BONNEVILLE SECOND POWERHOUSE FISH GUIDANCE EFFICIENCY (B2FGE) OVERVIEW FOR B2 STS REHAB PHASE 1A

Based on a presentation originally prepared by Max Wilson-Fey (ENC-HD) August 2025 and modified to inform B2 STS rehab pre-design work.

Presented at FFDRWG on 2/5/2026 by Kyle Sautter and Jake Macdonald

30% Phase 1A	60% Phase 1A	90% Phase 1A	Capital Work Group Presentation	Phase 1: DESIGN	Phase 2: CONSTRUCTION
• constraints and criteria	• alternatives evaluation • class 5 estimate for all alternatives	• preferred alternative chosen • class 3 estimate for preferred and next best alternatives	• CWG approves or disapproves continuing on to phase 1	• design preferred alternative	• construct preferred alternative
• FFDRWG reviews the PDT's constraints and criteria	**• FFDRWG assists the PDT in alternatives development**	**• FFDRWG assists the PDT in choosing preferred alternative**	**• FFDRWG provides moral support to the PDT**	**• FFDRWG reviews interim and final products**	**• FFDRWG takes a back seat to FPOM during construction**

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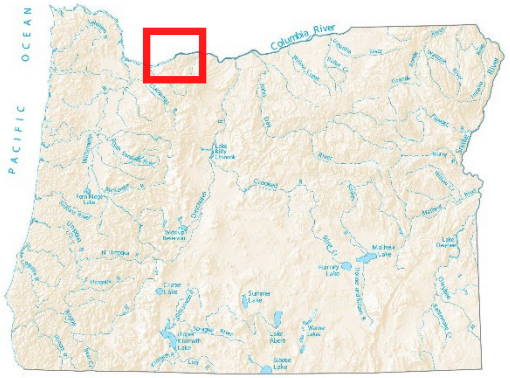

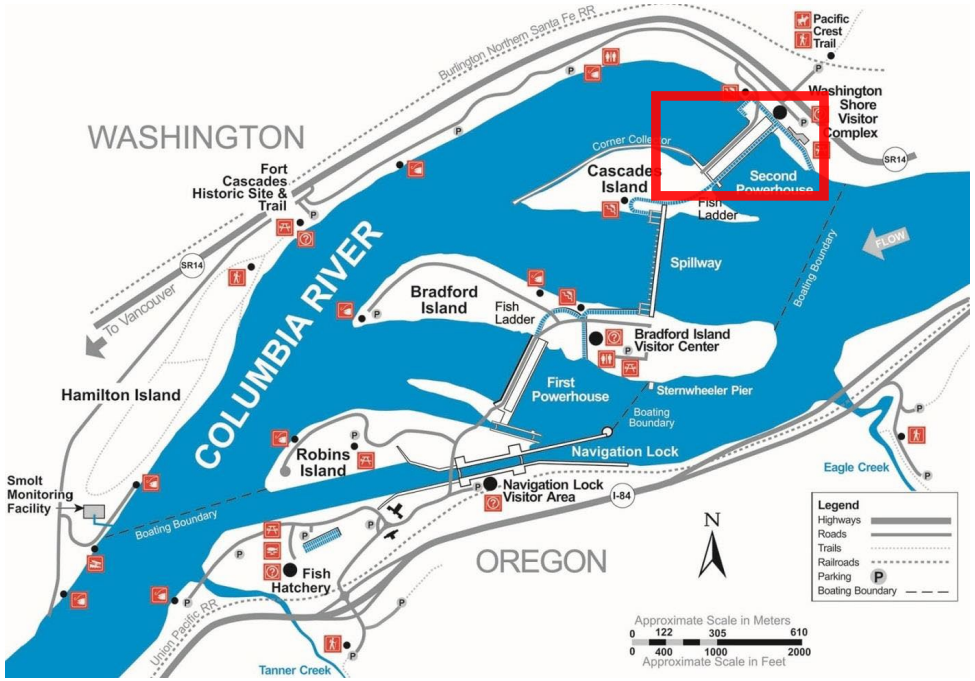

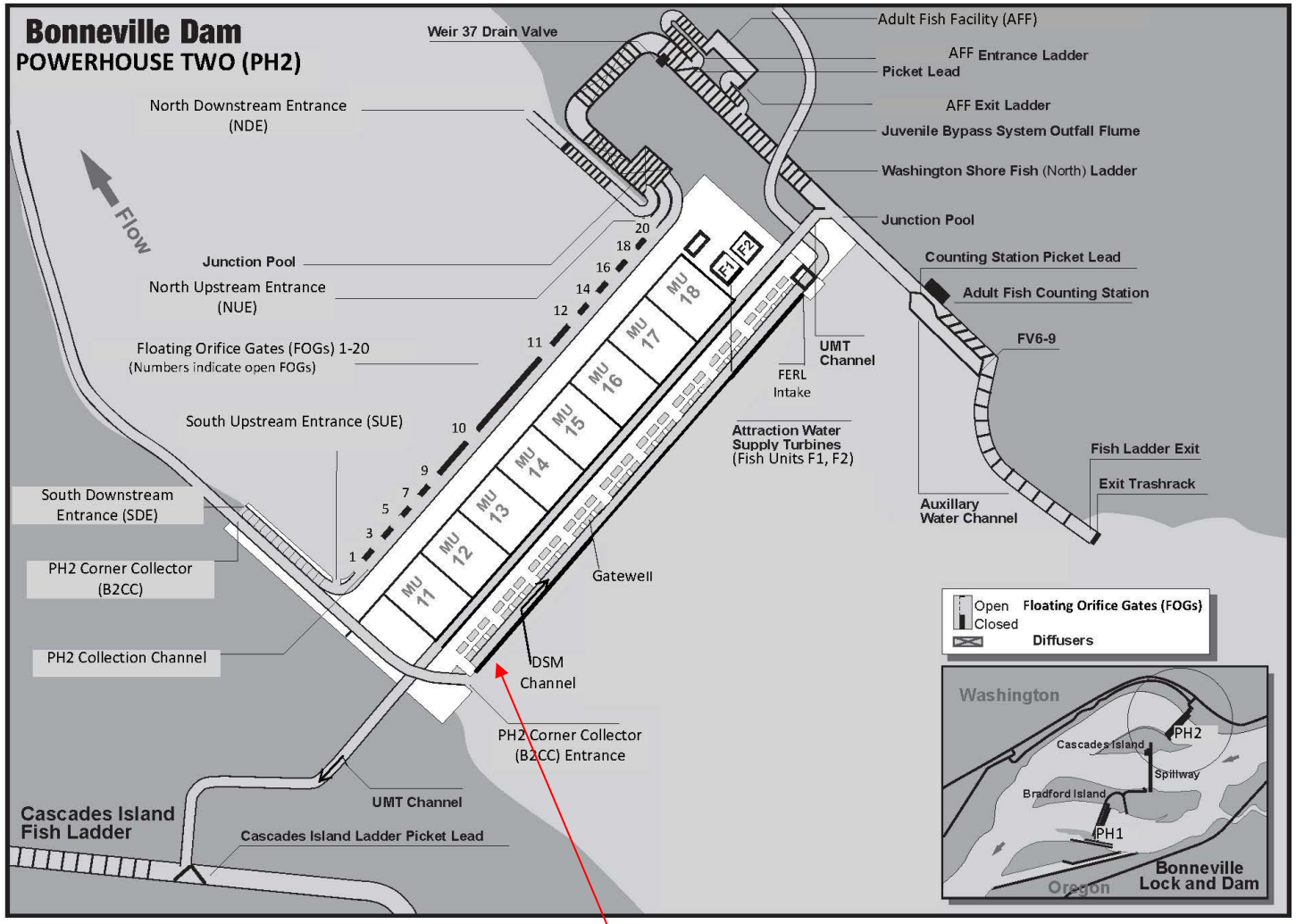

Each PH2 unit has 3 slots: A, B, C

LOCATION

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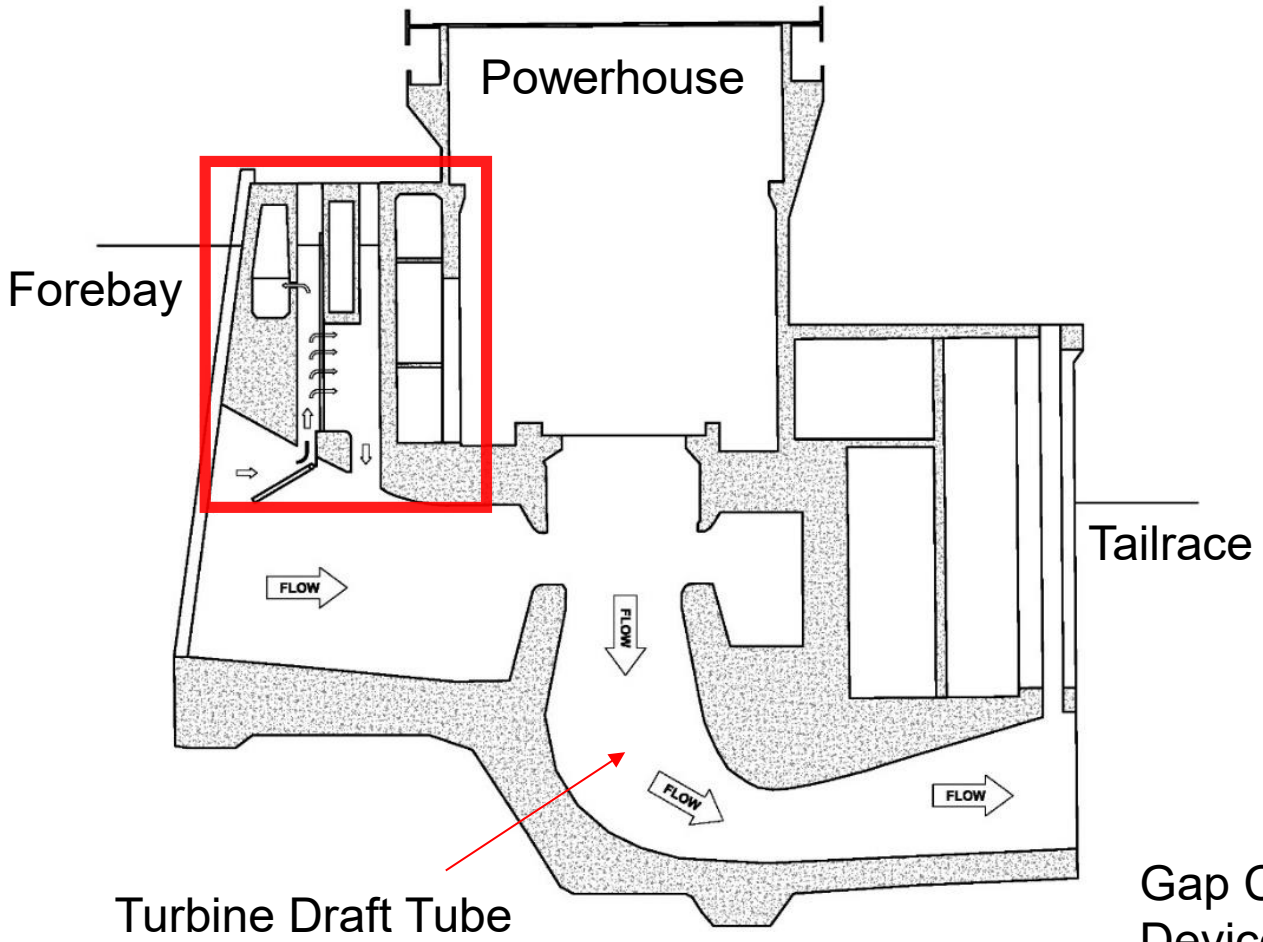

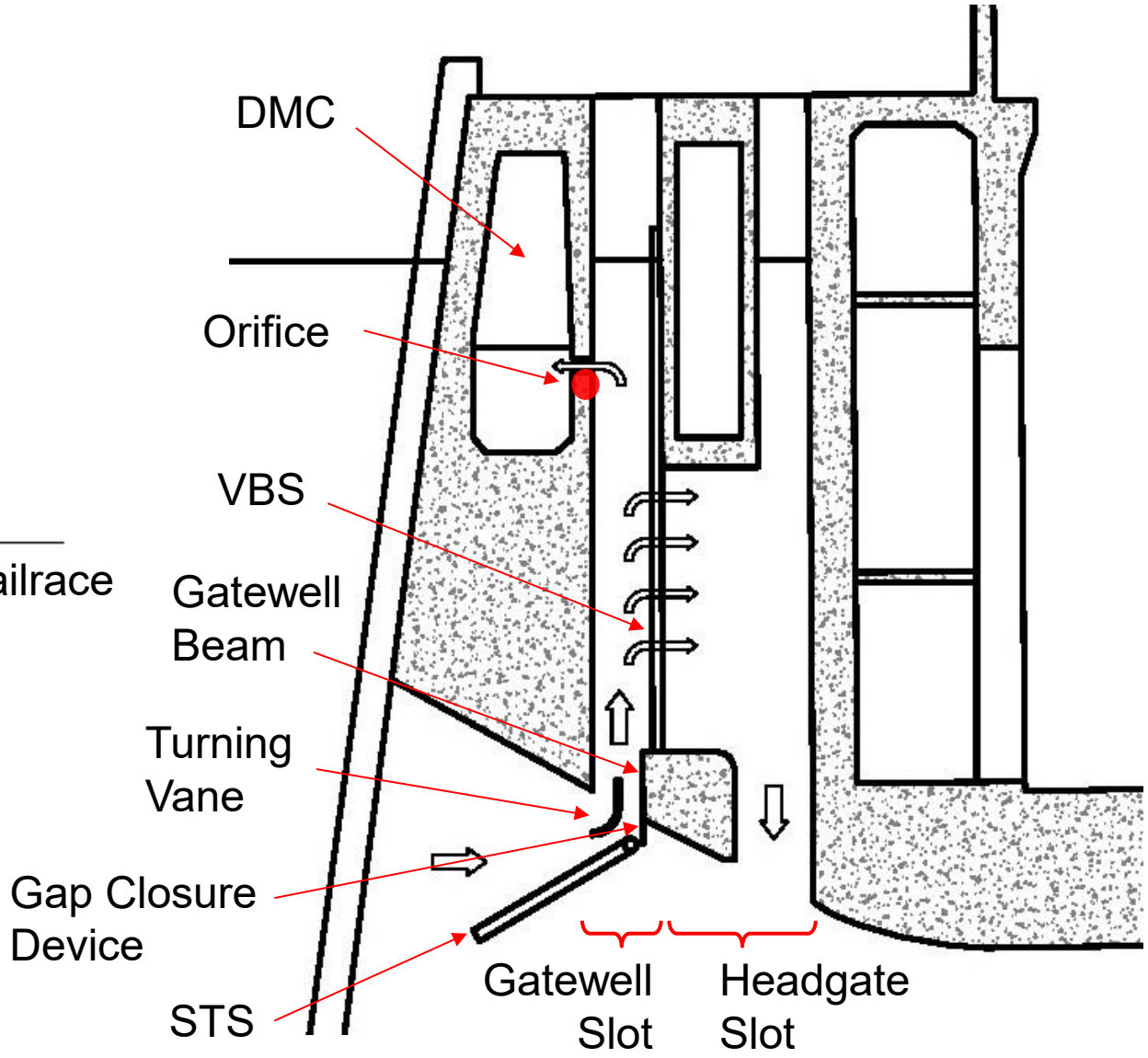

BACKGROUND

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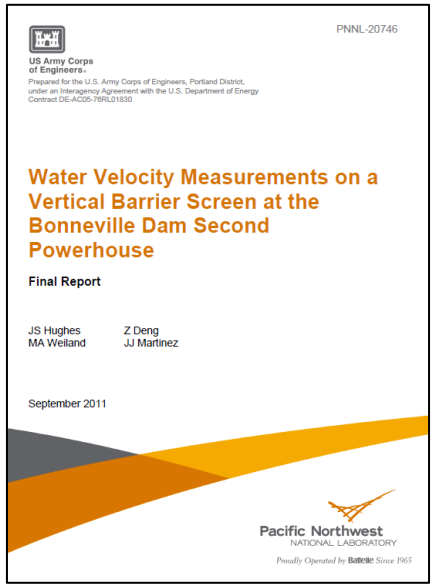
Problem Identification

- In the early 2000's, a higher-than-expected mortality and descaling rate of hatchery Chinook salmon within the JBS was observed at the juvenile monitoring facility (JMF).
- Testing by NMFS in 2008 and 2009 suggested undesirable flow conditions in the gatewell and risk of impingement, impact, descaling, and mortality.

Gatewell Improvements

- Gatewell improvements at B2 have been developed, constructed, and evaluated over the last 15 years…


PNNL-20746

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Prepared for the U.S. Army Corps of Engineers, Portland District, under an Interagency Agreement with the U.S. Department of Energy Contract DE-AC05-76RL01830

Water Velocity Measurements on a Vertical Barrier Screen at the Bonneville Dam Second Powerhouse

Final Report

JS Hughes, MA Weiland, Z Deng, JJ Martinez

September 2011

Pacific Northwest NATIONAL LABORATORY

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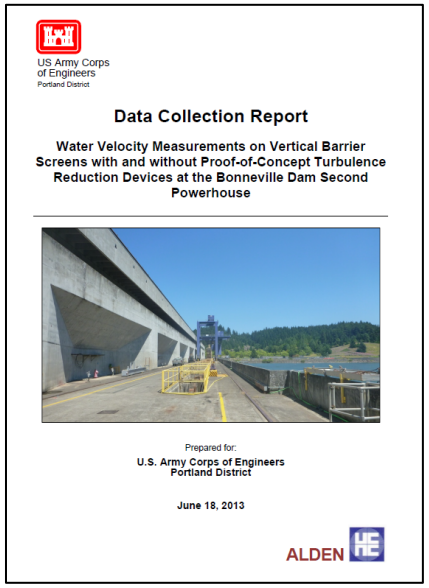
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Data Collection Report

Water Velocity Measurements on Vertical Barrier Screens with and without Proof-of-Concept Turbulence Reduction Devices at the Bonneville Dam Second Powerhouse

Prepared for:
U.S. Army Corps of Engineers
Portland District

June 18, 2013

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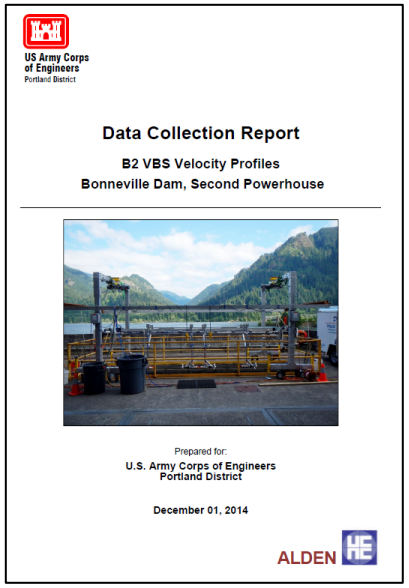
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Data Collection Report

B2 VBS Velocity Profiles
Bonneville Dam, Second Powerhouse

Prepared for:
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December 01, 2014

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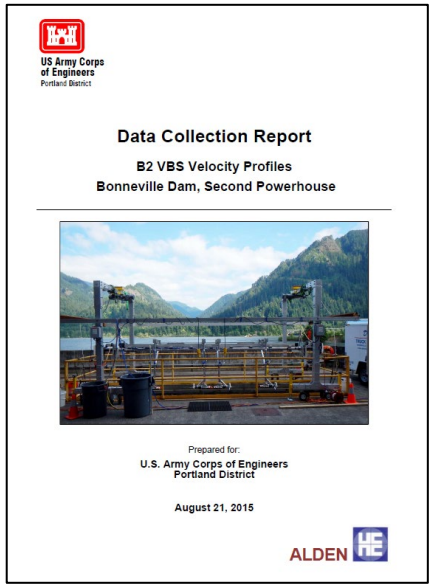
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Data Collection Report

B2 VBS Velocity Profiles
Bonneville Dam, Second Powerhouse

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August 21, 2015

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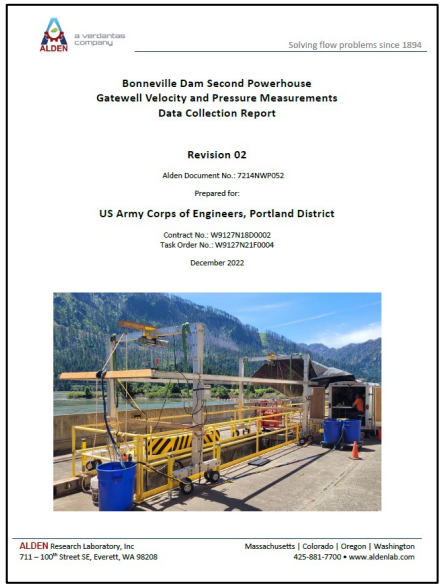
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Bonneville Dam Second Powerhouse
Gatewell Velocity and Pressure Measurements
Data Collection Report

Revision 02

Alden Document No.: 7214NWP052

Prepared for:

US Army Corps of Engineers, Portland District

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2001-2002

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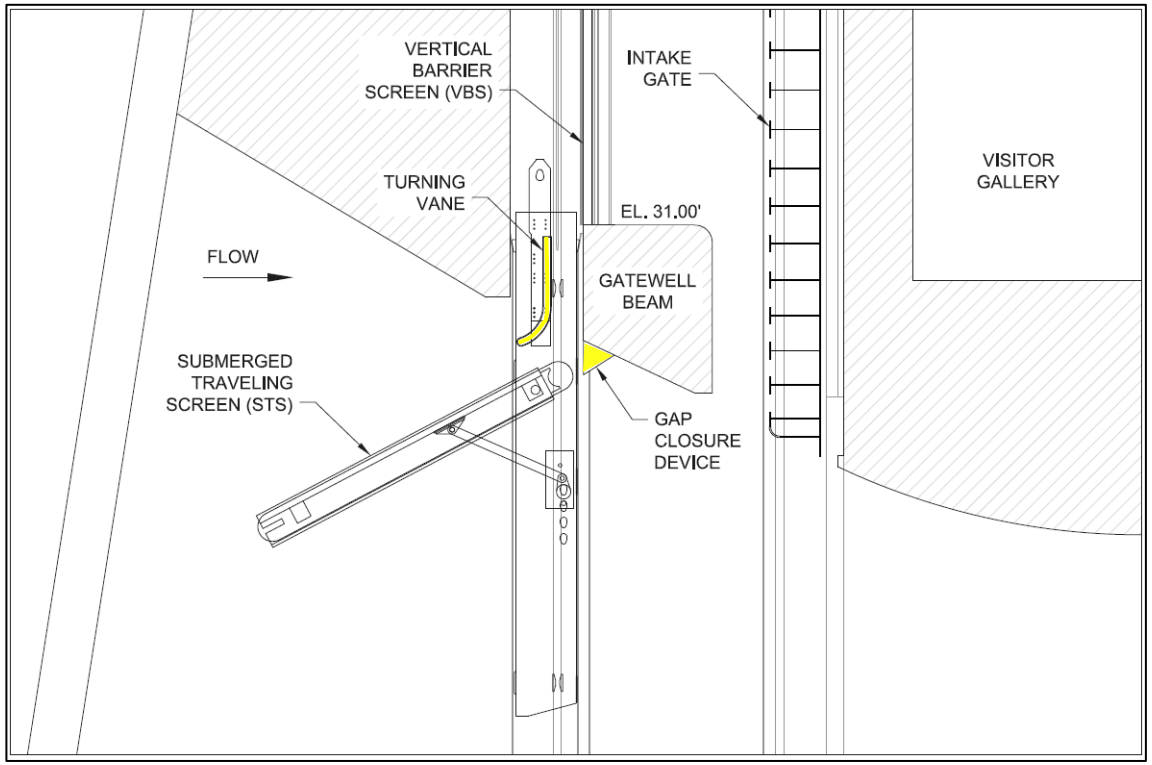
- Prototype gatewell modifications installed in 2001 and 2002 at PH2 units 15 and 17 included:
  - larger VBSs
  - turning vanes to train flow up the gatewells
  - gap closure devices (GCD) to reduce fish loss at the STSs
  - allowances for screen removal and cleaning without outages or intrusive gatewell dipping.

- These prototype changes were shown through both hydraulic modeling and biological studies to increase FGE by 21% for yearling Chinook and 31% for sub yearling Chinook.
  - These increases in FGE would be expected to yield an increase in overall project survival by 0.7% for late migrating subyearling fish and 0.3% for spring and summer migrating fish.

- Remaining PH2 units 11-18 were outfitted with gap closure devices, turning veins, and larger interchangeable VBSs by 2008.



2008-2009

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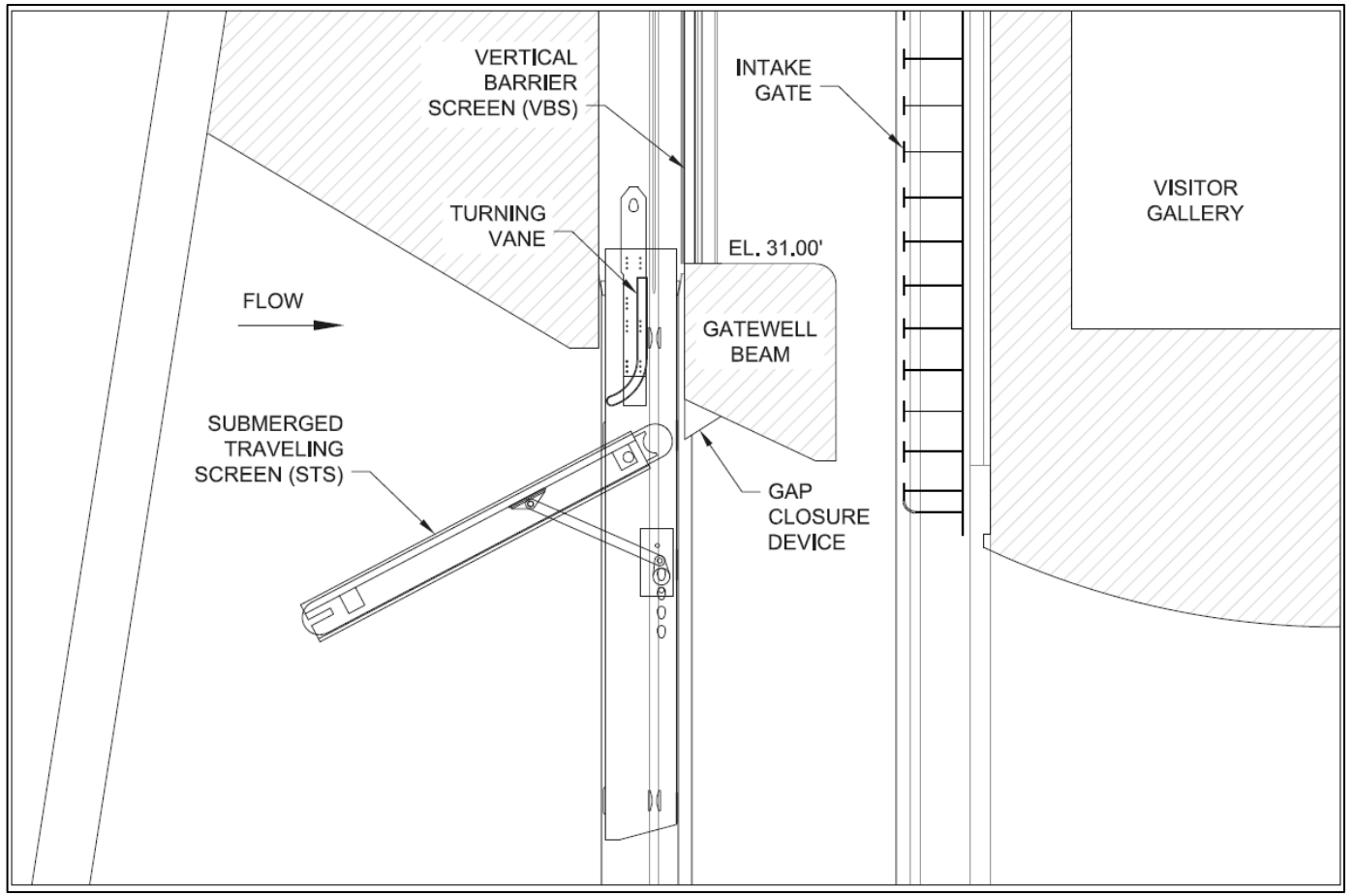
- Testing in 2008 and 2009 suggested undesirable flow conditions remained in the gatewells when the powerhouse was operated at the upper 1% efficiency range with modifications in place (Hughes et al., 2011; Gilbreath et al., 2012).

- Since 2011, PH2 units have been operated at the middle to lower end of the 1% peak efficiency range with regionally coordinated special operations to minimize PH2 screened bypass descaling and mortality.



2011-2013

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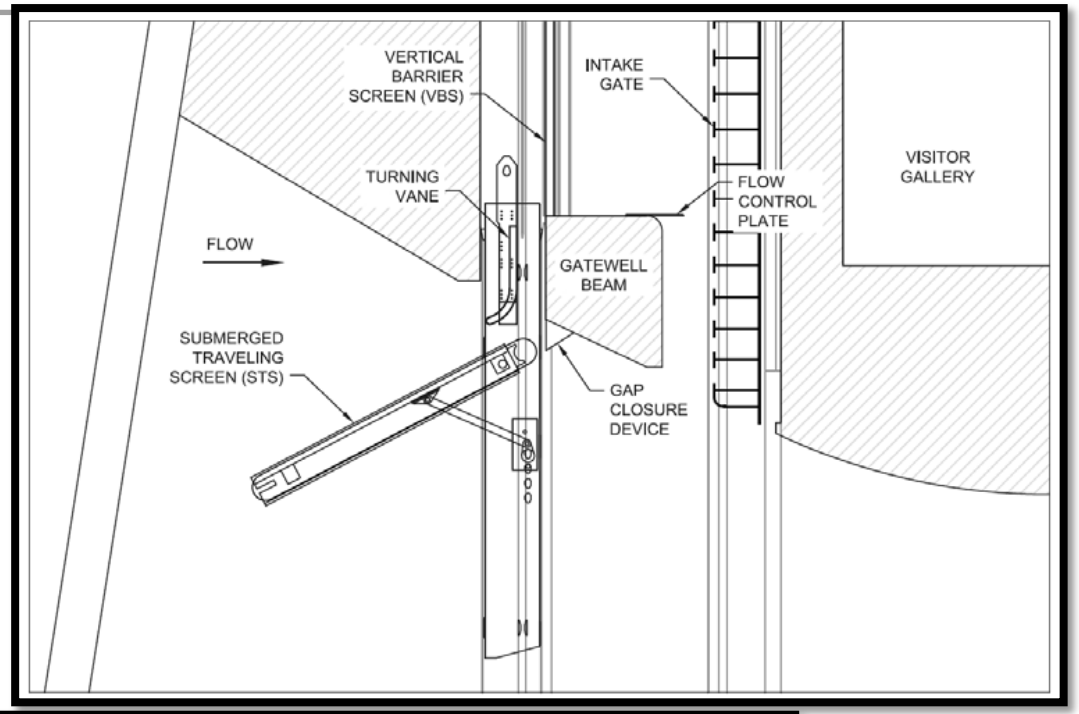
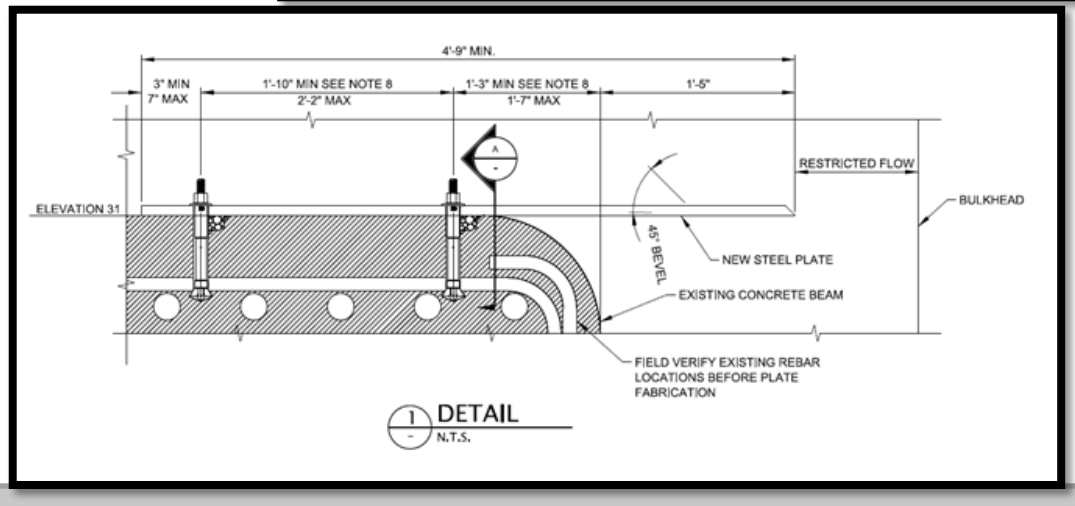
- In response to the results of the 2008 biological testing and with the support of regional fisheries agencies, the USACE developed preliminary alternatives for potentially reducing turbulence in the gatewells and presented them to the regional fisheries agencies in an EDR (USACE, 2013).

- The 2013 EDR evaluated multiple structural and operational alternatives to improve FGE and survival at the Bonneville second powerhouse and initially recommended a slot filler turbulence reduction device (TRD). Prototype TRD was fabricated and installed in Gatewell 14A prior to the 2013 juvenile fish-passage season (Gilbreath et al. 2014).

- Subsequent high flow hydraulic testing in 2015 led to a reevaluation of alternatives in a supplemental EDR (USACE, 2015) that adjusted the recommended alternative to a **static flow control plate on the gatewell beam**.





2014-2021

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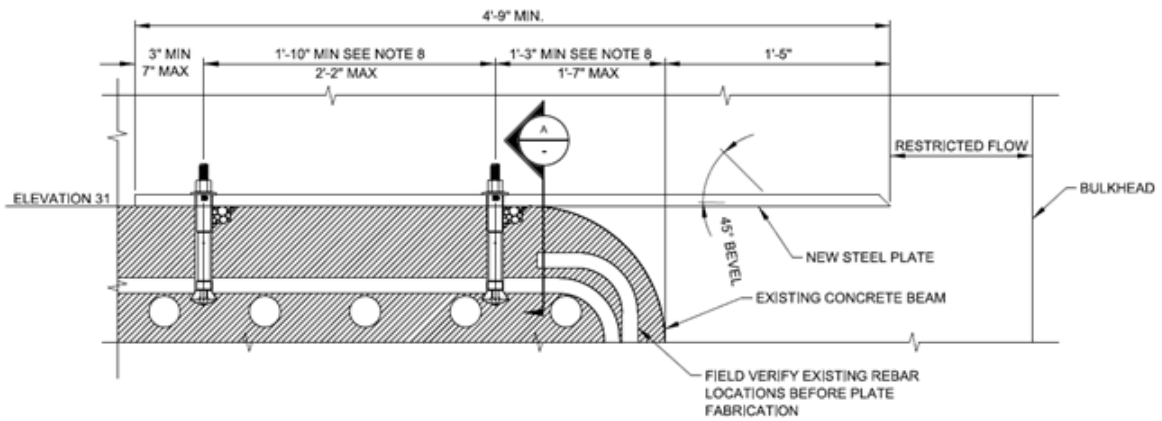
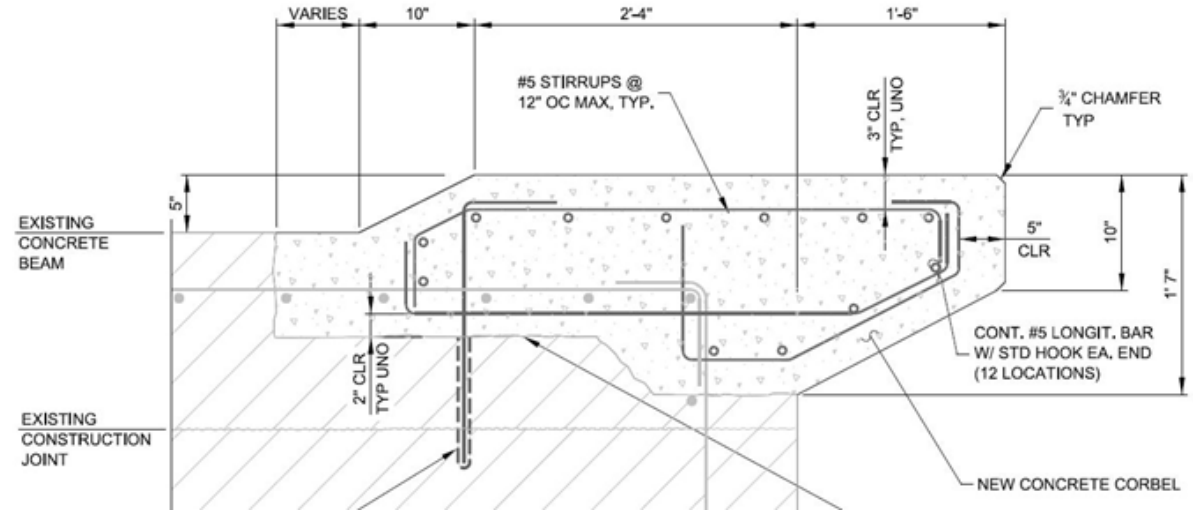
- A prototype **static flow control plate** concept was tested in 2014 and 2015 along with modifications to VBS porosity in the top two rows. The combined effect of the modifications resulted in a well distributed VBS approach flow.
- In 2016 and 2017, all PH2 unit intakes were outfitted with steel flow control plates and modified VBS porosity to directly improve hydraulic and fish passage conditions via reduction in turbulence.
- A 2017 biological evaluation at the JMF concluded that the injury and mortality rates observed in 2007 had been addressed and FFDRWG was pleased with the performance of the steel plates.
- However, inspection of the plates found anchor bolt failures, likely due to vibration and all plates were removed to prevent possible turbine unit damage. Without flow control, B2 units cannot exceed 15kcfs.
- A prototype **concrete corbel** was installed in unit 15 in 2021. The goal of the corbels is hydraulic similitude to steel plates with a mitigated risk for connection failure. Hydraulic testing showed the prototype corbel to provide the same benefits as the steel plates and corbels were installed at all PH2 unit intakes 2024-2025.





CRITERIA AND CONSTRAINTS FOR B2 STS REHAB

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- BON2 STS rehab must not negatively affect the gatewell hydraulics developed under B2 FGE. Alternatives with potential to **improve** gatewell hydraulics will be sought. B2 FGE reports suggested a couple opportunities for improvement:
  - "Obstructions near the edges of the gatewell such as the STS hoist arms, sudden contractions and expansions and increased boundary layer effects likely contribute in part to the significantly higher turbulence and reduced sweeping velocities near the edges." (Alden, 2015)
  - "In all [test] cases, the flow field was biased toward the north, which suggests, perhaps, that flow approaches the gatewells from the south side, and flow momentum toward the north is not dissipated at the STSs or turning vanes leading to the gatewells." (Alden, 2022)
- The BON2 STS must be in place when a turbine is running during salmonid migration season. Normally, STS maintenance is performed during the annual fishway outage period from December 1 to February 28. During BON2 operation, any maintenance work would be sequenced so available units would have adequate STS available to use during unit operation. (BON2 STS Living Ph1A Report)
- BON2 STS rehab must not upset the existing operations detailed in the Fish Passage Plan, Section 2.3.2.5.

ALTERNATIVES CONSIDERED

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Alternatives	A: No Action	B: Replace All Existing STS	C: Replace Damaged STS	D: Replace Damaged STS and All Inner Frames	E: Replace All Inner Frames	F: Replace Damaged Inner Frames	G: Replace Mechanical and Electrical Components	H: Replace John Day Style STS
Constructability (10%)	5	5	5	3	3	3	1	5
Impact to Site Work (15%)	1	5	5	3	1	1	1	5
System Reliability (30%)	1	5	4	5	3	2	1	1
Overall Cost (20%)	4	2	3	2	1	1	3	5
Service Life (20%)	0	5	4	4	2	1	1	0
Environmental Risk (5%)	1	5	4	3	2	2	1	1
Total Weighted Score	1.8	4.4	4.05	3.6	2.05	1.55	1.4	2.6
BCR	n/a	0.87	1.25	0.39	0.69	0.76	0	0

SELECTED ALTERNATIVES

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Alternative	B	C	D	E	F	G	H
BPA Discount Rate	RA 8.55%	RA 8.55%	RA 8.55%	RA 8.55%	RA 8.55%	RA 8.55%	RA 8.55%
Total Cost ($)	27,223,007	18,869,828	47,853,466	33,188,994	28,745,186	14,499,990	5,105,598
Total Benefits ($)	23,594,503	23,594,503	18,595,343	22,956,994	21,984,697	-	-
NPV ($)	(3,628,503)	4,724,675	(29,258,123)	(10,232,000)	(6,760,489)	(14,499,990)	(5,105,598)
BCR	0.87	1.25	0.39	0.69	0.76	0.00	0.00

Recommended Alternative:
Alternative C: Replace all damaged STS

- Replaces 12 STS found to be in poor condition
- Estimated to cost $18.9M

Next Best Alternative:
Alternative B: Replace all STS

- Replaces all 24 STS
- Estimated to cost $23.6M

BAD FRAMES

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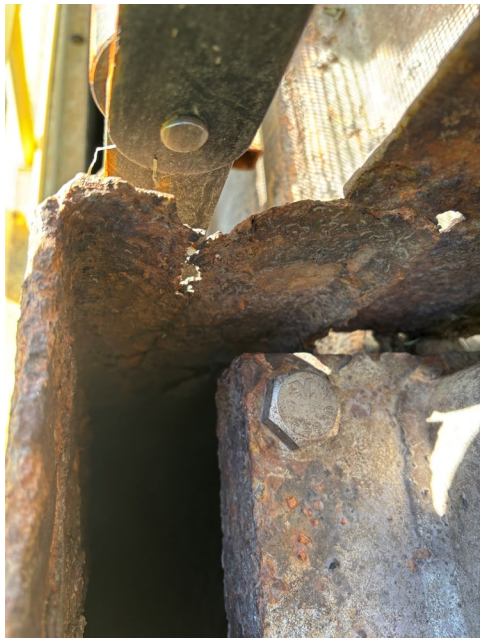
About half (12) of the B2 STS frames are considered in poor condition.

- Material loss in key structural components
- Loss of protective coating accelerating material loss
- Reasonably expected to fail within next 10+ years without major overhaul



GOOD FRAMES

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About half (12) of the B2 STS frames are in serviceable condition.

- Little to no material loss in key structural components
- Intact protective coating inhibiting material loss
- Reasonably expected to last for decades with routine maintenance before needing complete overhaul.