Washington Group International
Integrated Engineering, Construction, and Management Solutions

January 31, 2007

U.S. Army Corps of Engineers
Hydroelectric Design Section
Attention: Randy Lee, USACE
P.O. Box 2946
Portland, OR 97208-29746

Subject: The Dalles North Fish Ladder Inspection
Contract No. W9127N-06-D-0009, Task Order No. 0004
Final Trip Report

Dear Randy:

The Dalles North Fish Ladder was inspected by the USACE, Washington Group International (WGI), and ENSR on December 28, 2006. The purpose of the inspection was to establish baseline conditions of the ladder to support future reliability studies. The attached trip report summarizes the observations of the inspection participants. Photos referenced within the body of the report are attached.

We appreciate the opportunity to have participated in this inspection. Please contact me if you have any questions.

Sincerely,

No signature required

Doug Hartsock, P.E.
Project Manager

Attachment: Report and Photos

cc: File

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Washington Group International
Integrated Engineering, Construction, and Management Solutions

THE DALLES DAM

COLUMBIA RIVER BASIN, WASHINGTON - OREGON

The Dalles Dam North Fish Ladder Inspection Report

JANUARY 2007

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INTRODUCTION

The Dalles North Fish Ladder (NFL) was inspected by the USACE, Washington Group International (WGI), and ENSR on December 28, 2006. The purpose of the inspection was to establish baseline conditions of the ladder to support future reliability studies. This trip report summarizes the observations of the inspection participants. Photos referenced within the body of the report are attached.

INSPECTION PARTICIPANTS

The follow individuals participated in the inspection:

Randy Lee	PM/Hydraulic	USACE	(503) 808-4876
Bob Cordie	Fishery Biologist	USACE	(541) 298-7406
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Bob Guidinger	Hydro Dept. Mgr.	N. Wasco County PUD	(541) 298-3325
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BACKGROUND AND PURPOSE

As part of The Dalles System Improvement Study (SIS), a spillwall was constructed in 2004 between spillway bays six and seven of The Dalles Dam. During the downstream migration of juvenile fish, approximately 40 percent of the river flow is released between the spillwall and spillway bay one.
The spillwall and concentrated spill pattern, however, create a new set of fish migration issues, including:

1. Downstream migrating juvenile survival rates, although improved, are not to the level desired due to predation from predator fish located in rock outcrops adjacent to the stilling basin.
2. Water velocities in the vicinity of the north fish ladder (NFL) entrance are relatively high, reducing the availability of the ladder to upstream migrating fish.

To address the predation issue, the SIS team is evaluating a 650-foot extension of the spillwall to the river thalweg. The extended spillwall would facilitate the egress of juveniles from the stilling basin and farther downstream, past the predators. As far as access to the NFL by upstream migrating fish is concerned, preliminary physical hydraulic model investigations on a 1:80 scale general model of The Dalles Dam at the Corps Engineer Research and Development Center show that the extended spillwall would reduce the velocities near the NFL entrance, and the resulting increase in water surface elevations could impact the operation of the fish ladder. The model studies also predict an increase in velocities along the north shore as a result of extending the spillwall, which could hamper access to the NFL by upstream migrating fish.

The purpose of the NFL inspection is to observe and document the current civil/structural, mechanical, hydraulic, electrical, and geotechnical conditions of the overall facility. The observations will be used to support future NFL reliability and spillwall extension studies.

METHODOLOGY

The following methodology was adopted for this task:

1. Review NFL and N. Wasco PUD facility drawings
2. Conduct site inspection
3. Prepare draft trip report
4. Review draft trip report with USACE
5. Finalize trip report

INSPECTION CHRONOLOGY

The following represents an approximate chronology of the inspection day:

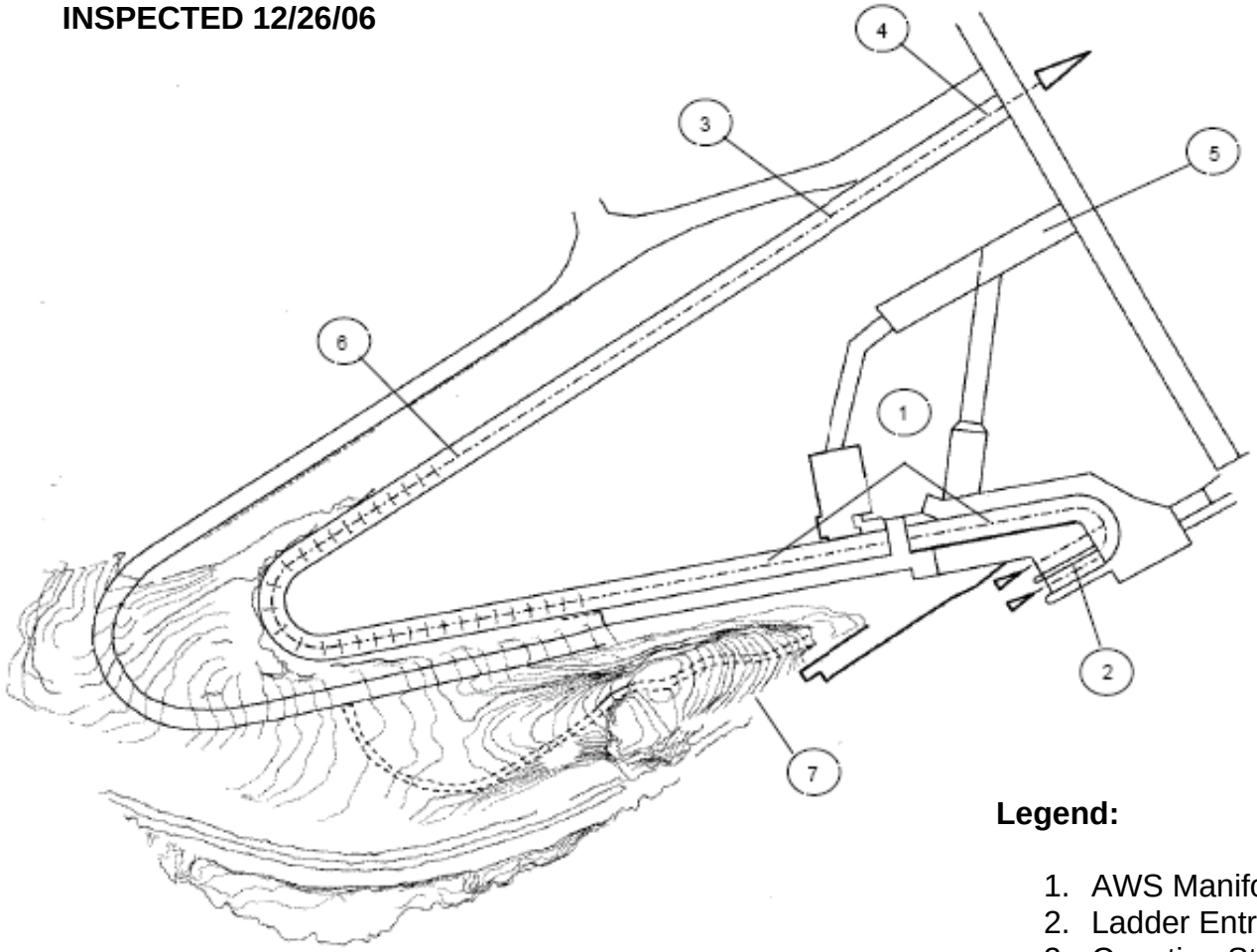
1. Met at The Dalles Fisheries Office at 8:30 a.m. Introduced participants, reviewed project history and objectives, safety, and agenda.
2. Drove to North Wasco PUD Powerhouse. Accessed Auxiliary Water System (AWS) water supply conduit via draft tube. Observed conduit structure, diffusers, original AWS plunge pool, and conduit dewatering pump.
3. Exited draft tube, observed miscellaneous elements of powerhouse.
4. Walked to fish ladder entrance facilities. Observed weir gates, north shoreline (from a distance) plunge pool (from above), gate hoists, and channel structure.

5. Drove to fish ladder exit section. Observed counting station, fish crowder, control channel structure. Walked upstream within channel to inspect weirs and exit facilities.
6. Walked to North Wasco PUD Powerhouse intake structure. Observed electrical panels, tainter gate and hoist, AWS gates and hoists, powerhouse shutoff gates, gantry crane and hoist, juvenile bypass gate, hoist and pipeline.
7. Drove to transition of concrete channel with rock lined channel. Observed weirs, channel structure.
8. Drove to fisheries office, dropped off gear.
9. Drove to east side of dam, met at conference room adjacent to powerhouse. Ate lunch and reviewed day. Interviewed operations and fisheries personnel. Made additional document requests. Discussed plan going forward.
10. Departed at 3:00 p.m.

INSPECTION RESULTS

The following sections provide a description of the areas that were inspected (Figure 1), followed by discipline specific observations.

FIGURE 1: THE DALLES NORTH FISH LADDER AREAS INSPECTED 12/26/06



Legend:

1. AWS Manifold
2. Ladder Entrance
3. Counting Station
4. Ladder Exit
5. AWS Supply Channel
6. Channel Transition
7. North Shore

Auxillary Water System (AWS)

The water that flows through the NFL originates from two sources: the ladder's fish exit, which provides between 75 and 102 cubic feet per second (cfs) of flow, and the turbine discharge from the N. Wasco PUD powerhouse, which provides between 870 and 940 cfs. Under normal operating conditions, water exits the powerhouse draft tube and enters a rectangular, concrete-lined water supply conduit that extends beneath the floor of the ladder between units 10 and 18. From the conduit, water passes through a series of square orifices fitted with slide gates located in the wall of the conduit and into the channel via grated floor diffusers. If the powerhouse unit goes offline, flow to the powerhouse is diverted to a plunge pool and enters the water supply conduit through a separate entrance. The overall system is referred to as the auxiliary water system (AWS).

Civil/Structural Observations

Structural concrete work within the water supply conduit appeared to be maintaining its integrity with mostly hairline cracking revealed by seeping water (Photo **CS-1**).

Mechanical Observations

It was reported that the slide gates in the lower section of the water supply conduit (Photo **M-1**) are designed for unseating head and therefore need to be fully open or fully closed in order to operate correctly. A few of the gates downstream of Unit 15, however, were observed to be partially open. It was unclear whether this indicated that the gates were stuck, or if they were intentionally placed in a partially open position (Note: the project has since opened them).

Considerable corrosion was evident on the gates (Photo **M-2**). The PUD operator advised that the gates were exercised within the past year, and that normally they are left in a fully open position.

A submersible centrifugal pump is located in a pipe well at the downstream end of the water supply conduit (Photo **M-3**) and is used to dewater the conduit for inspection and maintenance purposes. The pump was operating during the inspection to remove water that was seeping from the river into the water supply conduit.

Hydraulic Observations

During the inspection, we entered the AWS conduit via the N. Wasco PUD draft tube at AWS diffuser chamber unit 15. Walking toward the upstream units (10 through 12) in the diffuser chamber, fine sediment and mud was observed on the chamber floor, indicating that velocities in the chamber are likely quite low during operation and fine sediment settles out. The sediment was not observed in the lower units. The conduit connection to the N. Wasco PUD draft tube, conduit floor, walls, and ceiling are smooth concrete.

Staff reported that the diffuser outlet gates are designed to operate either fully open or closed. Several of the diffuser outlet gates were observed from units 10 through 15 and were fully open (Photo **H-1**). A few of the diffuser gates from diffuser units 15 through 19 were closed approximately 9 to 15 inches (Note: the project has since opened them). The upstream-most gate opening had been permanently sealed by a metal plate. The diffuser chambers beyond the gated openings are rough rock on the outside wall, much like that observed in the AWS pool and the rock portion of the fish ladder, with considerably higher roughness than the inner concrete walls.

The junction between the original AWS plunge pool and the diffuser conduit was observed from the downstream side. Several structural reinforcements were noticed as described in the geotechnical notes. A view of the plunge pool from the upstream side is shown in Photo **H-2**.

The conduit dewatering pump was operating at the downstream end of the dewatering conduit and 12 to 15 inches of water was present in the conduit (Photo **H-3**).

Geotechnical Observations

The rock anchors and strapping on the walls of the original AWS plunge pool (Photo **G-1**) were heavily corroded and appeared loosened from the rock face in places. It appeared that rock had fallen out from behind some of the strapping.

Ladder Entrance

The NFL fish entrance is located adjacent to spillway one. It consists of two triple-leafed weirs designated N-1 and N-2. Two rollers on each side of each 6'-9" by 15'-0" fabricated steel leaf ride in vertical guides cast into concrete slots. The leaves are raised and lowered using a wire rope hoist and spreader beam arrangement. A third weir gate designated N-3 and situated 90° to N-1 and N-2 has been removed and the opening permanently sealed with concrete. During normal operation, only one weir is operated.

Mechanical Observations

The District and the PUD agreed that their current number one need is to obtain a new set of entrance weirs. They also shared that the guide rollers for the original weirs were thought to be damaged by pulsating water from the adjacent spillway, which made raising the leaves difficult, that the leaves often became disconnected from each other when being raised, and that the hoist's wire ropes had failed in the past, possibly due to vibration or being submerged for long periods. The method for lifting the leaves was improved by adding a lifting beam (Photo **M-4**).

Steel bulkheads were installed in weir gate bays N-1 and N-2 during the inspection (Photo **M-5**). The gate leaves were evident in N-1, but missing from N-2.

The electric hoist (Photo **M-6**) used to raise and lower the weir gates appeared to be in serviceable condition.

The hoist push button control enclosure (Photo **M-7**) was fairly corroded.

Hydraulic Observations

Based on discussions with staff, the N-1 weir is currently being repaired. Maintenance issues have included problems with the hoist cables, the rollers on the weir leaf sides, and the infrequent operation of the lower leaf due to high tailwater elevations. Some of the hoist cable problems have been remedied using a new spreader beam arrangement for operation and hydraulic operation of the entrance weirs has been effective. The weir leaves for N-1 and N-2 are interchangeable with those used for the EFL. The weirs are operated greater than 8 feet below tailwater to achieve a channel to tailwater differential of one foot to two feet under normal operating conditions. Optimum differential is 1.5 feet. Normally, the channel to tailwater differential is 1.3 feet. The closed entrance weirs at N-1 and N-2 are shown in Photo **H-4**.

Just upstream of the entrance weirs, the diffuser grating for the AWS system is visible in Photos **H-5**, **H-6**, and **H-7**. The diffuser grating has approximately 1-in by 4-in openings and appears to be in satisfactory condition with plating securing the grating to prevent lifting in the flow. We were only able to view this area from above, not in the ladder channel due to access constraints.

The Corps reported that the north ladder used to attract about 30% of the adult salmon passing the project, the percentage varying depending on the run. Since installation of training walls and changes to spill procedures to use only spill gates 1 through 6 for downstream migrant spill, the ladder attracts only about 10% of the adults. This is despite installation of a new wall between the ladder entrance pool and spillway bay 1 to keep the spillway flow from rolling across into the ladder flow. Photos provided by the Corps and the PUD show white water extending from the spillway across the ladder entrance to the north riverbank.

The Corps is studying the problem of predation on downstream migrating smolts using the spillway. The predation occurs in the shallow tailwater. One idea for protecting the smolts is to extend the training wall at spill gate 6 further downstream to the rim of the thalweg canyon. They expect that this may locally raise the tailwater in the vicinity of the approach to the NFL entrance.

Electrical Observations

The water supply conduit dewatering pump control enclosure was located on the deck adjacent to the intake (Photo **E-1**).

PUD powerhouse staff was interviewed with regards to the operation of weir gates N-1 and N-2. No problems were reported with either operation or control of the gates.

Geotechnical Observations

The north shore of the fish ladder facility was visible from this vantage point (Photo **G-2**). From a distance, the bank appears to be rougher than other rock cut slopes in the vicinity. The blocky, near vertical fracture pattern appears to be susceptible to plucking, possible due to the spill turbulence. However, there does not appear to be major local recession of the bank or evidence of caving.

Counting Station

The fish counting station is located on the upper ladder leg between weirs 151 and 152. The original station was modified in the late 1980's and currently consists of a viewing room with window, upstream and downstream fish leads, a fish crowder with light box, and a rotary brush mechanism for cleaning the viewing window and light box. Fish climbing the ladder are directed to the crowder opening by the leads. As they pass in front of the viewing window, the light box illuminates the crowder opening, facilitating the counting process. When algae accumulates on the window and light box, the rotary brush mechanism is activated to clean both surfaces.

Civil/Structural Observations

The condition of the various structural elements of the counting station appeared to be generally sound, although the floor diffuser grating appeared to be somewhat corroded (Photo **CS-2**). The District's fishery biologist stated that the diffuser grating just upstream of the counting station had 1-inch openings, which is too coarse to prevent Lampreys from falling or swimming through and getting lost in the exit section's AWS system. The District stated that future analyses will be conducted to detemine how reducing the grating opening to prevent the passage of Lampreys and other fish may impact the hydraulics of the fish ladder.

Mechanical Observations

The fish crowder operates to crowd fish towards and past the viewing window for counting. A Rotork actuator (Photo **M-8**) drives two Acme screws (Photo **M-9**) that translate the moving half of the crowder towards or away from the viewing window. The range of movement is a reported 12 to 36 inches. The Rotork actuator appeared to be relatively new.

The viewing window (Photo **M-10**) and opposing light box are cleaned using an electric rotary brush mechanism (Photo **M-11**). District staff reported that the mechanism had been troublesome in the past, but that routine maintenance had corrected the situation.

Hydraulic Observations

During the crowding operation, picket gates (Photo **H-8**) exclude fish and allow water to pass downstream past the counting station and appeared adequate hydraulically. The opening size on the pickets may be wide enough to allow lamprey to pass through the pickets rather than through the crowder and miss the counting window. Observations about the flow control section and the associated auxiliary water are provided in the Ladder Exit Section.

Electrical Observations

Staff reported that changing the lamps in the lightbox was difficult due to inaccessibility. A District-designed PLC level control panel for controlling the water level between the upstream floor diffuser and the downstream picket of the counting station was installed recently to maintain the ladder water level downstream of the counting station at 80 feet. The interior of the counting station was inspected, and five electrical distribution panels noted. One panel was for lighting, two for control of the crowder, and two were undesignated.

Ladder Exit Section

The NFL fish exit section was modified in the late 1980's at the same time as the counting station. The section of ladder between the counting station and the dam opening was narrowed from 24 to 20 feet, and new vertical slot weirs constructed. Auxiliary water is diverted immediately downstream of the fish exit into a conduit that parallels the ladder and diffused through the ladder floor immediately upstream of the counting station. This auxiliary flow is controlled by a differential water surface level system that regulates a slide gate supplying the floor diffuser, thereby ensuring that the flow downstream of the counting station meets ladder operating criteria.

Civil/Structural Observations

The ladder weirs appear to have been raised by the addition of concrete (Photo **C/S-3**). The walls of the ladder exhibit slight spalling of fines which is normal for concrete exposed to flowing water.

Mechanical Observations

The electric gate actuator (Photo **M-12**) used to control flow to the floor diffuser appeared to be in serviceable condition.

Hydraulic Observations

This section of the ladder is the flow control section and is used to regulate flow into the fish ladder. Based on discussions with staff on site, the flow control section and the associated upstream auxiliary water supply system between the dam and the

counting station are operating sufficiently. A new water level sensor was installed recently to control the auxiliary water flow through the floor diffuser into the ladder upstream of the counting section.

Flow enters from the forebay into the modified flow control section and passes through a slotted weir and orifice section with PIT tag detectors on the slot and orifice (Photo H-9). Flow then passes through a series of slotted weirs with orifice openings. Each weir has a different slot height (Photo H-10). We walked through the entire flow control section and the slotted weirs and orifices appear to be in satisfactory hydraulic condition.

The auxiliary water supply system for the flow control system draws water through the grating shown in Photo **H-11** at the upstream end of the flow control section and diffuses flow through the floor grating just upstream of the counting section (Photo **H-12**). Both areas of grating are 1-in by 4-in grating and have reduced open area due to significant corrosion.

AWS Supply Structure

The AWS supply channel, or powerhouse intake structure, was constructed at the same time as the N. Wasco PUD Powerhouse. It consists of a reinforced concrete channel with grated roof. Under normal operation, water passes a normally open tainter gate and into the channel. The channel is fitted with a fish screen that prevents fish from entering the powerhouse penstock. The screened fish are passed along with 10 cfs of flow through an HDPE by-pass pipe and discharged at the mouth of the ladder entrance.

If the powerhouse trips, a pair of slide gates at the upstream end of the channel are opened and flow is diverted into a plunge pool as described previously.

Civil/Structural Observations

The upper end of the fish bypass pipe (Photo **CS-4**) is separating from the intake structure wall. The PUD intends to repair it.

Mechanical Observations

The hoists used to operate the tainter gate, AWS bypass gates, and turbine inlet gates appeared to be in serviceable condition. No problems were reported by PUD staff.

Hydraulic Observations

The AWS tainter gate shown in Photo **H-13** and the fish channel structure were observed from above. The fish screen was not visible from above and was not accessed during the trip. The tainter gate has new side seals and staff reported that the gate operation is improved with the new seals.

The plunge pool was observed from above as shown in Photo **H-2** previously. The plunge pool structural issues are described in the geotechnical observations section and were noted during the hydraulic inspection.

Electrical Observations

The switchgear located inside the dam was inspected. The switchgear observed was reported to supply power to the gates.

Channel Concrete/Rock Transition

The NFL consists of a reinforced concrete channel transitioning to a rock-lined channel at Unit 9.

Civil/Structural Observations

A step on the bridge crossing the transition was damaged (Photo **CS-5**).

Hydraulic Observations

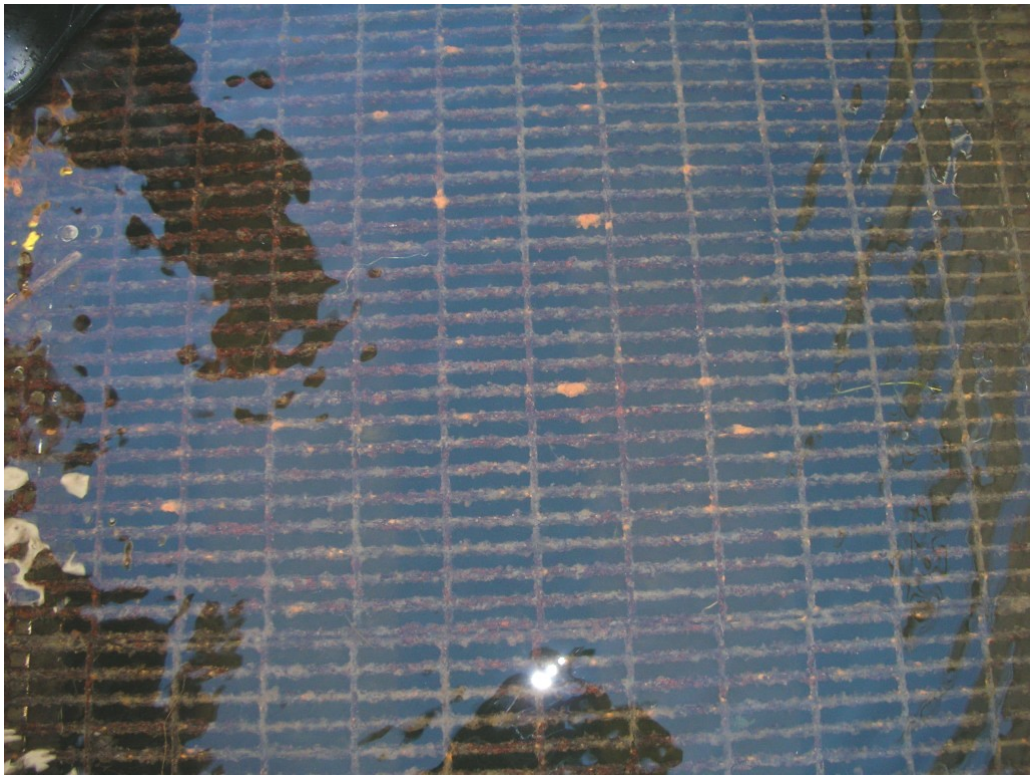
The NFL was observed from the transition from concrete channel to rock-lined channel at unit 9. We did not walk the entire length of the interior of the ladder due to time and access constraints, but the weirs and orifice openings appeared in satisfactory condition from our viewpoints. The orifice openings were modified to a smaller open area as shown in Photo **H-14** by the addition of a metal collar around each orifice. These modified orifice plates appear to have a relatively smooth transition from the concrete ladder weir to the orifice opening. The ladder weirs appear to be intact from visual inspection from above, with no large sections missing. Most of the weirs have moss growing on the downstream edge.

Just upstream of the transition to the rock-lined channel, a root wad was observed growing into the weir opening on one of the ladder weirs (Photo **H-15**). The operating water line is also visible in Photo **H-15** at the mossy line, with a gray line extending above the water line from splash and/or the higher operating levels for shad migration.

Geotechnical Observations

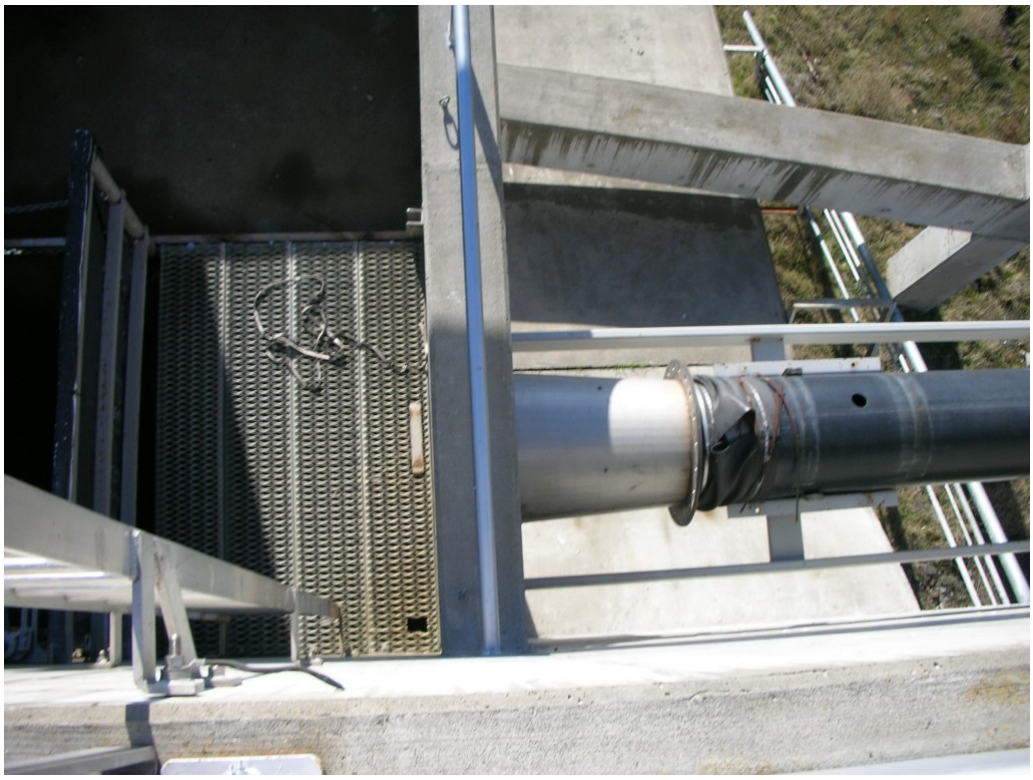
The walls of the rock-lined reach of ladder are supported in some of the deeper sections by concrete struts. Although doubtless there has been occasional spalling from the rock faces, in general the rock appears to be sound. Only a few small rockfall fragments were observed lying about during the inspection.

CS-1 Concrete Crack



CS-2 Diffuser Grating

CS-3 Weir Extensions



CS-4 Fish Bypass Pipe

CS-5 Crossover Bridge

E-1 Dewatering Pump Panel

G-1 Plunge Pool Tiebacks

G-2 North Shore View Looking Downstream

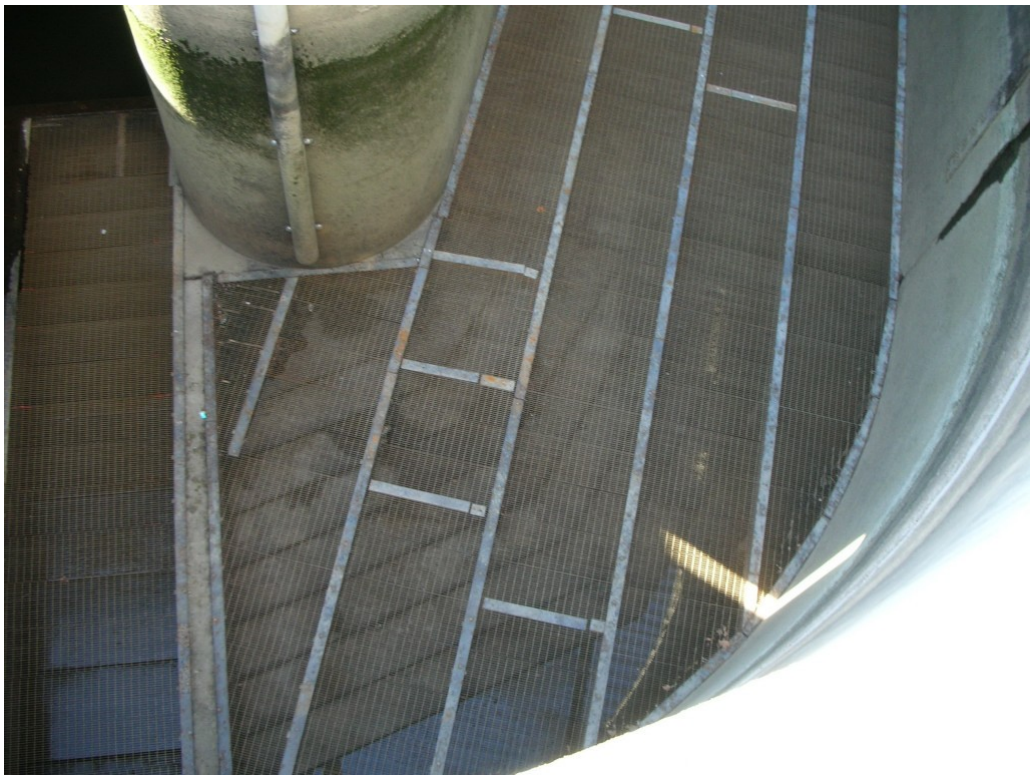
H-1 Diffuser Gate

H-2 Original AWS Plunge Pool

H-3 Conduit Dewatering Pump

H-4 Entrance Weirs

H-5 Entrance Pool Floor Diffuser Grating



H-6 Entrance Pool Floor Diffuser Grating

H-7 Floor Diffusers and Weirs

H-8 Picket Leads at Counting Station

H-9 Exit Section Flow Control Weirs Looking Upstream

H-10 Vertical Weir Slot Looking Upstream

H-11 Fish Channel Exit

H-12 Counting Station Floor Diffuser Grate and Picket Leads

H-13 Tainter Gate

H-14 Modified Orifice

H-15 Root Ball in Channel

M-1 Diffuser Gate Opening In AWS Chamber

M-2 Diffuser Gate Corrosion

M-3 Conduit Dewatering Pump

M-4 Entrance Weir Lifting Beam

M-5 Entrance Weirs

M-6 Entrance Weir Hoist For Gate N-1

M-7 Entrance Weir Controls

M-8 Counting Window Crowder Actuator

M-9 Counting Window Crowder Drive Screw

M-10 Counting Window (View from above)

M-11 Counting Window Cleaner

M-12 Juvenile Fish Bypass Gate Actuator