John Day Dam
South Fish Ladder
Section 12
Wall Leak

January 28, 2015

Revision 1

Contents

Inspection Report

1 General

Location:	John Day Dam, Rufus, Oregon
Element:	East wall of south fish ladder in section 12
Inspection Date:	January 28, 2015
Weather:	Partly sunny and about 50 degrees
Inspectors:	David R. Hamernik, PE, CENWP-EC-DS
Report Prepared by:	David R. Hamernik, PE, CENWP-EC-DS
Report reviewed by:	Matt Hanson, PE, CENWP-EC-DS, Kristy Fortuny, PE, CENWP-EC-DS

2 Inspection Attendees

Dave Hamernik, CENWP-EC-DS
Pat Hunter, CENWP-OD-J
Eric Bretthauer, CENWP-OD-J
John Day riggers and mechanics

3 Drawings

The following drawings can be referenced for information in this area:

a. JDF-1-4-3/1, Section 1 of SFL
b. JDF-1-4-3/40, Section 12 of SFL
c. JDF-1-4-3/45, Section 13 of SFL
d. JDF-1-4-8/1 - 6, abandoned fish ladder
e. JDF-2.0-4-4/1, JBS Outfall Shoot plan and profile
f. JDF-2.0-4-4/2, JBS Outfall Shoot plan and profile
g. JDF 2-10/14, Elevated Chute Plan and Profile
h. JDF 2-10/17, Elevated Chute Detail at Crest Gate
i. JDF 2-10/21, Elevated Chute – Support Sections and Details
j. JDF 2-10/24, Elevated Chute – Typ Support Sections and Details

4 Description

The south fish ladder is a reinforced concrete structure that is both below and above grade. This portion of section 12 of the fish ladder is below grade and is located next to the power house (Figure 1). In this particular location, the fish ladder intersects an abandoned fish ladder (Figure 2). There is also an elevated concrete chute in the area (Figure 3). Figure 3 shows the abandoned and new fish ladders as well as the elevated chute and its foundation system. At the junction of the two ladders is a bulkhead slot that has been plugged with concrete. The bulkhead's steel guide framing is visible in the wall of the ladder (reference cover page).

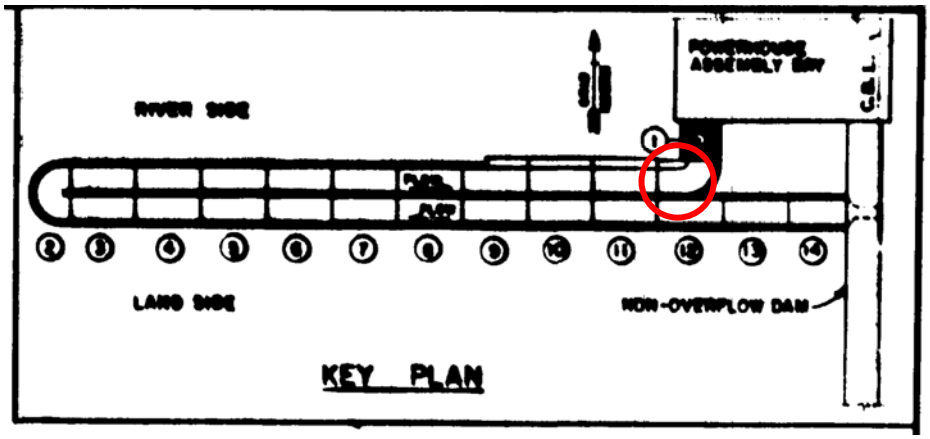

Figure 1 - South Fish Ladder Key Plan

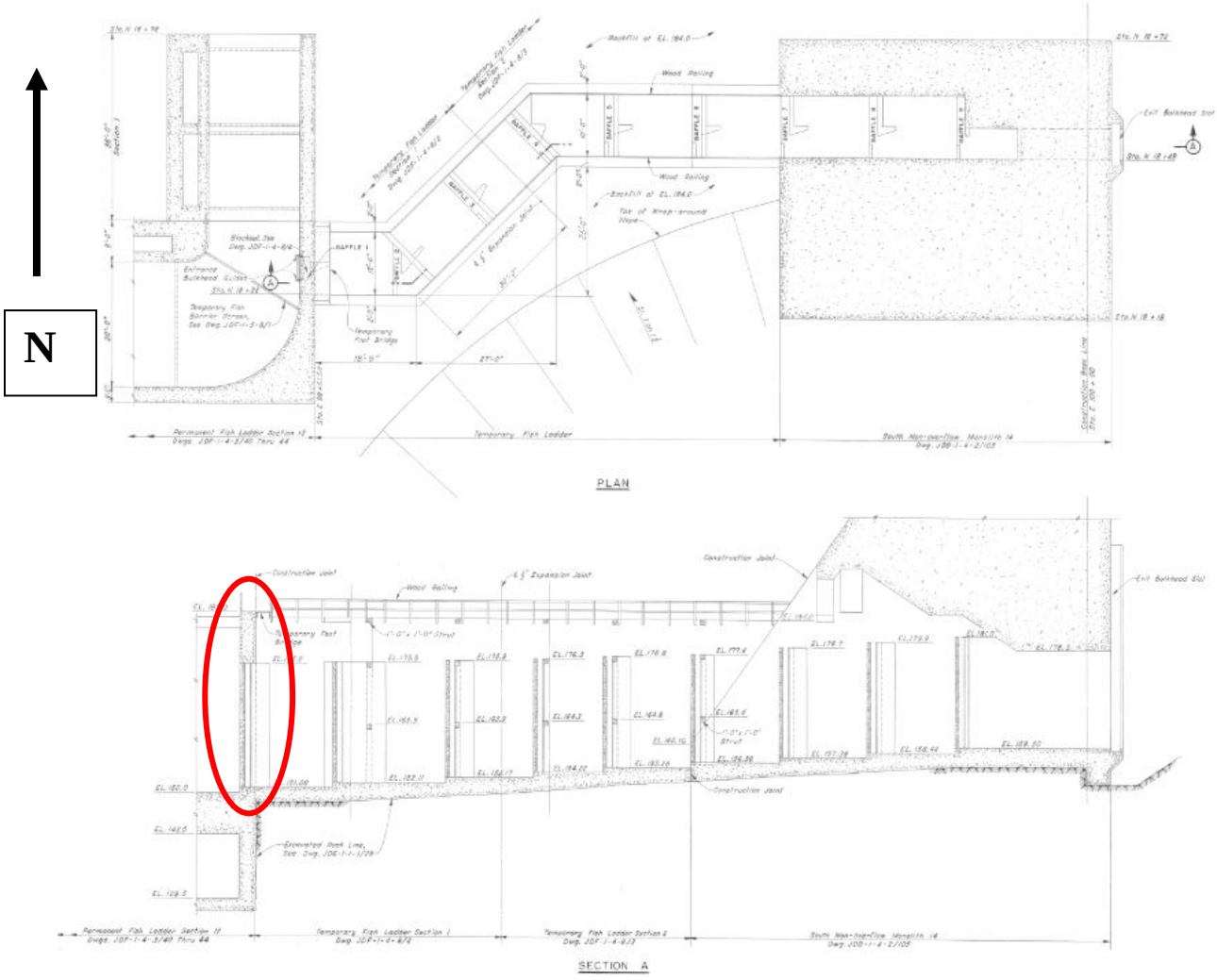

Figure 2 - Abandoned Fish Ladder at SFL, JDF-1-4-8/1

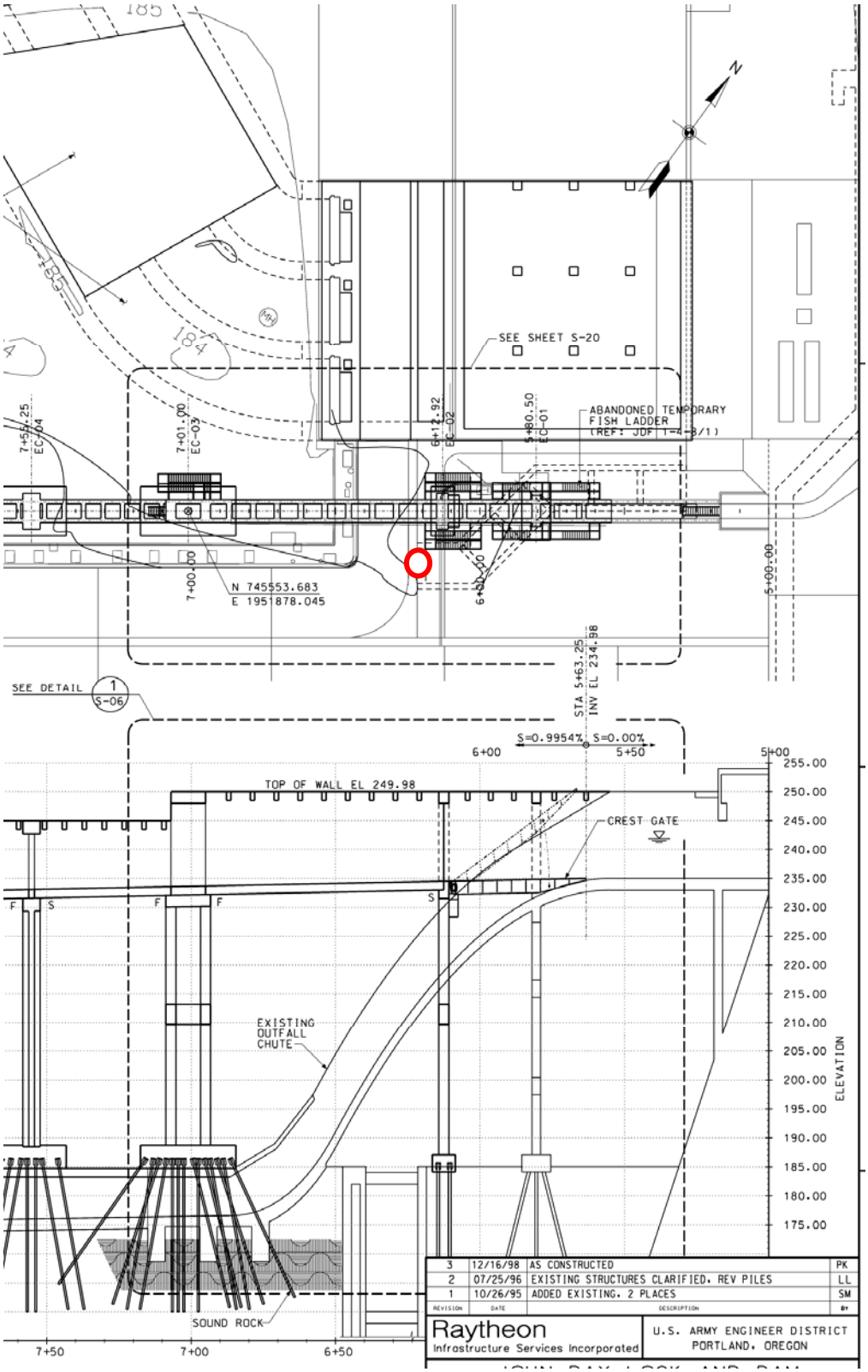

Figure 3 - Plan & Elevation of Site Area, JDF 2-10/14

5 Inspection Scope

The scope of this inspection was to inspect the area of the south fish ladder wall that had been previously patched and is currently leaking. This area is a plug from an abandoned fish ladder

6 History

This area had been repaired by the Project on February 21, 2014. In interviewing the repair crew the following information was obtained:

a. The size of the hole was approximately 24” wide by 18” tall.
b. The portion of the concrete plug that was removed for patching preparation was approximately an inch deep. Beyond this thin concrete, vertical reinforcement was seen. The reinforcement did not have concrete around it but rather had sand and silt with a pasty consistency (Figure 4, Figure 5and Figure 6).

Figure 4 - Patched Area between Abandoned Fish Ladder Bulkhead Slots (Plug is between Vertical Steel Embeds)

Figure 5 - Close-up of Leak, 2014

Figure 6 - Close up before Patch Installed, 2014

c. Bags of Sakrete were mixed to a damp consistency and then packed into the hole while water was running out of it.
d. Sheet metal plates were applied over the patched areas with expansion anchors. The anchors were noticed to be in ‘soft’ concrete as they were installed
e. The sidewalk at grade level above the wall leak has subsided and cracked (Figure 7 and Figure 8).

Figure 7 - Subsided Sidewalk above Leak Location

Figure 8 - Overview of Area

7 Observations

7.1 Surrounding Structures

There are several large, elevated structures in the area. The elevated portion of the south fish ladder is to the south and the elevated juvenile bypass chute is directly overhead. The columns of sections 12 and 13 of the elevated ladder can be seen in the background of Figure 9. The tree shown is the start of Section 13. Section 12 is to the right (west) and the ladder is running from east to west. One of the juvenile bypass chute columns can be seen in the foreground of Figure 9. There are actually 2 columns here that land on a pile cap which is in turn supported by multiple plumb and vertical piles. The columns of both structures were measured for plumbness with a 4' bubble level and found to be plumb. A visual observation was performed looking for distress in the structures such as cracking and spalling. No distress was found.

Figure 9 - Structure Overview of Area

7.2 Sinkholes

Sinkholes were looked for in the ground to the east of the fish ladder. None were found. Reference Figure 10.

Figure 10 - Area to East of SFL (Chute Columns in fore and background, non-overflow Dam Beyond)

7.3 Cracked Sidewalk

The sidewalk immediately above the wall leak has cracked and sunk. Reference Figure 11. This is undoubtedly from the leak that has been carrying soil away from below the sidewalk into the fish ladder (internal erosion). At the time of the observation the water leaking through the wall was noted to be clear. It appears that at this time the sidewalk is the only structure that has been affected by internal erosion however, there is potential for other structures to experience settlement if this condition goes unchecked. The bottom of the spread footings supporting the columns of the elevated fish ladder (section 12 and 13) are above the leak elevation. The bottom of the leak is approximately at elevation 153'. The bottom of the footing in section 12 is at elevation 158' and the bottom of the footing in section 13 is at elevation 154'-6". The foundation for the juvenile bypass chute (immediately next to the subsided sidewalk) is pile supported. This foundation is labeled 'EC-2' in the Juvenile Fish Sampling and Monitoring Facility drawings from 1995 (Figure 12). The piles have a tip elevation of approximately 137'. The tip elevation is dependent upon the elevation of the top of sound, fresh, hard rock and should be verified with pile installation logs. Reference Figure 13 for pile embedment details and assumed top of rock elevations from the 1995 Juvenile Fish Sampling and Monitoring Facility contract drawings. It is unknown if any of these foundations have been undermined from internal erosion and should be monitored for future distress.

Figure 11 - Cracked and Subsided Concrete Walk

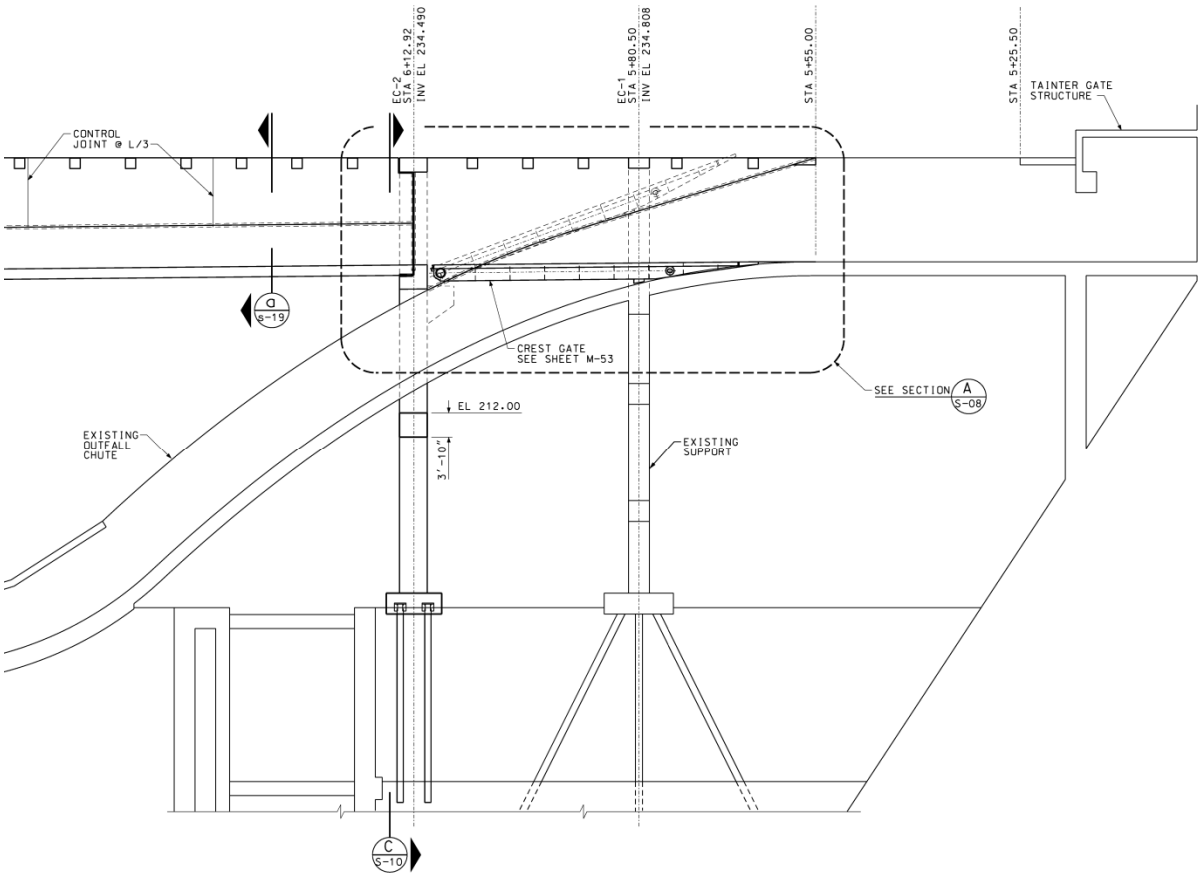

Figure 12 - Elevation of Chute Foundation System and SFL, JDF 2-10/17

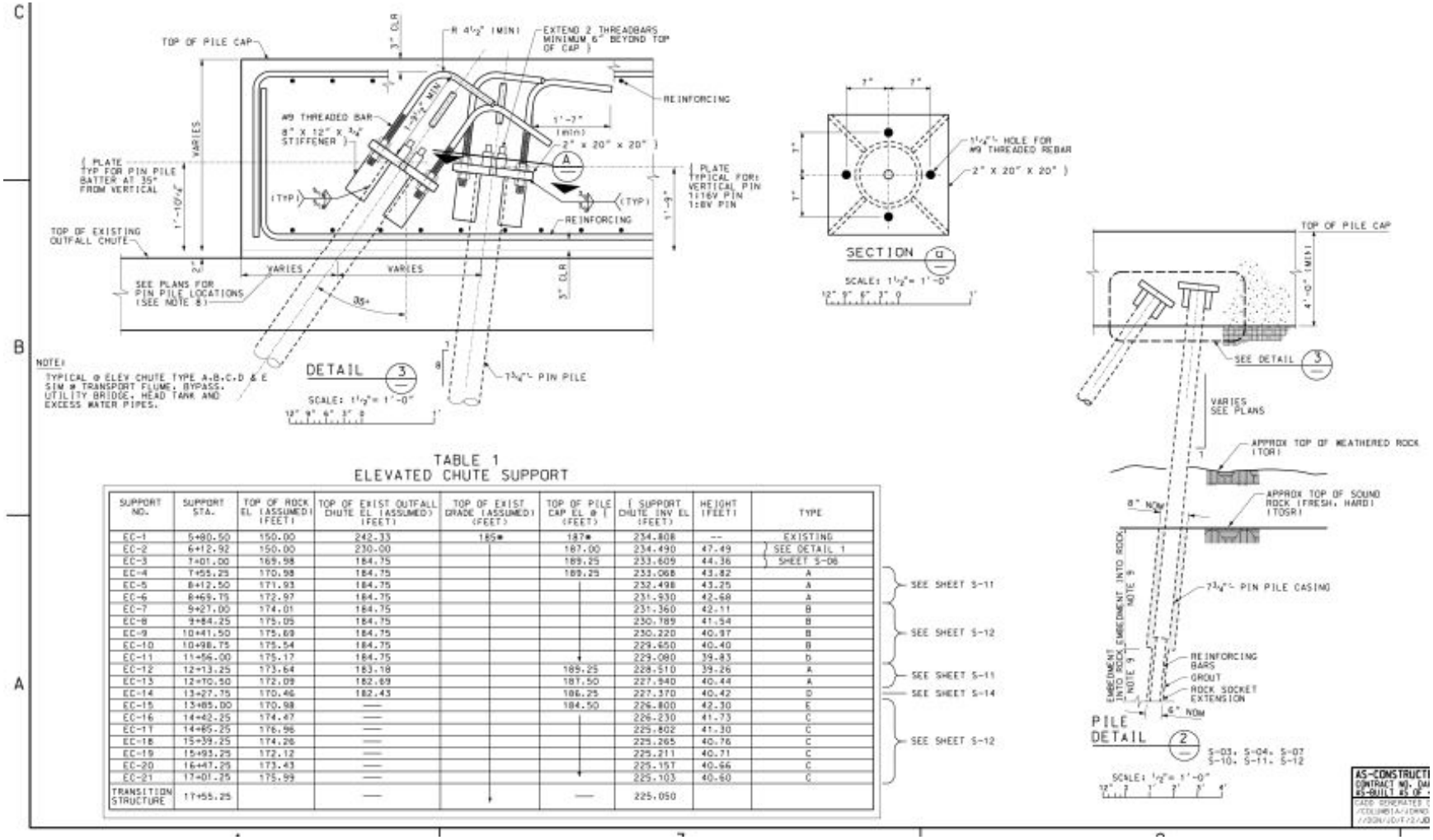

TABLE 1
ELEVATED CHUTE SUPPORT

SUPPORT NO.	SUPPORT STA.	TOP OF ROCK EL (ASSUMED) (FEET)	TOP OF EXIST OUTFALL CHUTE EL (ASSUMED) (FEET)	TOP OF EXIST GRADE (ASSUMED) (FEET)	TOP OF PILE CAP EL @ ℄ (FEET)	℄ SUPPORT CHUTE INV EL (FEET)	HEIGHT (FEET)	TYPE	
EC-1	5+80.50	150.00	242.33	185*	187*	234.808	--	EXISTING	
EC-2	6+12.92	150.00	230.00		187.00	234.490	47.49	SEE DETAIL 1 SHEET S-06	
EC-3	7+01.00	169.98	184.75		189.25	233.609	44.36		
EC-4	7+55.25	170.98	184.75		189.25	233.068	43.82	A	
EC-5	8+12.50	171.93	184.75			232.498	43.25	A	SEE SHEET S-11
EC-6	8+69.75	172.97	184.75			231.930	42.68	A	
EC-7	9+27.00	174.01	184.75			231.360	42.11	B	
EC-8	9+84.25	175.05	184.75			230.789	41.54	B	
EC-9	10+41.50	175.69	184.75			230.220	40.97	B	SEE SHEET S-12
EC-10	10+98.75	175.54	184.75			229.650	40.40	B	
EC-11	11+56.00	175.17	184.75			229.080	39.83	D	
EC-12	12+13.25	173.64	183.18		189.25	228.510	39.26	A	SEE SHEET S-11
EC-13	12+70.50	172.09	182.69		187.50	227.940	40.44	A	
EC-14	13+27.75	170.46	182.43		186.25	227.370	40.42	D	SEE SHEET S-14
EC-15	13+85.00	170.98	—		184.50	226.800	42.30	E	
EC-16	14+42.25	174.47	—			226.230	41.73	C	
EC-17	14+85.25	176.96	—			225.802	41.30	C	
EC-18	15+39.25	174.26	—			225.265	40.76	C	SEE SHEET S-12
EC-19	15+93.25	172.12	—			225.211	40.71	C	
EC-20	16+47.25	173.43	—			225.157	40.66	C	
EC-21	17+01.25	175.99	—			225.103	40.60	C	
TRANSITION STRUCTURE	17+55.25		—		—	225.050			

Figure 13 - Pile Foundation EC-2 Details and Assumed Rock Elevations, JDF2-10/24

7.4 Sounding

The concrete on either side of the abandoned bulkhead slot was hit numerous times and locations with a hammer. The results were that the concrete sounded solid without any hollowness. This is a good sign that the concrete in this area is solid and does not have any delaminations. Therefore, the concrete on either side of the bulkhead is adequate. The concrete patch in-between the bulkhead slot was not sounded due to safety concerns.

7.5 Drawing Research

Drawings were reviewed to gather information and are listed in the front of this report. Drawing JDF-1-4-8/1 noted (note 1c) that *"The blockout in the wall of section 12 of the permanent fish ladder shall be reinforced and plugged with concrete….This concrete will have to be placed while the permanent fish ladder is in operation."* This is an important note since it is alluding to the plug concrete (or portions of it) were likely placed underwater. Underwater concrete placements can be tricky and can lead to the mix falling apart (dis-associating) as it travels through the water if it is not placed correctly. So, it is likely that the area that is leaking (and the area in the general vicinity) is not solid through its thickness due to a poor underwater concrete placement. Ground water has found this weak spot(s) and is eroding the ground behind the wall (and possibly in other areas unknown to us). This is called internal erosion and is typically a dam safety concern since it can lead to failure whether it is a breach, slope instability or an above ground structure instability due to undermining of foundations.

8 Non-Destructive Testing of Suspect Concrete

Carlson Testing was called to determine if there was a way to test the concrete in question in order to determine the extent of bad concrete. A technique called Impact-Velocity can be used to determine the relative soundness of the concrete. An impact is made on the face of the concrete which creates a vibration that can be measured. As the vibration travels through different mediums (solid, air, pasty/soft concrete, etc) it travels at different speeds. Usually 3' is the extent of this technology. The fish ladder wall in this area is at least 3' thick and is probably thicker since parts of it were cast in excavated rock. However, the inspection technique would probably still be beneficial since the plug concrete is not as solid as the concrete on either side of the bulkhead. If the concrete on the outside of the bulkhead is used as a baseline then readings of the plug concrete can be compared to see the extents of where it is 'bad'. From there a determination can be made on whether and how to repair the bulkhead slot plug. Carlson Testing gave a rough estimate of $3,500 to perform this work. An additional cost of $1,300 can be spent to perform GPR (ground penetrating radar). GPR is used to provide thickness measurements of the concrete. However, when talking to Carlson Testing it didn't sound like the GPR would be very conclusive. Its results would help define the problem area however is somewhat subjective.

9 Conclusions and Recommendations

9.1 Conclusions

1. Internal erosion has taken place and is likely still taking place. The extent of erosion is unknown. Further internal erosion could lead to structure foundation undermining which could destabilize the surrounding structures. One possible explanation could be that water is getting into the abandoned fish ladder (from the old entrance possibly?) and is loading the concrete plug in the south fish ladder and eventually leaking through.

Therefore, the internal erosion may be constrained to just the abandoned fish ladder area which could explain that the only grade level subsidence that is seen in the area is directly over the abandoned fish ladder. However, the extent of the internal erosion is still unknown.

2. Parts of the bulkhead plug have failed and continue to fail. This is a progressive failure in motion. Further failures could lead to debris entering the fish ladder which may require the ladder to be shut down. Additionally, further failures could lead to foundation undermining of structures in the surrounding area.
3. The concrete on either side of the bulkhead slot is sound.

9.2 Recommendations

1. **Perform an impact-velocity survey in order to determine the extent of bad concrete within the bulkhead plug. This survey should be performed now during the existing outage so that the extent of the problem can be determined**. Once the extent of the bad concrete has been defined then the scope and urgency of the repair can be determined. For instance, it may be determined that the concrete is only bad in a small area located in the rock cut for the ladder. If this is the case then it may be possible to repair the concrete from within the ladder without worrying about backfill from behind the wall sloughing off into the ladder. Sloughing off of a large amount of backfill could have the potential to negatively affect the foundations of the surrounding structures. On the other hand, the survey may find that the extent of bad concrete is throughout the entire area and depth of the former bulkhead slot. If this was the case then the potential for the whole plug sloughing off would be greater as well as the consequences to the stability of the surrounding structures and the operation of the fish ladder.
2. Monitor the ground area for future sink holes on a monthly basis.
3. Monitor the structures in the immediate area for signs of distress such as cracking, spalling and out of plumbness on a monthly basis.
4. Repair the plug.

10 Point of Contact

Contact Dave Hamernik for any questions at phone number 503-808-4943.