable)		1				2		3

**Comments:**

1. LEW-3 operating until LEW-2 has new slotted gate installed; slotted gates in REW-1 and LEW-4.
2. Stillwell tw elevation was 0.2 to 0.4 ft lower than reported tw elevations from staff gage; spill pattern different from spill pattern calculation due to head changes. We asked that this be clarified and updated so that everyone could assess actual volume.
3. Stillwell reading 0.6 ft lower than staff gage; needed calibration. Audible vibration at Gate LEW4/5. Sluiceway = 2,000 cfs.

## WANAPUM DAM

The Wanapum Dam hydro project was completed in 1963, incorporating ten main turbine units for power production and 12 spill gates to pass flow at the project. The project is owned and operated by Grant County PUD.

Flow to the East Fishway is supplied by two turbine-operated pumps that draw water from the tailwater of the dam plus gravity flow water from the forebay of the dam. This water flows to the two main slotted fishway entrances, SE-2 at the eastern end of the powerhouse (shore), and SE-3 at the western end of the powerhouse. This same water supply also feeds ten operating orifice gates along the powerhouse collection channel. Auxiliary water for the Right Bank fishway is a gravity flow system that pulls water from the forebay of the dam. This flow of water supplies water to the diffusers in the lower end of the fish ladder and to the main entrance gate, REW-2.

A pre-season meeting was held at Wanapum Dam to discuss fishway operation for the previous season (1998), to review changes that were anticipated for the upcoming fish passage season, and to finalize the year 1999 operating criteria for the adult fish passage facilities at Priest Rapids and Wanapum dams.

Bryan Nordlund, NMFS completed seven fishway inspections beginning April 5 and ending October 7. A summary of the inspections is listed in Table 6 and in the text below.

### **Left Bank Fishway**

The east entrance SE-2 operates as a continual open gate with the head differential targeted for 1.5 ft. Gate SE-2 operated within the following range: 1.1 ft to 1.8 ft and was within acceptable range the whole season (1.0 ft to 2.0 ft). The project maintained the targeted head of 1.5 ft on 2 of the 7 inspections. The west entrance, SE-3 is also a continual open slotted gate with a targeted head differential of 1.25 ft. Gate SE-3 operated within the following range: 1.1 ft to 1.5 ft for the year. All readings were within the desired range of 1.0 – 2.0 ft with the target of 1.25 ft met on 6 of 7 inspections.

Water velocity was estimated along the channel and readings ranged between 1.5 and 2.0 fps. All were within acceptable criteria of 1.5 to 4.0 fps. All orifice gates were closed along the channel during the April inspection, but were back in service by the May inspection. On all other inspections, the orifice gates were operating satisfactorily and in proper sequence.

**Fish Ladder:** The depth of water over the fish ladder weirs ranged from 1.0 ft to 1.1 ft for the season. The ladder exit had varying amounts of floating debris around the exit on 4 of the 7 inspections.

### **Right Bank Fishway**

The Right Bank Gate was targeted to operate with a head differential of 1.25 ft and within the range of 1.0 ft to 2.0 ft. Gate REW-2 is a continuous-open slotted gate and operated with head differentials ranging from 1.3 ft to 1.6 ft. All inspections met the targeted head differential during 1999.

**Fish Ladder:** The right fish ladder operated with acceptable depth of water over the weir crests; the range was 1.0 ft to 1.2 ft for the season. The fish ladder exits were reported clear of debris for most of the 1999 season with some floating debris noted on 2 of the 7 inspections.

**Spill Patterns:** The large prototype juvenile fish bypass system was not operated at the project in 1999. Spill for juvenile fish was used to pass fish downstream of the project. Changes to the spill schedule were coordinated through the fish agencies and tribes.

**Overall,** the Wanapum fish facilities operated satisfactorily through the fish passage season with few exceptions. Some problem areas are listed:

- The project should complete installation of a computer-controlled fishway to potentially improve overall operation of the flows to the main entrances and through the channel.
- As tailwater elevations drop during the summer/fall, many of the staff gages become unreadable. Either removable staff gages should be installed or bench markers placed that would allow use of a sensor tape to obtain accurate elevation readings for the main entrances.
- As at Priest Rapids Dam, the radio telemetry studies completed on adult fish should be assessed to confirm what orifice gates should be operated in upcoming years.
- During 1998, the project used cameras to assess passage (count fish) through the upper section of the fish ladders at the project. What was the outcome of the study? Based on the large discrepancies noted in fish counts between Priest Rapids Dam and Rock Island Dam in 1999, it would be very beneficial to have accurate fish counting at Wanapum Dam

**Table 6. Pertinent Data for Fish Facility Inspections in 1999 at WANAPUM DAM.**

CRITERIA	DATE OF INSPECTION							
		<u>5-Apr</u>	<u>11-May</u>	<u>16-Jun</u>	<u>21-Jul</u>	<u>11-Aug</u>	<u>13-Sep</u>	<u>7-Oct</u>
<b>LEFT BANK FISHWAY</b>								
<i>Left Bank Entrance:</i>								
<u>Head at entrance</u>								
SE-2 (target head = 1.5 ft)	ft	1.2	1.5	1.1	1.3	1.2	1.8	1.3
SE-3 (target head = 1.25 ft)	ft	1.4	1.2	1.2	1.3	1.5	1.2	1.1
Dep. over ladr. weir (Crit. = 1.0-1.2ft)	ft	1.0	1.0	1.0	1.1	1.1	1.1	1.0
Channel velocity (Crit. = 1.5-4.0 fps)	fps	2.0	1.5	2.5	~2.0	2.0	2.0	2.0
Staff gages clean (Crit. = yes or no)		yes	yes	yes	yes	yes	yes	yes
Ladder exit clean (Crit. = yes or no)		yes	Fair	yes	yes	Fair	Fair	Fair
<b>RIGHT BANK FISHWAY</b>								
<i>Right Bank Entrance:</i>								
<u>Head at Entrance</u>								
REW-2 (target head = 1.25 ft)	ft	1.5	1.5	1.6	1.6	1.5	1.3	1.5
Depth over ladder weir	ft	1.2	1.0	1.0	1.0	1.2	1.0	1.2
Ladder exit clean		yes	Fair	yes	yes	yes	Fair	yes
Staff gages clean		yes	yes	yes	yes	yes	yes	yes
Auxiliary H2O Pumps (RPM)		150/150	150/150	160/160	160/155	150/150	150/150	155/155
Comment number (if applicable)		1	2					3

**Comments:**

1. All orifice gates are closed; being repaired and expected back in service by mid-April.
2. Spring spill approx 21%; Juvenile sluiceway operated full season at 2,100 cfs.
3. Biological test for spillbay #3 - testing new deflectors.

## ROCK ISLAND DAM

The Rock Island hydro-project is comprised of two powerhouses; an old powerhouse with 10 main turbine units that was constructed in 1933 with a major upgrade of the turbine units in 1953. A new powerhouse with 8 main turbine units and located on the right bank of the Columbia River was completed in 1979. The spillway consisting of 32 spillbays is located between the two powerhouses. The dam is owned and operated by Chelan County PUD.

The old powerhouse adult fish facilities consist of the Left Bank fishway and the Middle or Spillway fishway, while the new powerhouse has the Right Bank fishway. Each fishway has a fish counting station located near the top of the fish ladder.

Denise McCarver and Glen Liner, WDFW, inspected the adult fish facilities at Rock Island Dam on 7 occasions during the 1999 fish passage season beginning on April 14 and ending on October 26 (Table 7). Through the inspection season, few out of criteria conditions were reported except for the time frame when tailwater elevations were at highest levels in June and July.

### **Left Bank Fishway**

Gravity feed water is supplied from the forebay to the lower end of the Left Bank fish ladder through diffuser gratings. This auxiliary water supplies sufficient flow to allow Gates LO5 and LO6 to operate at 6.0 ft or greater depth and with a corresponding head differential of 1.0 ft minimum through any tailwater elevation.

Gates LO5 and LO6 were normally submerged the same depth or within a tenth of the other gate during the 1999 season with the gate depths ranging from 6.5 ft to 6.9 ft for the season. Head differentials ranged from 1.0 ft to 1.3 ft. In 1999, the gate depth and head differential readings were found within acceptable criteria range through the inspection season.

**Fish Ladder:** Depth of water measured over the Left Bank fish ladder weirs was 1.0 to 1.1 ft during the passage season. The exit trash racks located at the exit from the fish ladder and the picketed leads at the counting station were clear of debris during the fish passage inspections.

### **Middle Fishway**

Gravity feed water from the forebay of the dam supplies water to the lower end of the fish ladder through floor diffusers. The end gate and a fixed-open side gate operate to attract adult fish from the spillway section of the dam. The end gate, MO3 is required to operate at 8.5 ft or greater depth below tailwater while the side gate is continually open and depends on head differential to be within acceptable criteria. The head differential required for both gates is the standard 1.0-ft to 2.0-ft range.

In 1999, gate depths recorded during the inspections ranged from 8.7 ft to 9.1 ft. The head differentials during the season ranged from 1.1 ft to 1.5 ft. All readings should have provided satisfactory passage for adult fish at the Middle ladder this year. Flow was high enough on the September and October inspections that the gate did not rest on sill, as reported in previous fall seasons.

**Fish Ladder:** The depth of water over the fish ladder weirs was reported at 1.1 ft for six of the seven inspections, with the other reading at an even 1.0 ft. The picketed leads and the ladder exit were clear of debris during the inspections.

**Spillway:** Specific spillways at the project have been modified (notched) to improve passage for juvenile salmonids. Bays affected for the year were 1, 16, 17, 18, 25, 26, 29 through 32. Approximately 21 – 42 kcfs was available for fish spill during the spring and the summer through these gates. It appeared that adult fish passage through the middle ladder was not affected due to the spill or spill pattern based on fish counts at the middle ladder.

### **Right Bank Fishway**

Auxiliary water is supplied to the Right Bank Fishway from three fish pumps that pull water from the tailwater and gravity-fed water from the forebay of the dam. Most of this flow enters the fishway in the lower end of the fish ladder through sidewall diffusers. The attraction water is distributed to an entrance gate at the downstream end of the project, one main gate at the left end of the powerhouse, and through 2 gates at the right end of the powerhouse. Each entrance gate is opened 3-ft, but its depth will increase as flow and tailwater elevation increases. The gates are operated to meet head differential criteria of 1.0 to 2.0 ft. In addition to the entrance flow, a high velocity flow of water is discharged below the water surface near the right powerhouse entrance gates. The purpose of this high velocity flow is to attract fish to the right powerhouse entrances from across the face of the dam. The gravity flow water was operated at 100% open on all inspections; the pumped water was at 100% flow on 4 of the 7 inspections.

The entrance gates, TPE, LPE, and the RPEs were reported with head differentials that ranged from 0.6 ft to 1.7 ft through the season. Head differentials were less than 1.0 ft at each entrance during the June and July inspections and less than one ft only at the downstream entrance in August. When tailwater elevations exceed or are near elevation 575.0 ft, the head differentials drop below the minimum 1.0 ft. The velocity estimated down the transportation channels was again measured using a flow meter during the year. Velocity ranged between 3.7 to 4.3 fps during the inspections and was near identical to the 1998 readings.

**Table 7. Pertinent Data for Fish Facility Inspections in 1999 at ROCK ISLAND DAM**

<b>CRITERIA ITEMS</b>	<b>DATE OF INSPECTION</b>							
	<b>14-Apr</b>	<b>20-May</b>	<b>24-Jun</b>	<b>22-Jul</b>	<b>19-Aug</b>	<b>22-Sep</b>	<b>26-Oct</b>	
<b>LEFT BANK FISHWAY</b>								
<b><i>Left Bank Entrance:</i></b>								
Depth over entrance weir								
LO5 (Crit. = 6.0 ft or >)	ft	6.8	6.5	6.6	6.6	6.7	6.9	6.7
LO6 (Crit. = 6.0 ft or >)	ft	6.8	6.6	6.7	6.6	6.7	6.9	6.7
Head at LO5 & 6 (Crit. = 1-2 ft)	ft	1.3	1.2	1.2	1.3	1.3	1.2	1.0
Dep. over ladr. weir (Cr. = 1-1.2')	ft	1.0	1.0	1.0	1.1	1.1	1.1	1.1
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	yes	no
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
<b>CENTER FISHWAY</b>								
<b><i>Center Entrance:</i></b>								
Depth over entrance weir								
MO7 (Criteria = 8.5 ft or >)	ft	8.9	8.8	9.1	9.0	8.7	9.1	8.6
Head at MO7 (Criteria = 1-2 ft)	ft	1.3	1.3	1.1	1.3	1.3	1.5	1.3
Dep. over ladr. weir (Cr. = 1-1.2')	ft	1.1	1.0	1.1	1.1	1.1	1.1	1.1
Picket leads clean		yes	yes	yes	yes	yes	yes	yes
<b>RIGHT BANK FISHWAY</b>								
<b><i>Right Bank Entrance:</i></b>								
Head Differential (Crit. = 1-2 ft)								
LPE-1	ft	1.3	1.0	0.7	0.9	1.1	1.4	1.1
RPE-1 and RPE-2	ft	1.5	1.2	0.8	0.9	1.2	1.5	1.7
TRE	ft	1.1	1.0	0.6	0.8	0.9	1.3	1.5
Dep. over ladr. weir (Cr. = 1-1.2')	ft	1.0	1.0	1.1	1.1	1.1	1.1	1.1
Channel velocity (Cr. = 1.5-4 fps)	fps	4.2	~4.0	3.7	4.1	4.2	4.3	4.2
Picket leads clean		yes	yes	yes	yes	yes	yes	yes
Pumps operating		3	3	3	3	3	3	3
Comment number (if applicable)		1	2	3	3			4

**Comments:**

1. Juvenile fish sampling on-going; Larger boat for sampling fish to test survival was parked near the left entrance.
2. Juvenile spill program w/41 kcfs through designated gates.
3. Tailwater elevations above 576 ft; result was very low head differentials at the Right Fishway entrances.
4. Survival study through slotted gates in the spillbays; Normandieu (Company) doing study.



**Fish Ladder:** Depth of water measured over the ladder weirs ranged between 1.0 to 1.1 ft for the Right ladder on each inspection and was within acceptable range of 1.0 to 1.2 ft. The exit from the fish ladder was clear of debris, as was the picketed leadsection at the fish counting station.

**Overall,** the fish passage facilities operated within criteria limits through the 1999 season with exception of the June and July inspections at the Right Bank Fishway. Areas of concern are listed below.

- Adult fallback should be assessed given the increased number of spillbay gates that are presently being used to pass juvenile fish at the project. Likewise, Chelan PUD should assess passage of adult fish through the Middle Ladder to assure that impacts are not occurring at the MO3 Entrance. (Same as the 1998 Report)
- The Right Bank Fishway cannot meet criteria at the main entrances when tailwater elevations increase to near or above elevation 575.0 ft.
- The Right Bank fish counting station should be further assessed for passage delays of adult salmon and steelhead, especially during the summer and fall season.
- Based on the previous season, the project should inspect the diffuser gratings (wall and floor) on at least an annual basis to confirm that they are in satisfactory condition and change or modify them as necessary.

## **ROCKY REACH DAM**

Rocky Reach Dam was completed in 1961 and is owned and operated by Chelan County PUD. The project is comprised of 11 main turbine units and 12 spillbays. Four of the turbies are fixed blade units (8-11) and are on the north end of the powerhouse. The project has been modifying turbine units in recent years to make them more “fish friendly” and that will hopefully result in less mortality for juvenile or adult fish that pas through the turbines.

The adult fish facilities are comprised of three turbinèdriven propeller-type fish pumps that supply water from the tailwater of the project for the powerhouse fishway entrances, most of the spillway entrance flow and the six orifice gates along the powerhouse collection channel. The fish pumps operated satisfactorily again during the 1999 fish passage season. Additional gravity flow water was supplied at the main spillway entrance to maintain the agreed upon criteria for the entrance. The powerhouse collection, left powerhouse, and spillway channels merge in the junction pool area to form the transportation channel. The transportation channel allows fish to

move to the lower end of the fish ladder. The fish ladder exit is located on the Right Bank of the Columbia River.

Prior to the 1999 fish passage season, a meeting with Chelan PUD was completed that reviewed the 1998 season activities and any problem areas noted at Rock Island or Rocky Reach dams. The planned winter activities were discussed along with project activities that might affect fish passage. This was also the initial review of what the Biological Opinion might include that would affect fish facilities (presented by NMFS). Also, it was an opportunity to let the projects know that there would be new inspectors for the 1999 season.

Denise McCarver and Glen Liner, WDFW inspected the adult fish passage facilities 7 times during the 1999 fish passage season with the initial inspection on April 14 and the final inspection on October 26. Normally, the fishways were operating near acceptable criteria ranges with some exceptions. Table 8 lists inspections and pertinent data with the text giving details of the season activities.

### **Powerhouse Entrances**

The Right Powerhouse Entrances (RPE-1 and RPE-2) are rotary wing gates that should operate with a 3-ft opening, and a head differential of 1.0 ft to 2.0 ft. During the late fall, tailwater elevations fluctuations were at times extreme (>5 ft in a few hours), and this resulted in the system trying to adjust to meet these large changes in elevation. During the final inspection, head differential was recorded at 0.8 ft at the RPEs even though it had been set only an hour prior. The fishway attendant adjusted the pumped flow at that time and brought the reading back up to the 1.0 ft level. The remaining 6 inspections had “head” ranging between 1.1 ft to 1.2 ft. Six orifice gates along the channel operated satisfactorily this season.

The Left Powerhouse Entrances, LPE-1 and LPE-2, are located at the left end of the powerhouse nearest to Main Turbine #11. One entrance discharges its flow back toward the powerhouse with the other discharging its flow toward the retaining wall that separates the spillway flow from the powerhouse flow. The main powerhouse discharge is at right angle to the spillway discharge.

In 1999, gate depths at LPE-1 and LPE-2 ranged from 9.4 ft to 11.2 ft with head differentials that ranged from 1.0 ft to 1.6 ft. The “head” was within the required range of 1.0 – 2.0 ft on all inspections. During the September inspection, the gate depth was less than 10.0 ft (9.4 ft recorded), and it appeared that the Gate could have been lowered since there was sufficient “head”, 1.6 ft, to achieve that.

A new velocity meter is mounted in mid-channel of the transportation channel so no more wood chunks were required this year. For the season, the velocity ranged from 1.5 to 1.8 fps and all readings fell within acceptable range, i.e., 1.5 to 4.0 fps.

### **Spillway Entrance**

The Spillway Entrance, MSE, discharges attraction water between spillbays 8 and 9. The spillway entrance was opened prior to May 1 in 1999. The MSE gate operated with depths ranging from 8.3 ft to 11.5 ft. Head differentials ranged from a low of 0.6 ft on April 14 to 1.2 ft. Only during the initial inspection was the head differential less than 1.0 ft. Similar to the LPEs, the spillway entrance had gate depth that was less than 10.0 ft during the September inspection.

Main Turbine Unit #11 was operating on 5 of the 7 inspections during the season. It is still unknown whether operation of this Unit affects passage of adult fish at the LPEs; probably not; however, the turbine boil does not allow the flow from the LPEs to extend, as far into the tailwater as when the Unit does not operate.

**Fish Ladder:** The exit from the fish ladder was clear of debris during the 1999 inspections. The depth of water over the fish ladder weirs was 1.0 ft during all inspections and was within the criterion range of 1.0-1.2 ft.

**Overall,** the fishways were normally operating near criteria with few exceptions. During the season, pump 1 was operated on manual for most of the year with pumps 2 and 3 operated in auto to keep the required head and gate depths. In addition, the fishway attendants covered a larger part of the day to assure that the fishways were kept closer to criteria levels during the early morning hours when flows were rapidly changing at the project. This effort should have resulted in better passage conditions for adult fish during the 1999 season.

- Head differentials were less than 1.0 ft on one of seven inspections at the RPEs and 1 of 7 at the MSE.
- Gate depth exceeded 10.0 ft on 6 of 7 inspections; however, head differential was satisfactory during that inspection.
- Where possible, Chelan PUD should reduce the level of peaking or tailwater fluctuation during a 24-h period.

**Table 8. Pertinent Data for Fish Facility Inspections in 1999 at ROCKY REACH DAM.**

<u>CRITERIA ITEMS</u>	<u>DATE OF INSPECTION</u>						
	<u>14-Apr</u>	<u>20-May</u>	<u>24-Jun</u>	<u>22-Jul</u>	<u>19-Aug</u>	<u>23-Sep</u>	<u>26-Oct</u>
<b>ADULT FISHWAY</b>							
<b><i>Left Powerhouse Entrance:</i></b>							
Depth over entrance weirs							
LPE-1 & 3 (Depend. On Tw Elev) ft	11.2	10.1	10.1	10.7	10.5	9.4	11.1
Head at LPE-1 & 3 (Crit. = 1-2 ft) ft	1.3	1.0	1.0	1.2	1.1	1.6	1.1
Depth over Ladr Weir (Crit = 1-2 ft) ft	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Channel velocity (Crit. = 1.5-4 fps) fps	1.5	1.8	1.7	1.6	1.6	1.5	1.5
Ladder exit clean (yes/no)	yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes/no)	yes	yes	yes	yes	yes	yes	yes
Turbine Unit 11 Operating (yes/ no)	yes	yes	yes	no	yes	no	yes
<b><i>Right Powerhouse Entrance:</i></b>							
Wing gate opening (Criteria = 3.0 ft)							
RPE-1 and RPE-2 ft	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Head at RPE-1&2 (Crit. = 1-2 ft) ft	1.1	1.2	1.1	1.1	1.1	1.1	0.8
Pumps operating	3	3	3	3	3	3	3
<b><i>Spillway Entrance:</i></b>							
Depth over entrance weir							
MSE (Dependent on Tailwtr Elev.) ft	10.7	10.2	10.0	11.5	10.7	8.3	11.0
Head at MSE (Criteria = 1-2 ft) ft	0.6	1.2	1.0	1.1	1.0	1.2	1.1
Comment number (if applicable)	1	2	2				3

**Comments:**

1. The head differential at the spillway entrance was 0.6 ft; the project will attempt to improve head.
2. Pump A was operated in manual for 4 months until repair could be made in late August.
3. Large tailwater fluctuation required manual adjustment of the head differential; pumped flow increased and head corrected to 1.0 ft.

## WELLS DAM

Wells Dam was completed in 1967 with 10 main turbine units and the spillbays placed directly above them. The turbine units are termed hydrocombines. The hydropower project is owned and operated by Chelan PUD.

The adult fish passage facilities were built and incorporated into the project during the construction phase. The West and East Bank fishway entrances are similar in design and normally operate with an end gate and a side gate open. The end and side gates are wing gates and can open to 8-ft at maximum width. The depth of water passing through the entrance gates extends from the floor of the fishway to the water surface elevation in the entrance pool. High velocity water discharge pipes normally operate near the side entrances. Two or three of them operate at different elevations (depending on tailwater elevation) and send flow out toward Unit 1 and Unit 10 discharge. This flow is supposed to attract adult fish to the side entrances. These jets normally operate when the side entrances are open.

Stewart Mitchell, WDFW, completed 7 inspections of the adult fishways during 1999. The initial inspection was April 14 and the final inspection on October 26. Results of the inspections are summarized in Table 9 with discussion in the text below.

Water is supplied to the main entrances by two turbinedriven fish pumps (2 per side) that diffuse water into the lower end of the fish ladder through wall and floor diffuser gratings. The pumps operated satisfactorily throughout the 1999 fish passage season. The project can normally meet head differential criterion at the main entrances through all tailwater and flow conditions.

The West and East fish ladders incorporate trapping facilities for adult brood collection. Trapping schedules are coordinated among the various agencies with WDFW doing the actual trapping and handling at the Project.

Inspection procedures follow a given pattern, i.e., the inspector normally goes to the Control Room to take the computer readings of the fishway main entrance gates, etc. These readings are then compared with staff gages and deck gages located at the entrances. These readings should be within 0.2 ft. If the gages vary by more than the 0.2 ft to 0.3 ft, then the project would calibrate the deck or Control Room gage. This was valid as long as the tailwater and entrance staff gages could be easily read or the tailwater elevation was somewhat flat.

### **East and West Fishways**

During this year's inspections, the side entrances were closed on four of the seven inspections due to the high spill levels or an operational change. When the side gates are closed, the end gate was opened 8-ft. The head differentials reported at the **East** entrances for the 1999 season ranged between 1.1 ft and 1.5 ft based on the staff gage reading when feasible. The staff gages were unreadable on one occasion and resulted in using a combination of staff and deck or computer reads to complete the inspection (similar to 1998). The head differential readings at the **West** fishway entrances ranged between 1.1 ft and 1.6 ft. The staff gage readings were unreadable on one of the 7 inspections.

The head differential target of  $1.5 \text{ ft} \pm 0.1 \text{ ft}$  was met on 5 of the 7 inspections at the East fishway and 3 of 7 inspections at the West fishway entrances. The head differential was greater than 1.0 ft on every occasion during the 1999 season, and should have provided satisfactory adult passage conditions at the main entrances throughout the main fish run.

**Fish Ladder:** At both fishways, the exits from the fish ladder were monitored for differential between the last fish ladder pool and the forebay elevation. Normally, the differential ranges between about 0.5 ft to 0.8 ft depending on the forebay elevation. In 1999, differentials at the exits ranged from 0.5 ft to 1.0 ft (same as 1998). The exit from the fish ladder appeared clear of debris through most of the year; however, three and four inspections (different sides) reported a differential of 0.9 ft to 1.0 ft. The project was asked to clean debris from the trash racks if needed. The picketed leads at the counting stations appeared clear of debris during the inspection dates except for the final one. The operator cleaned the grating and that improved the flows through that area. The depth of water over the ladder weirs ranged from 1.2 ft to 1.3 ft at the West and East ladders. Preferred depth over ladder weir readings should be nearer 1.0 ft than 1.3 feet.

**Spill Basin:** During this year's inspections, spill was only provided through the juvenile bypass system in bays 2, 4, 6, 8, and 10. Generally 1012 kcfs spill was passing through those spillbays.

**Table 9. Pertinent Data for Fish Facility Inspections in 1999 at WELLS DAM.**

<b>CRITERIA ITEMS</b>	<b>DATE OF INSPECTION</b>						
	<b>29-Apr</b>	<b>27-May</b>	<b>15-Jun</b>	<b>20-Jul</b>	<b>27-Aug</b>	<b>21-Sep</b>	<b>25-Oct</b>
<b>EAST FISHWAY:</b>							
Head at main entrance (Target = 1.5ft)	ft 1.5	1.4	1.1	1.3	1.4	1.5	1.5
D/Stream entrance open (Criteria = 6-ft)	ft 8.0	6.0	6.0	8.0	6.0	8.0	8.0
Side entrance open (Criteria = 4-ft)	ft 4.0	4.0	4.0	Closed	4.0	Closed	Closed
Depth over ladder weir (Crit.= 1-1.2 ft)	ft 1.2	1.3	1.3	1.3	1.3	1.2	1.2
Ladder exit differential (Criteria = .6-.8ft)	ft 0.5	0.7	0.8	1.0	0.9	1.0	0.9
Staff gages clean/readable (yes or no)	no	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)	yes	yes	yes	yes	yes	yes	no
Fishway entrance jets	2-open	2-open	2-open	Closed	2-open	2-open	2-open
<b>WEST FISHWAY: (Criteria same as East)</b>							
Head at main entrance	ft 1.5	1.3	1.2	1.1	1.4	1.3	1.6
Downstream entrance open	ft 8.0	6.0	6.0	8.0	6.0	8.0	8.0
Side entrance open	ft 4.0	4.0	4.0	Closed	4.0	Closed	Closed
Depth over ladder weir	ft 1.2	1.2	1.3	1.3	1.3	1.2	1.2
Ladder exit differential	ft 0.6	0.7	0.9	0.9	0.7	0.9	0.8
Staff gages clean/readable	yes	yes	yes	yes	no	yes	yes
Picket leads clean	yes	yes	yes	yes	yes	yes	no
Fishway entrance jets	2-open	2-open	2-open	Closed	2-open	2-open	2-open
Comment Number (if applicable)	1		2	3			

**Comments:**

1. Fishway entrance jet at elev 708 OOS for April and May inspections; juvenile spill about 10 kcfs through 5 bays.
2. Forebay down 5 ft to flush mouth of Methow River; End gate open 8 ft during higher spill; debris being cleared from forebay.
3. Staff Gages unreadable; unable to calibrate the deck gage and computer gage located in the Control Room.

**Overall**, it appeared that the main fishway entrances at Wells Dam performed satisfactorily throughout the adult fish passage season. Some changes or improvements should be taken by the project include:

- Staff gages at the project should be changed to be removable ones if possible as they were unreadable on several inspections. Either that or the gages should be cleaned at a regular basis, especially during periods of low tailwater. (same comment as in 1998)
- Hydraulic evaluation or flow measurements should be taken to determine velocities through side and wall diffusers.
- A determination should be made whether to operate the side entrances in future years.
- Operating the fish ladder at reduced depth of water over the ladder weirs; a target might be 1.1 ft ± 0.1 ft.
- More frequent checks of the ladder exits should be made later in the season (higher grass and milfoil buildup).

## **ICE HARBOR DAM**

Ice Harbor Dam was the initial dam constructed in the lower Snake River and was completed in 1961. The project now has 6 main turbine units along with ten spillbays and is operated by the COE. A recent change at the project has been the addition of flippers in the spillbays and a training wall (completed in 1999) to “straighten” flow on the south end of the spillway.

The adult fish facilities consist of 2 separate water supply systems for the south and north shore fishways. Attraction flow to the **south fishway** is supplied by up to eight electric pumps and about 200 cfs flow from the juvenile bypass system. Normally 5 to 8 fish pumps operate depending on the tailwater elevation. Under most river flow conditions, the project can maintain the fishway within acceptable criteria for gate depth and head differential. Three electric fish pumps supply attraction water to the **north shore** fishway. The pumps appeared to work satisfactorily this season but it has remained a problem to meet both gate depth and head differential at the north shore entrance gates.

Steve Richards, WDFW inspected the Ice Harbor Dam adult fishways seven times during the 1999 fish passage season. Details of the inspections are found in Table 10 and the summary of the 1999 inspections that follows.

A fishway inspection is completed as follows: The inspector reports into the operations office, obtains hydraulic information including river Q, spill patterns, and turbine operation from the control room. The inspector also receives a computer printout of the elevations of the entrance gates, corresponding head differentials, etc. Site readings are taken to compare how well the



computer system correlates to the site readings. Readings should be fairly close between the computer and the on-site elevations especially during lower flows when tailwater elevations are more stable and spill levels are reduced.

### **South Shore Fishway Inspections**

In 1999, eight fish pumps were operating on 6 of the 7 inspections along with the excess juvenile bypass flow. The south shore entrance gate (SFEW-1) was on sill 2 of the 7 inspections with the remaining 5 inspections having flexibility to lower the gate and rest on sill if required. Existing criteria require that Gate SFEW-1 be submerged 8 ft or greater or rest on sill as tailwater elevations drop to where 8' can not be achieved. On 4 of the 7 inspections the Gate was submerged 8 ft with the remaining inspections having less than 8 ft depth. It appeared that on one occasion an additional pump was required to meet depth and "head" criteria. Note that the 8<sup>th</sup> pump was started immediately after the inspection. For the season, the gate depths ranged from a low of 6.6 ft to a high of 8.6 ft. The head differential measured at SFEW1 ranged from 1.0 ft to 2.0 ft.

The north powerhouse entrance gate (NFE-2) has similar criteria relating to gate depth and head differential as the south entrance. Similar to 1998, the weir depths ranged between 8.1 ft and 9.5 ft from April through July. The August, September, and October inspections had weir depths of 6.4 ft, 6.8 ft, and 7.0 ft, respectively with head differentials for the same inspections of 1.5 ft, 1.3 ft, and 1.7 ft. The overall range for head was 0.9 ft to 1.7 ft for the season. The May inspection reported the low head of 0.9 ft, but the gate depth was 9.2 ft and it appears there was sufficient flow out the entrance for that inspection.

It appeared from the inspection reports that on several occasions, sufficient water was available to meet criteria, but that the control system was not functioning properly to allow the gate depth or head differential to be within the proper range. The Ice Harbor project should continue to work on their control system and make it workable prior to and during the year 2000 fish passage season. The 1999 season appeared to have very similar results as in 1997 and 1998 when flow was sufficient, but the system was not balanced properly between head and gate depth.

Across the powerhouse, 7 floating orifice gates operated throughout the fish passage season. It appeared from the inspections that they worked satisfactorily during 1999. The collection channel velocity was not reported during the initial 4 inspections due to the meter broken and out of service. From August on, the velocity ranged between 3.6 to 4.0 fps.

**Fish Ladder:** The inspector reported that the exit from the fish ladder, and gatewells (juvenile fish bypass system) across the powerhouse forebay deck were clear of debris during the season. The maximum differential measured across the picketed leads was 0.2 ft and that would indicate that

debris was settling on the leads. The head loss from the first exit pool to the forebay was even throughout the year indicating that the racks were clear of debris.

### **North Shore Fishway Inspections**

Gate NEW-1 was submerged 8.0 ft or greater depth on 2 occasions, both during the higher flow period (through June). The gate depths ranged from 7.2 ft to 8.4 ft from April through June and then gate depths dropped to 5.2, 5.6, 7.4, 5.6 ft for the final four inspections. Head differentials were greater than the 1.0-ft minimum on all 7 inspections with the range from 1.1 to 2.4 ft. The control system appeared to be not working properly as there was sufficient head differential to allow the gate depth be increased on several inspections.

**Fish Ladder:** The exit from the north shore fish ladder and also the picketed leads at the counting station were reported clear of debris through the inspection season. The tailwater staff gage was not usable for calibration or calculation through much of the inspection season.

**Overall,** the inspections completed during 1999 showed the following items that required action on part of the project to improve fish facilities and inspections.

- Higher flows and spill experienced during the spring and early summer affected operation of the gates or else the computer-controlled system was unable to properly keep the head differential or gate depth at the correct elevation. Normally the system was found to be out of criteria for a short time before it could catch up and move back in proper elevation. Same problem as noted in 1997 and 1998.
- The project needs to place staff gages or assure that electronic measuring devices are calibrated and accurate. Normally it was impossible to obtain best data at the north shore and north powerhouse during spill periods.
- The north powerhouse entrance flow (observed from deck level) appeared to go almost out a short distance from the entrance and pile straight into the spill effect that pulled that flow directly north.
- As discussed at the FPOM meeting (June 1999), a change in the FPP should be made to assure that the fish pumps at the project remain on line unless there are specific requirements to shut them down. The fish pumps were off line from May 26 to June 2 and tailwater elevations were less than elevation 353. The COE reviewed the structural drawings and design and they are revising emergency procedures for the project. Presently, the deviation 353 ft will be taken out of the document.

**Table 10. Pertinent Data for Fish Facility Inspections in 1999 at ICE HARBOR DAM.**

<b>CRITERIA ITEMS</b>	<b>DATE OF INSPECTION</b>							
	<b>14-Apr</b>	<b>20-May</b>	<b>25-Jun</b>	<b>13-Jul</b>	<b>26-Aug</b>	<b>14-Sep</b>	<b>25-Oct</b>	
<b>SOUTH SHORE FISHWAY</b>								
<b>South Shore Entrance:</b>								
Depth over entrance weir								
SFEW-1 ( Crit. = 8 ft or >)	ft	8.4	8.3	8.6	6.6	8.1	7.7	7.2
Head at SFEW-1 (Criteria = 1-2 ft)	ft	1.7	1.6	1.3	1.6	1.9	1.0	2.0
Dep. over ladr. weir (Cr. = 1-1.3 ft)	ft	1.0	1.1	1.1	1.1	1.1	1.2	1.1
Channel velocity (Crit. = 1.5-4 fps)	fps	OOS	OOS	OOS	OOS	4.0	3.6	4.0
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	no	0.2'	yes
Pumps Operating (8 available)		8	8	8	8	8	7	8
<b>North Powerhouse Entrance:</b>								
Depth over entrance weir								
NFE-2 (Criteria = 8 ft or >)	ft	8.1	9.2	8.7	9.5	6.4	6.8	7.0
Head at NFE-2 (Criteria = 1-2 ft)	ft	1.0	0.9	1.4	1.0	1.5	1.3	1.7
Staff gages clean	ft	yes	yes	yes	yes	yes	yes	yes
<b>NORTH SHORE FISHWAY</b>								
<b>North Shore Entrance:</b>								
Depth over entrance weir								
NEW-1 (Criteria = 8 ft or >)	ft	7.2	8.4	8.1	5.2	5.6	7.4	5.6
Head at NEW-1 (Criteria = 1-2 ft)	ft	1.5	1.7	1.6	2.4	1.1	1.1	1.9
Dep. over ladr. weir (Crit. = 1-1.3 ft)	ft	1.0	1.1	1.1	1.1	1.2	1.1	1.0
Ladder exit clean		yes	yes	yes	yes	yes	yes	yes
Staff gages clean		yes	yes	yes	yes	yes	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	yes
Pumps Operating (3 available)		3	3	3	3	3	3	3
Comment Number (if applicable)			1	2	3		4	5

**Comments:**

1. The south shore channel velocity meter is out of service. Surface velocity is estimated by the inspector.
2. With spill, about 2' difference in tw elevation between s and n shore entrances; Calibration freq req for n shore.
3. During season, it was difficult to estimate staff gage reading because of huge wave action by entrances.
4. Gate depths less than required at all 3 main entrance gates; project asked to turn on 8th fish pump.
5. North shore gates should have been lowered to provide more depth at those entrances.

## **Lower Monumental Dam**

Lower Monumental Dam was completed in 1969 and is operated by the COE. A full complement of six turbine units and eight spillbays with fliplips installed on 6 bays are presently in operation at the dam.

The project incorporates three turbine-driven pumps that pull water from the tailrace and supply water to a conduit that distributes this flow to the diffuser system along the collection channel and the north and south shore collection systems. Although the south shore of the project has a separate fish ladder, there was no separate water supply added to that side of the dam. In the early 1990s, about 200 cfs of excess water flow from the juvenile bypass system was also added to the north shore supply diffusers. The water supplied from the juvenile bypass system operates on an annual basis from approximately March through December. Since that time, and with other changes made to the fish pumps, they can normally meet gate depth and head differential criteria with 2 pumps if required. The adult fish passage facilities at Lower Monumental Dam were inspected seven times by Steve Richards, WDFW inspector during 1999. The first inspection was April 20 and the final inspection on October 28. Data from the inspections are reported in the discussion below as well as in Table 11.

### **North Shore Fishway**

The north shore fishway entrance gates, NSE-1 and NSE-2, were operated with gate depths ranging from 8.0 ft to 8.3 ft during the inspections. The depth criterion was 8.0 ft or greater submerged below tailwater elevation for the two gates. The head differentials ranged from 1.2 ft to 1.5 ft; all readings were in the acceptable range of 1.0 to 2.0 ft.

The inspector recorded that the water velocity in the collection channel was satisfactory through the season. An electronic velocity meter was located in the northern end of the collection channel. For the season, the velocity in the channel was recorded with a range of 1.4 fps to 2.8 fps. Along the collection channel 5 floating orifice were operated. All worked satisfactorily during the 1999 season.

The south powerhouse entrances, SPE-1 and SPE-2, were operated with gate depths ranging from 6.4 ft to 8.3 ft. Gate depths were above 6.0 ft on all inspections; above 8.0 ft on the first 3 inspections when tailwater elevation allowed the project to operate the gates off sill. During the final 4 inspections, the gates were on sill so no further depth could be attained. The head differentials measured at the entrances ranged from 0.9 ft on the initial inspection to a high of 1.5 feet.

**Fish Ladder:** The depth of water over the north shore fish ladder weirs was 1.1 ft on all inspections. All readings were acceptable. The differentials reported at the fish ladder exit and at the picketed leads at the fish counting facility were within acceptable ranges. Floating debris was accumulating on the outside of the exit during the September inspection, but the exit was not plugged with debris. The debris was likely the result of a windstorm that pushed the debris to the exits. Normally air from a high-pressure conduit was continually bubbled in near the surface of the water near the exit and this kept debris from the exit.

### **South Shore Fishway**

Two south shore entrances are operated (both downstream, no side entrance) to attract fish to the spillway or south fish ladder. All auxiliary water is supplied from the north shore turbine driven pumps except for the 80 cfs flow that enters from the fish ladder. Gate SSE2 is a fixed-open gate that remains 6-ft open while Gate SSE-1 is to be submerged 8 ft or greater during normal operation. Gate depths at SSE-1 ranged from 7.8 ft to 8.3 ft with the gate on sill during one inspection. The head differentials at the south entrances ranged from 1.1 ft to 1.8 ft during the 7 inspections and were within acceptable criteria. The head differentials ranged between 1.4- 1.8 ft during the final three inspections when the gate depth was just shy of 8.0 ft, so Q and velocity from the south entrances should have been satisfactory.

**Fish Ladder:** The south shore exit was within acceptable criteria range except the September inspection when a lot of floating debris was in the forebay from a windstorm; however, the trash racks did not indicate any buildup of debris (head loss across the rack). The picketed lead section at the fish counting station was reported clear of debris throughout the fish passage season. The depth of water over the ladder weirs ranged from 1.0 ft to 1.1 ft so the readings were acceptable throughout the inspections.

**Overall,** this year's inspections at the project showed the project operation of fishways to be within acceptable criteria on the 7 inspection with only minor problems. The computercontrolled fishway appeared to perform very well and readings from the computer were normally close to the site readings obtained by the inspector.

- When high debris loads are present, one solution would be to modify the racks in front of the fish turbines to allow for cleaning of the intake system.
- The end two spill bays were not used in 1999 due to damage and erosion on them.

**Table 11. Pertinent Data for Fish Facility Inspections in 1999 at LOWER MONUMENTAL DAM**

<b>CRITERIA ITEMS</b>		<b>DATE OF INSPECTION</b>						
		<b>20-Apr</b>	<b>20-May</b>	<b>29-Jun</b>	<b>29-Jul</b>	<b>26-Aug</b>	<b>16-Sep</b>	<b>28-Oct</b>
<b>NORTH SHORE FISHWAY</b>								
<b>North Shore Entrance:</b>								
Depth over entrance weir								
NSE-1 (Criteria = 8 ft or >)	ft	8.0	8.2	8.0	8.2	8.2	8.2	8.0
NSE-2 (Criteria = 8 ft or >)	ft	8.0	8.2	8.0	8.3	8.2	8.1	8.0
Head at NSE-1 & 2 (Crit. = 1-2 ft)	ft	1.2	1.2	1.3	1.3	1.3	1.3	1.5
Dep. over ladr. weir (Cr. = 1-1.3 ft)	ft	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Channel velocity (Crit. = 1.5 - 4 fps)	fps	2.4	>2.0	2.3	2.8	2.0	2.3	1.4
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	no	yes
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
<b>South Powerhouse Entrance:</b>								
Depth over entrance weir								
SPE-1 (Criteria = 8 ft or >)	ft	8.0	8.0	8.3	7.6	6.4	8.0	7.4
SPE-2 (Criteria = 8 ft or >)	ft	8.0	8.0	8.3	7.5	6.4	8.0	7.3
Head at SPE-1 & 2 (Crit. = 1-2 ft)	ft	0.9	1.0	1.0	1.0	1.1	1.0	1.5
Staff gages clean/readable (yes or no)		yes	yes	yes	yes	yes	yes	yes
<b>SOUTH SHORE FISHWAY</b>								
<b>South Shore Entrance:</b>								
Depth over entrance weir								
SSE-1 (Criteria = 8 ft or >)	ft	8.0	8.3	8.0	8.0	7.9	7.8	7.9
SSE-2 (permanent) 6-feet	ft	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Head at SSE-1 & 2 (Crit. = 1-2 ft)	ft	1.4	1.0	1.5	1.5	1.4	1.8	1.6
Dep. over ladr. weir (Crit. = 1-1.3')	ft	1.0	1.1	1.1	1.1	1.1	1.0	1.0
Ladder exit clean		yes	yes	yes	yes	yes	no	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	yes
Pump speed	rpm	70	70	71-72	72-73	74-75	72-74	69-73
# of Pumps Operating (3 available)		3	3	3	3	3	3	3
Comment Number (if applicable)							1	

**Comments:**

1. The exits from the fish ladders had large quantity of small woody debris floating above them;. The project should check to see whether the south fishway reads are accurate. It would appear that calibration of the tailwater and channel elevation levels are required.

## LITTLE GOOSE DAM

Little Goose Dam was completed in fall 1970 and is operated by the COE. The project consists of six main turbine units and eight spillbays of which 6 are equipped with fliplips.

The adult fish facilities incorporate three main entrances, south shore, north powerhouse, and north shore. Fish entering the north shore entrance are directed to the north end of the powerhouse and then to the one fish ladder passing the project at the south end of the dam. Three turbine-driven pumps supply auxiliary water to the fishway and with an additional 200 cfs excess flow from the juvenile bypass system, the adult fish facilities normally can operate within acceptable criteria throughout most flow conditions.

Shawn Rapp, ODFW completed 7 inspections of the Little Goose Dam fish facilities in 1999, commencing on April 13 and ending on October 26. Details of the inspections are given below and summarized in Table 12.

During 1999, the project operated the pumps with the rpm level between 7175 rpm. There were no reports that debris caused problems with operation of the pumps, i.e., reduced rpm from any pump this season.

### **Fishway Inspections**

The two South Shore entrances (SSE-1 and SSE-2) are operated to allow 8.0 feet or greater weir submergence with a head differential between 1.0 ft to 2.0. The project actually operated the south shore entrances to achieve 9.0 ft or greater depending on the tailwater elevation. Through the inspection season, the gate depths ranged from 8.9 ft to 10.0 ft with head differentials ranging from 1.0 ft to 1.6 ft. All readings were well above the minimum of 8.0 ft gate depth and 1.0 ft head differential and resulted in satisfactory operation through the year. The two north powerhouse entrances, NPE-1 and NPE-2 were operated to meet the depth criteria of 7.0 ft or greater submergence below tailwater. Through the inspections, the depths ranged from 6.3 ft to 7.8 ft. The NPE gates were on sill or within 0.5 ft of being on sill during all fishway inspections conducted in 1999. The head differential ranged between 1.0 to 1.9 ft for the season. With the gates on sill, and the "head" greater than 1.0 ft, the gates were operated at acceptable criteria throughout the season. The velocity through the collection channel and to the north shore generally was estimated near 0.5 to 1.0 fps on the south end of the channel (electronic meter) and increases to >2.0 fps at the northern end of the powerhouse channel. At the north shore entrance transport channel, a visual measurement of the surface velocity (floating chunk of wood) ranged

from 1.7 to 2.5 fps. Along the collection channel, 4 floating orifice gates were operated, and through the season, all operated in proper sequence and above the water surface.

**The North Shore Entrances** were set to operate at 6.0 ft or greater depth below tailwater with the head differential to be between 1.0 ft to 2.0 ft. Gate depths at NSE1 and NSE-2 ranged from 6.4 ft to 6.6 ft for the season with head differentials ranging from 0.2 ft to 1.4 ft. The gate depths at the north shore were rated satisfactory during all inspections. On two inspections, gate depth was 6.5 ft when the “head” was 0.9 ft, and still should have provided satisfactory flows through the entrances. The confusing inspection was on April 13 when we calculated the “head” at only 0.2 ft using the panel board reading in the powerhouse and the onsite collection channel elevation. The panel board indicated that the “head” was 0.98 ft or rounded off, 1.0 ft. This is the prime reason that we have asked that the project come up with a staff gage for the tailwater elevation or place a bench marker so that a Water Level Sensor can be used to accurately assess the elevations at the north shore.

**Fish Ladder:** The fish ladder at the project is located on the southern end of the dam with the exit from the ladder located between Unit 1 and the navigation lock. The spill basin is located on the northern end of the project. The fish ladder exit was reported clear of debris on all inspections except for September when floating debris was present near the exit. This was the same as at Lower Monumental Dam and likely due to the same windstorm pushing the debris against the project. Head measured across the trash racks was 0.2 ft and indicated that debris was building on the racks. Also, the picketed leads at the count station were clear of debris through the season with a maximum head differential measured across the leads of 0.4ft. The depth of water over the fish ladder weirs ranged from 1.1 to 1.2 ft for the season and readings were within acceptable range.

**Overall,** the project operated the main fishway entrances within acceptable limits during the 1999 fish passage season. Areas that should be improved follow:

- The staff gages should be replaced where necessary and calibrated so that readings can be compared between the computer and the on-site record; or else a stillwell should be placed to measure tailwater elevation at the northshore.
- Currently, all weir depth readings are taken from the panel board in the powerhouse. An on-site comparison would be helpful to assure the computer settings are correct.
- As at Lower Monumental Dam, the two outside spillbays at Little Goose are not used due to damage to the area of the spillbay. This section should be repaired.



**Table 12. Pertinent Data for Fish Facility Inspections in 1999 at LITTLE GOOSE DAM.**

<b>CRITERIA ITEMS</b>	<b>DATE OF INSPECTION</b>							
	<b>13-Apr</b>	<b>28-May</b>	<b>30-Jun</b>	<b>23-Jul</b>	<b>25-Aug</b>	<b>21-Sep</b>	<b>26-Oct</b>	
<b>SOUTH SHORE FISHWAY</b>								
<b><i>South Shore Entrance:</i></b>								
<u>Depth over entrance weir</u>								
SSE-1 (Criteria = 8 ft or >)	ft	8.9	9.9	9.3	9.5	9.2	9.6	9.6
SSE-2 (Criteria = 8 ft or >)	ft	9.1	10.0	9.3	9.6	9.2	9.6	9.6
Head at SSE-1 & 2 (Criteria = 1-2 ft)	ft	1.3	1.0	1.5	1.4	1.6	1.3	1.2
Dep. over ladr. weir (Crit. = 1-1.3 ft)	ft	1.1	1.1	1.1	1.1	1.1	1.2	1.2
Channel velocity (Criteria = 1.5-4 fps)	fps	1.2-1.8	1.0-1.4	0.9-1.9	1.0-1.7	1.2-2.5	1.1-1.9	1.8
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	no	yes
Staff gages clean (yes or no)		yes	yes	yes	yes	no	yes	yes
Picket leads clean (Criteria = 0.3' max)		yes	yes	yes	yes	yes	yes	yes
<b><i>North Powerhouse Entrance:</i></b>								
<u>Depth over entrance weir</u>								
NPE-1 (Criteria = 7 ft or >)	ft	6.1	7.8	6.6	6.5	6.3	7.4	7.6
NPE-2 (Criteria = 7 ft or >)	ft	6.2	7.7	6.6	6.5	6.3	7.3	7.6
Head at NPE-1 & 2 (Criteria = 1-2 ft)	ft	1.9	1.0	1.1	1.3	1.1	1.1	1.0
Staff gages clean		yes	yes	yes	yes	no	yes	yes
Pump speed	rpm	71	71-72	73-74	72-73	72-75	73-75	73-75
Pumps Operating (3 available)		3	3	3	3	3	3	3
<b><i>North Shore Entrance:</i></b>								
<u>Depth over entrance weir</u>								
NSE-1 (Criteria = 6 ft or >)	ft	6.5	6.4	6.5	6.5	6.5	6.6	6.6
NSE-2 (Criteria = 6 ft or >)	ft	6.5	6.4	6.5	6.5	6.6	6.6	6.6
Head at NSE-1 & 2 (Criteria = 1-2 ft)	ft	0.2	1.1	0.9	0.9	1.4	1.1	1.1
Staff gages clean		1	1	1	1	1	1	1
Comment number (if applicable)		1						

**Comments:**

1. All weir depth readings were taken from the panel board in the powerhouse. The n.sh tailwater staff gage was unusable for season. The low read at the N. Shore was likely due to a large change in the tailwater (0.8').

## LOWER GRANITE DAM

Lower Granite Dam was the last of the lower Snake River projects completed by the COE; the project began operation in 1975. The powerhouse consists of six main turbine units and eight spillbays that are equipped with flippers.

Three electric fish pumps supply water to the fishway; however, only two of the pumps can be operated at one time. Attraction flows are shunted to two south shore entrances, two north powerhouse entrances, and to four operating orifice gates along the powerhouse collection channel. There is no separate water supply for the north shore at Lower Granite Dam and is similar to Little Goose in design. Flow from the north end of the powerhouse is pushed to the north shore entrance located between the navigation lock and the spill basin.

Shawn Rapp, ODFW completed 7 fishway inspections at Lower Granite Dam during 1999. Details of the inspections can be found in Table 13 or the text below.

### **Fishway Inspections**

The South Shore fishway entrances, SSE-1 and SSE-2, operated with gate depths that ranged from 7.9 ft to 8.4 ft and head differentials that ranged from 1.2 ft to 1.7 ft. Normally, the gate depths were near 8.0 ft and “head” near 1.5 to 1.7 ft. Although the gate depths were 0.1 ft below the 8.0 ft required minimum, Q from the entrances should have been satisfactory with the “head” that was recorded during the inspections.

The water velocity was recorded via an electronic meter at the southern end of the collection channel. For the season, the water velocities ranged between 0.6 fps to 1.4 fps. The velocity meter is located at the start of the collection channel and obviously in the slowest part of the channel. All readings were below the desired 1.5 fps minimum acceptable criteria. This is an area that should be further evaluated based on fish behavior at the transition into the junction pool and turn pool.

The North Powerhouse entrances, NPE-1 and NPE-2 are to operate with gate depths of 8.0 ft or greater and head differentials between 1.0 ft and 2.0 ft. Gate depths for the season ranged from 6.2 ft to 8.2 ft. The gates were on sill during four inspections (April, June, July and August; same as in 1998). Head differentials ranged from 0.9 ft to 1.3 ft for the season. Only the May 25 inspection reported a “head” of less than 1.0 ft. When the gates were not on sill, the head and gate depth were normally in criteria or very close. All tailwater elevations from the north shore were again taken from the FSC Board as the tailwater staff gages were not re-installed during the 1998 or 1999 winter maintenance seasons. This year’s inspections showed North Shore entrances, NSE-1 and NSE-2,

had gate depths that ranged from 5.6 ft to 7.0 ft and head differentials that ranged 0.9 ft to 1.2 ft. To the extent possible, the project maintains a minimum head differential of 1.0 ft while allowing the gate depth to adjust to meet the “head”.

Problems occurred with the North Shore Entrance Gates on April 13. Gate NSE-2 was taken out of service as the pinion gear bearing failed resulting in failed gears, a chewed up shaft, and the cables broke. New shafts, bearings, bushings and gears were fabricated and installed in May. After placing Gate NSE-2 in service, Gate NSE-1 was taken off line and new cabling and gears replaced to assure that it would operate throughout the remainder of the season. When one Gate was off-line, the other was operated near 7.0 ft or as deep as possible to still maintain the head differential.

**Fish Ladder:** Adult fish exit the fish ladder at the south shore of the project. The ladder exit was reported clear of debris on all inspections during the fish passage season. The picketed leads were reported with 0.3 ft of head on one inspection and required cleaning. All other inspections reported little head loss across the leads. The depth of water over the fish ladder weirs ranged between 0.9 ft and 1.1 ft.

**Overall,** the adult fish facilities operated at less than optimal during April and May on the North Shore as only one gate operated rather than two. Several recurring problems still remain with the adult fish facilities at Lower Granite Dam:

- The project has 3 fish pumps, but only two can be operated due to hydraulic limitations of the system. As a result, the north shore entrance gates cannot operate to meet both gate depth and head differential criteria under most conditions, even though the gates could be lowered further in the gate slot.
- The project should reinstall the broken staff gage(s) at the north shore. There has been no way to obtain a reliable tailwater elevation reading for several years. Either that or a stillwell should be installed to allow a tailwater reading. It has been nearly impossible to tell whether the north shore is calibrated correctly.
- Water velocity through the beginning of the southern end of the powerhouse collection channel was less than desired for most of the fish passage season. A review of the radio telemetry study relating to fish passage through this section of the channel would be helpful in determining what effect this might have on adult fish.
- Based on initial radio telemetry study results, determination of whether one of the two south shore entrance gates should be made. It would appear that the downstream gate could be closed and the other SSE gate operated at a deeper depth.

**Table 13. Pertinent Data for Fish Facility Inspections in 1999 at LOWER GRANITE DAM.**

<b>CRITERIA ITEMS</b>	<b>DATE OF INSPECTION</b>							
	<b>13-Apr</b>	<b>25-May</b>	<b>29-Jun</b>	<b>22-Jul</b>	<b>25-Aug</b>	<b>22-Sep</b>	<b>27-Oct</b>	
<b>SOUTH SHORE FISHWAY</b>								
<b><i>South Shore Entrance</i></b>								
<u>Depth over entrance weirs</u>								
SSE-1 (Criteria = 8 ft or >)	ft	7.8	8.0	8.1	8.0	8.1	8.1	7.9
SSE-2 (Criteria = 8 ft or >)	ft	7.8	8.1	7.9	8.2	8.0	8.1	7.8
Head at SSE-1 & 2 (Crit. = 1 - 2 ft)	ft	1.8	1.3	1.7	1.7	1.7	1.5	1.6
Depth over ladr. Weir (Crit.= 1-1.3 ft)	ft	1.1	1.0	1.0	1.0	0.9	1.0	1.0
Channel velocity (Crit. = 1.5-4 fps)	fps	1.3	1.8	1.1	1.1	0.9	1.3	1.0
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Staff gauge clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		0.3-no	yes	no	yes	yes	yes	yes
<b><i>North Powerhouse Entrance:</i></b>								
<u>Depth over entrance weir</u>								
NPE-1 (Criteria = 8 ft or >)		6.2	7.7	7.0	6.4	6.1	8.2	8.1
NPE-2 (Criteria = 8 ft or >)		6.2	8.1	7.0	6.4	6.0	8.1	8.1
Head at NPE-1&2 (Criteria = 1-2 ft)		1.1	0.9	1.2	1.3	1.3	1.1	1.2
Staff Gauge clean		yes	yes	yes	yes	yes	yes	yes
<b><i>North Shore Entrance:</i></b>								
<u>Depth over entrance weir</u>								
NSE-1 (Criteria = 7 ft or >)		7.1	OOS	7.0	5.6	6.1	6.5	6.5
NSE-2 (Criteria = 7 ft or >)		OOS	7.4	7.0	5.6	6.2	6.8	6.6
Head at NSE-1&2 (Criteria = 1-2 ft)		0.9	1.0	0.9	1.0	1.2	0.9	1.1
Staff Gauge clean		TW staff gage broken for season						
Comment number (if applicable)		1	1					

**Comments:**

1. The n shore tailwater staff gage was not replaced in 1999 (broken since 1996 floods). NSE-2 weir gate cables broke so weir gate is stuck at bottom.
2. Gate NSE-1 was OOS as the project was changing the pinion on cabling during May inspection.

## SUMMARY OF RECOMMENDATIONS

### General Recommendations

In reviewing recommendations from previous inspection reports completed during the past few years, a number of the recommendations remain the same. Through the 1990's, adult fish passage research relied mainly on studies that used marked adult salmon to assess travel time, survival, passage through the dams, fallback, and other indices. Adult fish were normally captured at Bonneville Dam or other given site, a radio tag placed in its gut, pertinent data about the fish recorded, and then released to migrate to its spawning area. This has proven to be a valuable tool throughout the years. Most telemetry data will be in report form in the near future and management decisions on most passage issues can be addressed.

- Review adult radio telemetry study results; implement agreed upon changes that would improve adult fish passage through the mainstem dams. Some key elements include passage through floating or fixed orifices along the powerhouse collection channels, fallback at the dams, passage through main entrances and the fish ladders.

Other recommendations relating to adult fish passage have been reported at the FPOM committee meetings or in MCOL committee meetings during the 1998 season. Main issues relating to passage of adult fish continue to include.

- Projects should assure that screening systems for the auxiliary water systems are adequate to reduce impacts that might occur when large amounts of debris are in the river.
- Projects should seal bulkhead slots along the powerhouse channel. This would reduce amount of water that is basically wasted rather than going to the main entrances.
- Projects should fill or seal side entrance or other gates to reduce excessive noise from movement of gates currently set in these slots. This mainly pertains to spillway or powerhouse gates on the spillway side of the dam.
- Projects should assure that water-measuring devices are easy to read, and that includes at all water elevations during the year. Preferred staff gages would be those that can be cleaned easily or else have bench marks available so sensor readings can be taken.
- Projects should automate and computerize fishway operations so that fish facilities can be kept within criteria limits through all ranges of flows and changes in operations.
- Projects should evaluate backup water supply sources to assure that adequate water is available to attract adult fish should the main water supply fail.
- Projects should complete approved spill schedules prior to the fish passage season.
- Prior to the adult/juvenile fish passage season, a pre-season meeting should be held to discuss previous year's inspections and assess readiness for 1999. Issues at COE projects

should continue to be discussed at the FPOM monthly meetings and individual meetings set with Douglas, Chelan, and Grant PUDs .

- Projects should assure that diffuser gratings are intact and clear of debris before the main fish passage season begins.
- All projects should have a plan of action on how to deal with removal of debris from the forebay of each dam. This would help assure that fish turbines/pumps, exits from the dams, picketed leads, or other areas would have less chance of plugging or causing damage to mechanical systems of the fishways or to the adult or juvenile fish passing the dams.
- Where known sharp projections or other obstacles are located in the fish ladders, collection or transportation channels, they should be removed expediently.
- Based on past performance of the fishway equipment, the projects should purchase spare parts of critical operating equipment that would allow “quick” fix during the fish passage season should equipment fail.

**Project Specific Recommendations** relate to particular items in fishways that require action to improve fishway operations or to aid the fishway inspection program.

### **Bonneville Dam**

- Based on fallback of adult salmon from radio telemetry studies, efforts should be taken to reduce numbers of salmon that are “recycled” at the dam, mainly fish from the Bradford Island fish ladder.
- Keep debris from the new powerhouse fish turbine units and trashracks. This remains a problem at the project. Throughout 1998 and 1999, the fish turbines were taken off-line for about three hours per evening to reduce buildup of debris on the trashracks. There should be a better solution to the problem than shutting down auxiliary water flow.
- The project should build a large holding tank that would allow volitional exit for adult fish that have been anesthetized and are coming out of the effects of the anesthetic. Currently, the partially awakened fish are placed in a location of fairly high velocities that could injure the adult fish.

### **The Dalles Dam**

- Velocity should be increased through the eastern end of the powerhouse collection channel; this has been an ongoing problem area.
- Spill should be evaluated prior to the season to assure that conditions are favorable for adult fish as well as juvenile fish.

### **John Day Dam**

- Improvements are required at the north shore counting station to reduce fallback through the counting slot. This has been an on-going problem and should be corrected by the District.
- The project should continue working on the North Shore auxiliary water supply.
- Hydraulic conditions have not changed at the North and South shore fish ladder exit sections and this results in fish jumping and residing in the fish ladders. Fish have landed on the concrete weirs, jumped through the netting, and likely many fish are injured in the John Day fish ladders.
- Some type of debris excluder should be placed to reduce accumulation of debris in the forebay of the project.

### **McNary Dam**

- Although the Oregon fishway system including the pumps and gates are old, they appeared to function satisfactorily through most of the adult fish passage season. The newer WA shore fishway worked satisfactorily as well.
- Continue to aggressively repair the pumps and other fishway equipment to assure that they will operate successfully through the adult fish passage season.
- Assure better operation of the orifice gates along the powerhouse collection channel.
- The District should concentrate on improving their juvenile bypass system, mainly the screening system at the downstream end of the bypass collection channel. Many failures have occurred throughout the years.
- The District should keep debris away from the project as much as possible; this would reduce amount of debris in the juvenile bypass system.

### **Priest Rapids Dam**

- Overall, the water supply at the Right Bank should be from a separate source from the Left Bank system to allow better flexibility in operating the fishway. At Wanapum Dam, the water supply systems are separate and independent of the other sides operation.
- The adult fish trapping site located in the left bank fish ladder will slow passage of fish when it is operated. It would be better if the trap were changed to an off-ladder trapping system similar to the Bonneville trap site. Although any trapping site will affect passage of fish, an off-ladder trap provides less passage or delay problems than in-ladder traps.

### **Wanapum Dam**

- The project should complete computerized automation of the adult fishway facilities. This was initiated several years ago but never completed.
- With the higher volume spill that occurs at Wanapum and Priest Rapids dams, fish counts should be assessed at each project to assure that spill schedules are not affecting passage at the spillway (Right Bank Entrances). This would require that fish counting be continued at Wanapum Dam.

### **Rock Island Dam**

- Assess adult fish passage through the Spillway ladder in light of the spill schedule changes that have occurred during the past few years. Assure that adult fish passage will not be impacted at the spillway entrance during 2000.

### **Rocky Reach Dam**

- The project should maintain a head differential of at least one foot at the MSE and LPE gates during all times of the year. The Gate depths should be adjusted to 10-ft to maintain the required head differential as the tailwater elevation increases: generally this applies to May through June or when tailwater elevation approaches 622 ft.
- The project should upgrade automation of the fishway. This would allow better control of the fishway when the fishway attendants are not on site monitoring the fish controls/system.
- The project should add a separate source of water for the surface bypass collector. About 5-15% of the flow to the adult fish pumps has not been available since 1996. The additional flow might allow the project to meet head differentials/weir depths through the high tailwater elevations.

### **Wells Dam**

- Douglas County PUD should develop a spill schedule for levels of spill above the juvenile bypass-spill requirement and approved by the Wells Coordinating Committee.
- Operate the downstream entrance gates at 8-ft open and with 1.5 ft of "head" if studies show this to be best operating condition.
- The project should operate the fish ladder with depth over the weirs between the range of 1.0-1.2 ft rather than at the higher depths, 1.3 ft on several occasions during the past two inspection seasons.
- Passage of fish through the entrance section and to the lower end of the fish ladder should be improved based on adult radio telemetry studies.



- The project should modify their staff gages to make them more easily accessible, i.e., removable and easily cleaned so that they can be read at all elevations.

### **Ice Harbor Dam**

- We noted discrepancies between the computer printout and the on-site readings and believe that there needs to be better correlation between the two readings. We appeared to find the differential greatest on the north spill entrances. The staff gage on the north shore was not usable all season and the north powerhouse gage was also questionable during periods of heavy spill. This made it difficult for the inspector to interpret some readings. Basically, the project should provide good staff gages or an area to take a sensor reading that will be accurate.
- Add language to the FPP regarding operation of the adult fish passage facilities at tailwater elevations greater than 353 ft.

### **Lower Monumental Dam**

- As at John Day Dam, the turbine pumps at Lower Monumental Dam are susceptible to debris lodging in the wicket gates and other areas in the pumps. The trashrack section of the pumps should better exclude debris or else be selfcleaning or easily cleaned manually. This would help make the auxiliary water supply more reliable during periods of high debris flow in the Snake River. The District should budget to include modifications to this critical passage element.

### **Little Goose Dam**

- Same recommendation as Lower Monumental Dam & John Day Dam.
- Replace all broken staff gages and install this upcoming winter maintenance period.

### **Lower Granite Dam**

- The 2 electric pumps are unable to supply enough flow to meet gate depth and head differential criteria at main fishway entrances during high and low flow periods. The District should address the problem and modify the fishway to improve adult fish passage.
- Replace all broken staff gages and install this upcoming winter maintenance period.

## APPENDIX 1.

### **Summary of fishway criteria for mainstem dams on the Columbia and Snake River.**

Detailed criteria for COE and PUD projects can be found in the COE's Fish Passage Plan or in Detailed Fishery Operating Plans (Adult criteria). This Appendix summarizes the general standards for the fishways at each project.

#### **Entrance Head Differentials:**

1.0 to 2.0 feet standard at all projects.

Wells, Wanapum, Priest Rapids, and Bonneville dams target 1.5 ft at some entrances, other projects target 1.25 ft.

#### **Entrance Weir Gate Depths:**

**Bonneville** - At the old powerhouse, maintain 8.0 ft or greater depth at Gate 64/65; maintain 1.0' minimum head at Gate 1 and 2 with 6.0 ft minimum Gate depth; at the new powerhouse maintain 13' or > depth when tailwater elevation is above elevation 14 (sill = elev 1.0'). The spillway entrances target 1.5 ' head with free-flowing slots.

**The Dalles, John Day (OR fishway), McNary (north shore), Ice Harbor, Lower Monumental, Little Goose, and Lower Granite** - 8 ft or greater depth at Entrance Gates.

**McNary (OR fishway)** - 9.0 ft or > gate depths.

**Rock Island (spillway entrance)** - 8.5 ft or > gate depth.

**Rock Island left bank, Little Goose north shore, and John Day (WA fishway)** - 6.0 ft or > gate depth.

**Lower Granite north shore** - 7.0 ft or > gate depth.

**Rocky Reach left powerhouse & spillway** - 10' or > gate depth.

#### **Entrance Wing Gate Openings:**

**Wells** - 6.0 ft open end gate, 4.0 ft open side gate; **may chg in upcoming seasons**, 8.0 ft open during spill

**Rock Island** - 2.0 ft open on center fishway side gate; 3.0 ft open on all right powerhouse entrance gates.

**Rocky Reach** - 3.0 ft open on right powerhouse gates.

Entrance (fixed-open) Gates: Maintain head differential of 1.0-2.0 ft

**Bonneville** (spillway entrances), **Wanapum** (all entrances), **Priest Rapids** (all entrances) and

**Lower Monumental** (south shore, SSE-2 is a permanent fix 6-ft open gate).

**Turbine Unit Operating Priority:** Specific to each dam (See year 1999 FPP).

**Spillway Operation:** Specific to each dam (See 1999 FPP and DFOP).

**Collection or Transportation Channel Velocities:** 1.5 to 4.0 fps at all projects.

**Staff Gages or other Elevation Gages:** At all projects, gages must be maintained throughout the fish passage season and readable at all elevations.

Fish Ladder

**Depth of Water over Fish Ladder Weirs:** 0.9 ft to 1.4 ft; most project use a 1.0 ft to 1.2 ft or 1.3 ft; John Day has a 1.0 ft  $\pm$  0.1 ft during non-shad passage period.

**Head on Picketed Leads:** Maximum of four inches at most projects (0.3 ft); 6.0 inches is required at Chelan PUD projects.

**Head on Exit Trash Racks:** Maximum of 0.5 ft greater than reading with a dean trash rack. Debris should be removed when significant amounts accumulate.

## **ACKNOWLEDGMENTS**

Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, and National Marine Fisheries Service provided personnel to inspect adult fishways during the 1999 fish passage season. The Fish Passage Center has appreciated the Agencies' commitment of providing fishway inspectors during the year. We recognize the time and commitment it takes from the individual inspector's normal activities to assure that fishways at the mainstem dams were inspected each month. Fishery agency personnel who participated in the inspection program during 1999 are listed. For the 1999 season, there were two new inspectors for the year, Denise McCarver and Glen Liner of WDFW. Others listed have completed inspections from three to nine years.

<b><u>Agency</u></b>	<b><u>Inspector</u></b>	<b><u>Dams Inspected</u></b>
NMFS	Bryan Nordlund	Priest Rapids & Wanapum
NMFS	Ed Meyer	Bonneville
NMFS	Larry Swenson	McNary
ODFW	Doug Case	The Dalles & John Day
ODFW	Shawn Rapp	Little Goose & Lower Granite
WDFW	Denise McCarver	Rock Island & Rocky Reach
WDFW	Glen Liner	Rock Island & Rocky Reach
WDFW	Stewart Mitchell	Wells
WDFW	Steve Richards	Ice Harbor & Lower Monumental

Project operations personnel and biologists from Portland and Walla District Corps of Engineers provided on-site assistance whenever necessary to assure that the agency inspector could thoroughly inspect the adult and juvenile fishways. The inspectors were appreciative of assistance provided by the Corps of Engineers.

Grant, Chelan and Douglas Public Utility Districts were also very helpful in providing access and assistance for the fishway inspectors at the individual projects. This cooperation and assistance provided by PUD project personnel, fish biologists, fishway attendants and others were appreciated by the inspectors and the Fish Passage Center.

Funding for the FPC staff coordination of the inspections was provided by the following fishery agencies: WDFW, ODFW, IDFG, USFWS, and NMFS.