BONNEVILLE/THE DALLES/JOHN DAY GRATING IMPROVEMENTS FOR LAMPREY

LETTER REPORT

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The Portland District, U.S. Army Corps of Engineers
Portland, Oregon
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1. PURPOSE AND SCOPE

The purpose of this Letter Report is to provide design information necessary to prepare Plans and Specifications for making grating improvements for lamprey at Bonneville, The Dalles, and John Day.

The fish ladders on the lower Columbia River Dams typically have diffuser grating with bars spaced so there is a 1-inch clear opening between the bars (when measured at the smallest opening). Project fisheries biologists have identified a number of areas in fish ladders at Bonneville, The Dalles, and John Day where lamprey have been able to pass through the grating into the AWS system, but become trapped and are unable to escape the AWS system, leading to their demise. Further biological laboratory studies have shown that the lamprey are able to pass a 1-inch diffuser grating, but are unable to pass a 0.75-inch grating. The purpose of this study is to find a 0.75-inch grating that is acceptable biologically, hydraulically, and structurally for use in the lower Columbia fish ladders. The trash racks in the fish ladders also need to be upgraded to match the 0.75-inch gap grating recommended.

The stub walls at The Dalles East Junction Pool commonly trap lamprey during dewatering. This study will make recommendations to improve the passage of lamprey at this location.

The lower three weirs at the John Day South fish ladder are underwater a majority of the time. This study will make recommendations for the removal of the lower three weirs at the John Day South fish ladders.

2. PROJECT AUTHORIZATION

2.1 **Bonneville –** Bonneville Lock and Dam was authorized in 1933. The multi-purpose project is part of the Columbia River navigation system and provides recreational and hydropower benefits.

2.2 **The Dalles** - The Dalles Lock and Dam project was authorized by the River and Harbor Act of May 17, 1950. The multi-purpose project is part of the Columbia River navigation system and provides recreational and hydropower benefits.

2.3 **John Day –** John Day Lock and Dam was originally authorized for hydropower production and navigation in the Flood Control Act of 1950. The multi-purpose project is part of the Columbia River navigation system and provides recreational and hydropower benefits.

3. PROJECT LOCATION

This project includes all of the fish ladders and powerhouse collection channels at Bonneville Dam, The Dalles Dam, and John Day Dam. See Plates 3, 4, and 5 for the locations of the fish ladders and powerhouse collection channels.

4. BIOLOGICAL NEED AND FUNCTION

In the Columbia River Basin, Pacific lamprey Lampetra tridentata are of conservation concern. Lamprey populations have diminished, and as a result, tribal and commercial harvest of lamprey has been curtailed. Pacific lamprey have been nominated for listing under the Endangered Species Act, due to concerns about their population status. Pacific lamprey are anadromous, participating in migrations to freshwater spawning areas that can exceed 700 km. Protection of the adults during their migration past Columbia River hydropower dams has been identified as one of the priority for restoration of lamprey populations by the Lamprey Technical Workgroup.

Adult Pacific lamprey can suffer both delay and mortality during passage through the fishway systems at Columbia River hydropower dams. Fishways at these dams were originally constructed to promote adult salmonid passage. Consequently, many of the dam structures and operations do not optimize lamprey passage and survival. For example, picket leads and diffuser grating at these dams are sized to exclude salmonids from dead-end channels, pumps, and other sources of mortality. However, lamprey can pass through some of these structures and have been subject to both delayed migration (due to entry into channels that lead nowhere) and mortality (during de-watering operations for fishway maintenance).

Vertical and horizontal test scenarios indicated that the entire size range of lamprey collected in the lower Columbia River can be excluded by using a gap size or bar spacing of 1.9-cm or less (Moser, et al 2007 attached). Lamprey movement through a gap did not seem to be affected by the gap orientation. Lamprey moved nearly as easily through a vertically oriented 2.5-cm gap as they did through a horizontal one. This is probably due to the lamprey's tubular shape and generally compressible body. The 2.5-cm gap represents approximately 70% of the mean lamprey diameter and less than 60% of the largest lamprey diameter. When stranded on the horizontal grating, lamprey often opted to pass through tail first. After backing partially through the gap, they were able to flex the tail and thereby lever the rest of the body through. The use of the tail to attempt passage through a small opening has also been observed in juvenile Pacific lamprey (Moursund et al. 2000). When in water during the vertical gap trials, adult lamprey typically approached and passed through the gap headfirst. This tendency to move head first was also observed in experiments where lamprey encountered a vertically oriented set of bars or pickets (D. Ogden, National Marine Fisheries Service, personal communication).

Following these evaluations, the U.S. Army Corps of Engineers tested the results at Pool 16 of the John Day Dam south fishway (Columbia River km 347). This section of the fishway had historically been an area where lamprey died after passing through the existing 2.5-cm grating during dewatering operations. The 2.5-cm grating was replaced with 1.9-cm grating in winter 2005. During dewatering operations in winter 2006, no lamprey were able to pass through the new grating.

The results of these experiments indicated that by replacing traditional 2.5-cm (1-in) diffuser grating with the 1.9-cm (3/4-in) grating, nearly all adult Pacific lamprey in the lower Columbia River could be excluded from areas where they could be delayed, injured, or killed. Reducing the bar spacing of trash racks, picketed leads, and diffuser gratings could thereby confer protection to this species in a variety of applications.

5. DESCRIPTION OF CURRENT PROJECT FEATURES

5.1 EXISTING GRATINGS

Table 5.1 lists the features currently present in each fish ladder and powerhouse collection channel at Bonneville, The Dalles, and John Day. The lamprey gratings PDT made site visits to the Bradford Island fish ladder, The Dalles east, north, west, and south fish ladders, and the John Day north and south fish ladders. The trip reports for these site visits are included in Appendix C.

Location	Grating Material Type	Grating Manuf. Style	Grating Size (bearing bar spacing and dimensions)	Max. Grating Span
Bonneville				
Washington Shore Ladder	Galvanized Steel	Welded	1 1/4" x 3/16" b.b. w/ 1" clr opening w/ x-bars 4" o.c.	6'-3"
Bradford Island Ladder	Galvanized Steel	Welded	1 1/4" x 3/16" b.b. w/ 1" clr opening w/ x-bars 4" o.c.	6'-0"
Cascades Island Ladder	Galvanized Steel	Welded	1 1/4" x 3/16" b.b. w/ 1" clr opening w/ x-bars 4" o.c.	6'-0"
First powerhouse collection channel	Galvanized Steel	Welded	1 1/4" x 3/16" b.b. w/ 1" clr opening w/ x-bars 4" o.c.	6'-0"
Second powerhouse collection channel	Galvanized Steel	Welded	1 1/2" x 1/8" b.b. w/ 1 1/16" clr opening w/ x-bars 4" o.c.	5'-4"
The Dalles				
East Fish ladder	Galvanized Steel	Welded	1 1/4" x 3/16" b.b. w/ 1" clr opening w/ x-bars 4" o.c.	8'-4"
North Fish ladder	Galvanized Steel	Welded	1" x 3/16" b.b. w/ 1" clr opening w/ x-bars 4" o.c.	8'-0"
West Entrance and Powerhouse Collection Channel	Galvanized Steel	Welded	1 1/4" x 3/16" b.b. w/ 1" clr opening w/ x-bars 4" o.c.	6'-6"
South Fish ladder	Galvanized Steel	Welded	1" x 3/16" b.b. w/ 1" clr opening w/ x-bars 4" o.c.	6'-0"
John Day				
North Fish Ladder	Aluminum	Pressure-Locked	1 1/2" x 1/8" b.b. w/ 1" clr opening w/ x-bars 4" o.c.	7'-3"
South Fish Ladder	Aluminum	Pressure-Locked	1 1/4" x 3/16" b.b. w/ 1" clr opening w/ x-bars 4" o.c.	4'-6"
Powerhouse Collection Channel	Galvanized Steel	Welded	1 1/2" x 3/16" b.b. w/ 1" clr opening w/ x-bars 4" o.c.	6'-6"

Table 5.1 – Existing Diffuser Gratings

5.2 EXISTING TRASH RACKS

The existing trash racks are constructed with a 1-inch gap between the vertical bars. The existing trash racks are constructed of painted steel.

6. PROBLEM

This study is to find a grating configuration and material is suitable for lamprey and meets structural and hydraulic criteria. The biological criteria are 0.75-inch clear opening between the vertical bars and avoid galvanizing in order to prevent the leaching of zinc into the ladder system. The structural criterion is that the grating and support structure should support a live load of 100 psf. The hydraulic criterion is that the grating should have similar porosity as the existing gratings so that the head loss does not increase in the fish ladders.

7. ALTERNATIVES EVALUATION

7.1 ALTERNATIVE GRATING CONFIGURATIONS EVALUATED

7.1.1 Expanded Metal Grating – Expanded metal grating is standard bar grating with expanded metal material welded to the top. The expanded metal is in a honeycomb type configuration. This type of grating is used to decrease the gaps between the bearing bars. This alternative was rejected because it decreases the diffuser grating porosity and would increase head loss in the fish ladders.

7.2 ALTERNATIVE GRATING MATERIALS EVALUATED

7.2.1 Fiberglass – Fiberglass was evaluated as an alternative for grating material. Fiberglass gratings are reinforced with steel and are used in marine environments due to their high corrosion resistance. Fiberglass was rejected because it has low strength, requiring a large amount of additional structural supports. This increases both the cost and the amount time to install fiberglass gratings. Fiberglass was also rejected because it has very low porosity and would increase head loss in the fish ladders.

7.2.2 Aluminum – Aluminum was evaluated as an alternative for grating material. Aluminum was rejected because it has low strength compared to steel and many additional structural supports would be needed to support the design load. This increases both the cost and the amount of time to install aluminum gratings. Aluminum was also rejected because the aluminum supporting structure that comes into contact with concrete would need to be protected by either galvanizing or painting the aluminum. Galvanizing is not acceptable due to zinc leaching into the ladder systems and painting the supports would become a large maintenance issue in the future when the paint starts to crack or wear off.

7.2.3 Galvanized Steel – Galvanized steel gratings were considered as an alternative for grating material. Galvanized steel grating will not be used in the diffusers in order to prevent the leaching of zinc into the ladder system. The leaching of zinc from galvanized steel has been shown to be detrimental to fish passage.

7.2.4 Painted Steel – Painted steel gratings were considered as an alternative for grating material. Painted steel was rejected because the gratings would require painting maintenance in the future and it would be time consuming and costly to perform this maintenance. This maintenance would be expensive due to the large amounts of grating in the ladders and the amount of time required to remove the gratings from the supporting structures.

7.3 ALTERNATIVE TRASH RACK MATERIALS EVALUATED

7.3.1 Aluminum – Aluminum was evaluated as an alternative for trash rack material. Aluminum was rejected because the existing trash rack guides are made of steel. This would be an expensive alternative because the guides would all need to be changed to aluminum if aluminum trash racks were implemented.

7.3.2 Galvanized Steel – Galvanized steel was considered as an alternative for trash rack material. Galvanized trash racks will not be used in the diffusers in order to prevent the leaching of zinc into the ladder system.

7.3.3 Stainless Steel – Stainless steel was evaluated as an alternative for trash rack material. Stainless steel was rejected because the existing trash rack guides are made of steel. This would be an expensive alternative because the guides would all need to be replaced with stainless steel if stainless steel trash racks were implemented.

7.4 ALTERNATIVE STUB WALL MITIGATION EVALUATED

7.4.1 Ramps – Ramps were evaluated as a way to mitigate lamprey trapping issues at The Dalles East fish ladder junction pool. This alternative was rejected because the ramps would interfere with the gratings. The ramps would reduce the open area of the gratings and this is not acceptable.

8. SELECTED PLAN

8.1 DESCRIPTION OF PLAN FEATURES

8.1.1 Diffuser Grating Modifications – The grating material and configuration selected is McNichols "GCC" pressure locked stainless steel grating. This configuration has a clear spacing between bearing bars of 0.75-inch and it has 77% porosity. The cross bars are spaced at 4" on center. The gratings will support a 100 lb/ft^2 live load.

8.1.2 Diffuser Grating Support Modifications - The grating support structures will be reconfigured to support a 100 lb/ft^2 live load and the material will be stainless steel.

8.1.2.1 Bonneville Washington Shore – The new support beams will be shifted slightly so that the new attachments do not interfere with the old attachments. Plates 6 and 7 show the diffuser gratings support configurations and details for the Washington Shore fish ladder. Note: Team members were not able to field verify the drawings at Washington Shore because the ladder was not dewatered during the site visit.

8.1.2.2 Bonneville Bradford Island – The diffuser gratings will be raised to the original design floor invert elevation. New support beams will be added to support the gratings. Plates 8, 9, and 10 show the diffuser gratings support configurations and details for the Bradford Island fish ladder.

8.1.2.3 Bonneville Cascades Island – The diffuser gratings will be raised to the original design floor invert elevation. New support beams will be added to support the gratings. Plates 11, 12, and 13 show the diffuser gratings support configurations and details for the Cascades Island fish ladder. Note: Team members were not able to field verify the drawings at Cascades Island because the ladder was not dewatered during the site visit.

8.1.2.4 Bonneville Powerhouse 1 – The diffuser gratings will be raised to the original design floor invert elevation. New support beams will be added to support the gratings. Plate 14 shows the diffuser gratings support configurations and details for the Powerhouse 1 collection channel. Note: Team members were not able to field verify the drawings at the Powerhouse 1 collection channel because it was not dewatered during the site visit.

8.1.2.5 Bonneville Powerhouse 2 – The new support beams will be shifted slightly so that the new attachments do not interfere with the old attachments. Plates 15 and 16 show the diffuser gratings support configurations and details for the Powerhouse 2 collection channel. Note: Team members were not able to field verify the drawings at the Powerhouse 2 collection channel because it was not dewatered during the site visit.

8.1.2.6 The Dalles East – The new support beams will be shifted slightly so that the new attachments do not interfere with the old attachments. Columns will be added to support the beams and limit deflections. Plates 17 and 18 show the diffuser gratings support configurations and details for The Dalles East fish ladder.

8.1.2.7 The Dalles West – The existing concrete beams and columns will be removed. New stainless steel columns and beams will be installed to support the diffuser gratings. Plates 29 and 20 shows the diffuser gratings support configurations and details for The Dalles West fish ladder.

8.1.2.8 The Dalles North – The existing concrete beams and columns will be removed. New stainless steel columns and beams will be installed to support the diffuser gratings. Plates 21 and 22 show the diffuser gratings support configurations and details for The Dalles North fish ladder. Note: Team members were not able to field verify the drawings at The Dalles North entrance gratings (diffuser gratings in Unit 16 through Unit 19) because this area was not dewatered during the site visit.

8.1.2.9 The Dalles South – The existing concrete beams and columns will be removed. New stainless steel columns and beams will be installed to support the diffuser gratings. Plate 23 shows the diffuser gratings support configurations and details for The Dalles South fish ladder.

8.1.2.10 The Dalles Powerhouse Collection Channel – The existing concrete beams and columns will be removed. New stainless steel columns and beams will be installed to support the diffuser gratings. Plate 20 shows the diffuser gratings support configurations and details for the The Dalles Powerhouse collection channel.

8.1.2.11 John Day North – The existing aluminum beams and posts will be removed. New stainless steel columns and beams will be installed to support the diffuser gratings.

Plates 24 and 25 show the diffuser gratings support configurations and details for the John Day North fish ladder. Note: Team members were not able to field verify the drawings at the John Day North entrance gratings (diffuser numbers 1 and 2) because this area was not dewatered during the site visit. Also, the John Day North Diffuser grating 16 is not included in this report. This diffuser grating will be modified with 0.75-inch grating as part of the John Day North Fish Ladder Exit Section and Count Station Improvements project.

8.1.2.12 John Day South – The existing aluminum beams will be removed. New stainless steel columns and beams will be installed to support the diffuser gratings. Plates 26 and 27 show the diffuser gratings support configurations and details for the John Day South fish ladder.

8.1.2.13 John Day Powerhouse Collection Channel – The new support beams will be shifted slightly so that the new attachments do not interfere with the old attachments. Plate 28 shows the diffuser gratings support configurations and details for the John Day Powerhouse collection channel.

8.1.3 Trash Racks – The trash racks will replaced as originally designed, except that the vertical bars will be spaced with a 0.75-inch clear opening between the vertical bars. The trash racks will be constructed of painted steel.

8.1.3.1 Bonneville – The trash racks that will be replaced are: twenty trash racks at the Bonneville Powerhouse 2 fish units. Plate 29 shows the trash racks that will be replaced. Note: There are additional trash racks at Cascades Island and Bradford Island that need to be replaced, but are still being investigated. The additional trash racks that need to be replaced with 0.75-inch clear opening will be added to this section when they are determined.

8.1.3.2 The Dalles – None of the trash racks at The Dalles need to be replaced.

8.1.3.3 John Day – The trash racks that will be replaced are: six trash racks at the John Day North entrance, twelve trash racks at the John Day South entrance, and one trash rack at the John Day South exit. The trash rack at the John Day North exit has already been replaced with 0.75-inch spaced vertical bars. Plates 30 and 31 show the trash racks that will be replaced.

8.1.4 The Dalles East Fish Ladder Junction Pool Stub Walls – The six existing 12" stub walls will be sawcut and removed from the existing ladder structure. The stub walls be cut into smaller pieces and loaded onto a skiff for crane removal. Informational drawings DDF-1-4-5/T1 and DD-1-4-5/S2 show the existing stub wall details.

The bulkheads will be left in place. The Dalles Project indicated that these bulkheads have not been used for at least 15 years. If current operation change and the bulkheads are operated in the future, the bottom seals will need to be modified. The bulkheads currently seal against the concrete stubs walls. The existing bottom seals would be removed and new bottom crush seals would be added to the bulkheads.

8.1.5 John Day South Fish Ladder Lower Three Weir Removal – The lower three weirs (156, 157, and 158) at the John Day South fish ladder will be sawcut and removed from the existing ladder structure. The weirs will be cut into smaller pieces and loaded into a skiff box for removal. Informational drawings JDF-1-4-3/48 and JDF-1-4-3/51 show the existing weir concrete and reinforcement details.

8.2 DESIGN –

8.2.1 Diffuser Gratings – All gratings are designed for a live load of 100 psf to support project crew access. The grating spans were modified in some areas in order to support the design loads. The McNichols GCC pressure locked grating configuration was chosen because it has 0.75-inch clear spacing between bars and it has a porosity similar to the gratings that are currently in the fish ladders and the powerhouse collection channels. The height of the grating bars is indicated in the drawings. There is some variation in bar height due to the existing ladder configurations and to keep the ladder floor invert elevation the same as the original design. Stainless steel was chosen as the grating material because of its high strength and corrosion resistance.

8.2.2 Diffuser Grating Supports – The diffuser grating support configurations are designed to support a live load of 100 psf for project crew access and a grating dead load of 10 psf. Stainless steel was chosen as the grating support material to avoid galvanic corrosion with the stainless steel gratings. The grating support structures were modified because the existing configurations did not support the design loads in most of the ladders. The ladder gratings at the Bonneville Bradford Island and Cascades Island fish ladders were raised up to their original floor invert elevation to increase the open area through the diffuser grating openings. Also, the current grating configurations at Bradford Island and Cascades Island are subject to diffuser blow off due to insufficient structural attachments.

8.3.3 Trash Racks – The trash racks need to be modified in order to provide the same porosity as the diffuser gratings. The bar spacing will be reduced to provide a 0.75-inch opening between the vertical bars. The trash racks will be replaced with painted steel to avoid galvanic corrosion with the existing guides that are made of carbon steel. Painted steel trash rack material was chosen because there are not many trash racks that need to be replaced and would not be a large maintenance issue in the future. The trash racks are also easy to remove to perform maintenance on them.

8.2.3 The Dalles East Fish Ladder Junction Pool Stub Walls – The six existing stub walls at The Dalles East fish ladder junction pool are used to prevent debris accumulation under the six bulkheads. The bulkheads have not been used for over 15 years. The stub walls are 12” wide and 2’-6” tall. The stub walls can easily be removed by sawcutting.

8.2.4 John Day South Fish Ladder Lower Three Weir Removal – The John Day North fish ladder lower three weirs were recommended for removal as part of the John Day North Fish Ladder Exit Section and Count Station Improvements project. The hydraulic analysis of the north fish ladder lower three weirs was done as part of the John Day North Fish Ladder Exit Section and Count Station Improvements project and it is directly applicable to the lower three weirs of the John Day South fish ladder.

8.3 CONSTRUCTION METHODS AND MATERIALS –

8.3.1 Diffuser Gratings – The diffuser gratings are attached to the support beams with stainless steel saddle clips.

8.3.2 Diffuser Grating Supports – Existing concrete beams and posts that will be removed in The Dalles north, west, south fish ladders will be sawcut flush with the existing concrete. The beams and posts will be broken into manageable pieces and loaded in a skiff

for crane removal. Existing concrete beams in The Dalles Powerhouse collection channel will be sawcut flush with the existing concrete. The beams will be broken into manageable pieces and carried out of the powerhouse collection channel and loaded onto a skiff for crane removal. The existing grating support angles on all of the fish ladders will be removed. The existing anchor bolts will be burned back a minimum of 2" into the existing walls. The existing surface will be bush hammered or cut with a water jet and patched back with an epoxy material that is trowel finished to provide a smooth surface. The new grating support angle anchor bolts will be spaced so that they do not interfere with the existing anchor bolts.

8.3.3 The Dalles East Fish Ladder Junction Pool Stub Walls – The existing weirs will be sawcut flush with the existing ladder floor. The existing vertical reinforcing dowels will be burned back a minimum of 2" below the ladder invert. The existing surface will be bush hammered or cut with a water jet and patched back with an epoxy material that is trowel finished to provide a smooth ladder floor for fish passage. Existing stub wall concrete will be broken into manageable pieces and loaded in a skiff for crane removal.

8.3.4 John Day South Fish Ladder Lower Three Weir Removal – The existing weirs will be sawcut flush with the existing ladder floor. The existing vertical reinforcing dowels will be burned back a minimum of 2" below the ladder invert. The existing surface will be bush hammered or cut with a water jet and patched back with an epoxy material that is trowel finished to provide a smooth ladder floor for fish passage. Access to the exit sections weirs is not readily available to large cranes as the exit sections weirs are beneath the upper sections of the ladder. Also, the gratings and the concrete bubbler beams are not able to support the weir dead load. As a result, these weirs will need to be saw cut into manageable pieces that can be handled by laborers for loading into a skiff box that can be lifted with a small crane. In addition, the lack of large crane support in this area will require the contractor to erect support for the weir during demolition to prevent collapse of the weir and to provide for worker safety.

9. COST ESTIMATE

The cost estimate is based on the recommendations of this Letter Report. Quantities and information were provided by the designers. Preliminary price quotes for stainless steel gratings were obtained from a local grating supplier. Production rates and efforts to accomplish other tasks needed to replace the gratings are based on generic information and engineering judgment. These tasks include mobilization, demolition and removal of existing gratings, installing new support systems for the gratings, and upgrading the trashracks. It is assumed there are no HTRW materials.

See Table 9.1, Total Project Cost Summary, for the estimated costs. These estimates are based on preliminary information, conceptual in nature. As such, the cost estimates are of the same level and establish a "ball park" cost. Once actual details and specifics are determined to accomplish the work, the cost estimates could change markedly.

*** TOTAL PROJECT COST SUMMARY ***

THIS PROJECT IS BASE ON THE **DRAFT** DDR DATED APRIL 7, 2008 PAGE 1 OF 1

PROJECT: LAMPREY GRATING IMPROVEMENTS DISTRICT: PORTLAND

LOCATION: BONNEVILLE DAM, THE DALLES DAM, AND JOHN DAY DAM DATE: 7-APR-2008

CURRENT COST ESTIMATE PREPARED: 4/7/2008 P.O.C.: PAT JONES, CHIEF, CONSTRUCTION AND COST ENGINEERING

EFFECTIVE PRICING LEVEL: 3/15/2008 FEATURE DESCRIPTION	COST ($K)	CONTG (%)	($K)	SUBTOT ($K)	Feature Mid Pt	INFLATION (%)	(K)	TOTAL CONSTR ($K)	ENG ($K)	TOTAL PROGRAM ($K)
B1 Powerhouse										$9,762
Construction	$6,551	30%	$1,965	$8,516	6/1/2010	4.9%	$417	$8,933		
Eng, EDC, S&A	$620	30%	$186	$806	6/1/2009	2.8%	$23		$829	
B2 Powerhouse										$8,112
Construction	$5,532	30%	$1,660.0	$7,192	6/1/2010	4.9%	$352.0	$7,544		
Eng, EDC, S&A	$425	30%	$128.0	$553	6/1/2009	2.8%	$15.0		$568	
Bonn Washington Shore										$8,416
Construction	$5,553	30%	$1,666.0	$7,219	6/1/2011	7.0%	$505.0	$7,724		
Eng, EDC, S&A	$508	30%	$152.0	$660	6/1/2010	4.9%	$32.0		$692	
Bonn Bradford Island A & B										$11,062
Construction	$7,037	30%	$2,111.0	$9,148	6/1/2012	9.1%	$832.0	$9,980		
Eng, EDC, S&A	$778	30%	$233.0	$1,011	6/1/2011	7.0%	$71.0		$1,082	
Bonn Cascade Island										$8,272
Construction	$5,246	30%	$1,574.0	$6,820	6/1/2013	11.3%	$771.0	$7,591		
Eng, EDC, S&A	$480	30%	$144.0	$624	6/1/2012	9.1%	$57.0		$681	
The Dalles East Fishladder										$11,634
Construction	$6,917	30%	$2,075	$8,992	6/1/2014	13.5%	$1,214	$10,206		
Eng, EDC, S&A	$987	30%	$296	$1,283	6/1/2013	11.3%	$145		$1,428	
The Dalles North Fish Ladder										$4,166
Construction	$2,332	30%	$700.0	$3,032	6/1/2015	15.8%	$479.0	$3,511		
Eng, EDC, S&A	$444	30%	$133.0	$577	6/1/2014	13.5%	$78.0		$655	
The Dalles Pwrhse Collection Channel										$5,203
Construction	$2,841	30%	$852.0	$3,693	6/1/2016	18.1%	$668.0	$4,361		
Eng, EDC, S&A	$559	30%	$168.0	$727	6/1/2015	15.8%	$115.0		$842	
The Dalles West Entrance										$2,099
Construction	$1,099	30%	$330.0	$1,429	6/1/2016	18.1%	$259.0	$1,688		
Eng, EDC, S&A	$273	30%	$82.0	$355	6/1/2015	15.8%	$56.0		$411	
The Dalles South Entrance										$1,816
Construction	$920	30%	$276.0	$1,196	6/1/2016	18.1%	$216.0	$1,412		
Eng, EDC, S&A	$263	30%	$79.0	$342	6/1/2016	18.1%	$62.0		$404	
John Day Dam North Fish Ladder										$6,183
Construction	$3,427	30%	$1,028.0	$4,455	6/1/2017	20.5%	$913.0	$5,368		
Eng, EDC, S&A	$531	30%	$159.0	$690	6/1/2016	18.1%	$125.0		$815	
John Day Dam South Fish Ladder										$8,212
Construction	$4,525	30%	$1,358.0	$5,883	6/1/2018	23.0%	$1,353.0	$7,236		
Eng, EDC, S&A	$623	30%	$187.0	$810	6/1/2017	20.5%	$166.0		$976	
John Day Dam Pwrhse Collection Channel										$5,249
Construction	$2,758	30%	$827.0	$3,585	6/1/2018	23.0%	$825.0	$4,410		
Eng, EDC, S&A	$535	30%	$161.0	$696	6/1/2017	20.5%	$143.0		$839	
TOTAL PROGRAM	**$61,764**		**$18,530**	**$80,294**		**Ave**	**$9,892**			**$90,186**
Construction	**$54,738**	**30%**	**$16,422**	**$71,160**		**12.4%**	**$8,804**	**$79,964**		
Eng, EDC, S&A	**$7,026**	**30%**	**$2,108**	**$9,134**		**11.9%**	**$1,088**		**$10,222**	

Table 9.1 Total Project Costs

Contingency: A contingency of 30% is a guess. A cost risk analysis needs to be performed to quantity the possible cost variation and risk of increase. Recent experience with 2 different projects indicate a 100% contingency might be appropriate, although this seems excessive. The assumptions and circumstances of those other project may not apply to this case.

Inflation to Mid-point: Neither the priority of the work nor the amount of work versus time has been determined. (i.e. It has been mentioned replacing localized areas of gratings

particularly problematic for the lamprey, rather than changing all grating in a fishladder.) Inflation to midpoint of the construction parts has arbitrarily been shown over a ten year program time to illustrate the effect of inflation on the costs. Per Corps policy, the projected inflation is based on Office of Management and Budget (OMB) inflation factors which currently projects 2% annual inflation. In the recent past, this has been too low. Assuming 5% annual inflation would increase the estimated Total Program amount an additional $17 million. The Engineering Manual, EM 1110-2-1304, Civil Works Construction Cost Index System, repeatedly states that using the inflation index for projections beyond 2 years is not recommended. The recommended procedure is to re-estimate the project cost every 2 years.

10. BENEFIT ANALYSIS

Not Required

11. CULTURAL/ENVIRONMENTAL REQUIREMENTS

Not Applicable

12. SCHEDULE

The attached plates showing the grating arrangements need to have connections designed and detailed. The grating layouts and details need to be drawn in Microstation. The construction schedule is to be determined and depends on when funding is available and how many diffuser gratings will be replaced at a time. The construction will be limited to normal in water work periods from December 1 through February 28. The construction schedule will also be dependent upon the dewatering schedules for the ladders at Bonneville, The Dalles, and John Day.

13. LOCAL COOPERATION REQUIREMENTS

Not Applicable

14. FUNDING

Funds for Plans and Specs, Construction, Engineering During Construction, and Supervision and Administration are required for completion of this project.

15. REAL ESTATE REQUIREMENTS

Not Applicable

16. RECOMMENDATION

16.1 GRATINGS, GRATING SUPPORTS AND TRASH RACK RECOMMENDATION

It is recommended that the proposed gratings, grating supports, and trash racks, as described in this report, be approved.

It is recommended that the plans and specifications team field verify the Washington Shore, Cascades Island, Bonneville 1 and 2 Powerhouse, The Dalles North, and John Day North diffuser gratings. These areas were not dewatered during this study. It is also recommended that the plans and specifications team field locate the AWS diffuser gate arms in the Cascades Island fish ladder, the Bradford Island fish ladder and the Bonneville First Powerhouse collection channel.

It is recommended that the AWS diffuser gate floor covers at Cascades Island and Bradford Island be removed because they will interfere with the new diffuser gratings when they are raised up to the original design floor invert elevation. The covers will no longer be needed if the grating is raised up to the original invert elevation.

The John Day Project requested to raise the gratings that are located in the John Day South fish ladder triangular grating section at the entrance (shown in drawing JDP-1-5-0/3). There is approximately a 12 foot depression in this area that slows down lamprey passage. It is recommended that the plans and specifications team investigate the feasibility of raising the gratings in this section. A new structural support system will need to be designed to support the raised gratings in this section and this study did not include raising the gratings. The John Day Project also requested to have the wall diffusers plated over in this same triangular entrance section and is not included in this study. It is also recommended that the plans and specifications team look at the feasibility of plating over these six wall diffusers.

It is recommended that the stockpile of 1-inch galvanized gratings at The Dalles not be used for replacement in the fish ladders and collection channel. These gratings have been galvanized and are not recommended for use in fish facilities. Also, the grating does not meet the 0.75-inch gap criteria.

16.2 RECOMMENDED GRATING REPLACMENT PRIORITIES

This is a list of priorities for grating replacement from Bonneville, The Dalles, and John Day biologists. The trash racks need to be replaced before or at the same time as the ladder and collection channel gratings are replaced. The grating replacement priorities are listed for each project starting from downstream and proceeding upstream. The order of the projects presented below does not indicate a higher priority of one project over another project.

Bonneville:

1. WA shore ladder between weirs 33 and 19.
2. The entrance of Cascades Island ladder.
3. The entrance of B-Branch ladder. FG 3-29 through FG 3-33
4. Cascades Island diffusers FG 6-5 through FG 6-15.
5. B-Branch diffusers FG 3-18 through FG 3-28.
6. A-branch diffusers FG 3-3 through FG 3-9.
7. Downstream of weir 19 and triangle section at WA shore.

8. Powerhouse 2 collection channel.
9. Powerhouse 1 collection channel.

The Dalles:

1. Lower east #L6 through L15 and north #N5 through N15

2. Junction pool #J1 through J8 and L1 through L5

3. East #E1-1 through E1-6, West #E2-1 through E2-4, South #E3-1 through E3-8 and North #1-A through 1-H and #N-1 through N-5 entrance

4. Remainder of collection channel

John Day:

1. South ladder upper diffuser #17

2. South ladder dewater exposed grating #9-#16

3. North ladder dewater exposed grating #7-#15

4. South entrance and south collection channel grating

5. Remainder of collection channel

6. Remainder of north fishway

16.3 THE DALLES EAST FISH LADDER JUNCTION POOL STUB WALL REMOVAL AND JOHN DAY SOUTH LOWER THREE WEIR REMOVAL

It is recommended that the proposed stub wall removal at The Dalles East and the lower three weir removal at John Day South, as described in this report, be approved.