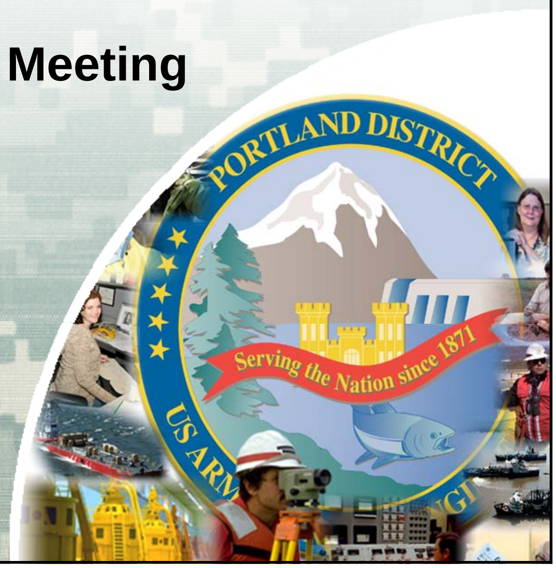
Bonneville Second Powerhouse B2 Auxiliary Water supply Trash Rake Special FFDRWG Meeting

5 September 2013



US Army Corps of Engineers
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Bonneville Second Powerhouse B2 Auxiliary Water supply Trash Rake

- Background
- VE Study
- CFD Analysis
- Recommendations

Background

- November 2001 – DDR Bonneville Second Powerhouse Auxiliary Water Supply Backup System

Proposed Improvements

- Stockpile Spare Parts
- Block off the lower fish unit trashrack panels
- Replace existing trashracks and trashrake with new continuous bar trash racks and automatic gripper rake
- Place a log barrier in front of the fish units
- Install two sets of level transducers across the diffuser grating at the A and B diffuser gates to monitor clogging

Background

Operations plan

- Perform annual soundings immediately upstream of the fish unit intakes and dredge during the in-stream work window (December through February if required)
- Outfit the floating orifice gates with aluminum sliding closure plates that can be installed into guides mounted around the orifices. Plates would be installed by raising the floating orifice gates up to the EL 55 deck level.
- Test and verify the recommended operations plan after modifications to the floating orifices have been made.
- Implement the proposed operations plan, in the event of a Fish Unit turbine failure, to modify gate settings, close floating orifices, closes selected gates, and regulate flow at the remaining Fish Unit Turbine
- Abandon use of the Ice and Trash Sluiceway as a backup to the AWS.

Background

Implemented recommendations pertinent to this project

- Blocked off lower trashracks
- 2004- New manual trashrake fabricated and delivered to project

General Operations Feedback

- Blocked racks create a bin for debris
- Infrequent dredging allows the bin to fill beyond the top of the blocked rack; at this point debris seems to collect on the racks at a higher rate
- New rake is ineffective at removing debris
- New rake trips upper crane limits because of its height
- New rake trips the load cell limits because of its weight

Design Constraints

Project Goal

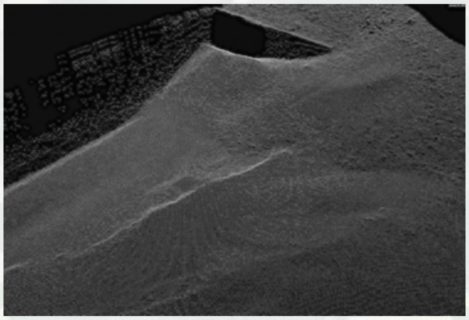
- Eliminate the need to float trash
  - ESA salmon passage impacts during recent high flow years
  - Lamprey passage impacts identified based on new data
  - Reduce wear and tear on Fish units
  - Evaluate if proposed design will work with ¾" open diffuser grating

Current rack cleaning and Inspection

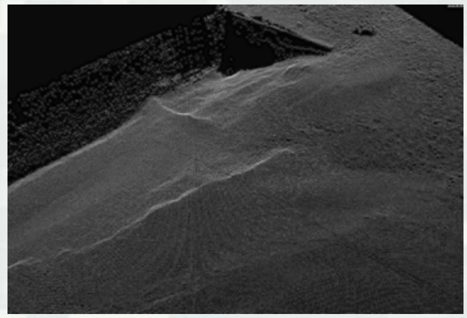
- Differential across the intake rack reaches 1 ft
- Nighttime floating of trash (approximately 3 hrs)
- Raking or floating as needed during the day in emergencies
- Racks are inspected and cleaned once every four years
- Hydrosurvey is performed as monies can be allocated

Dredging Effort

Before Dredging



After Dredging



Feb 1997- 2,850 CY Removed
Fall 1997- 4,550 CY Removed
Fall 2004- 2,000 CY Removed
Jan 2013- 6,000+ CY Removed

VE Study

Design Charrette

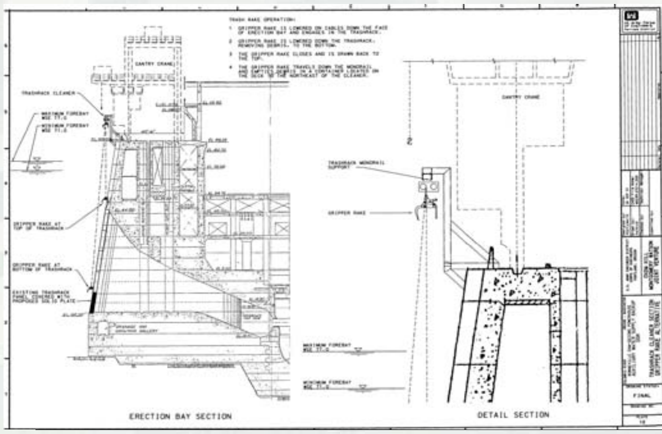
- Evaluation criteria:

Flow Delivery	Supply Power
"Fish" Friendly	Labor intensity
Schedule	Durable
Operability	Constructability
Maintainability	Flexibility
Reliability	High Confidence of success
Compatibility	Redundancy

- Alternatives
  - ► Debris Diversion Wall and Berm
    - Highest score; preferred alternative during preliminary rankings
    - 10 to 40 foot floating wall anchored between unit 18 and FU2
    - Berm placed at most upstream end of wall bridging the river area between the wall and the bank
    - Modeled by PNNL using Computational Fluid Dynamics
    - Modeling shows that the diversion wall is likely ineffective and may worsen debris loads at the trash racks

VE Study

- Semi-automated Trash Raking System
  - Second highest score during preliminary rankings
  - Operator initiated and process is observed
  - Operations personnel does not want the system installed
  - High implementation risk (Untested design depth and bar spacing)



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VE Study

- Manual Rake Modifications as necessary with new racks
  - Preliminary ranking closely follows semi-automated raking system
  - New or old rake is modified for use with the new racks
  - Rack replacement highest cost and uncertainty of benefits
  - Rack constructability issues with close bar spacing

New Rake

Old Rake

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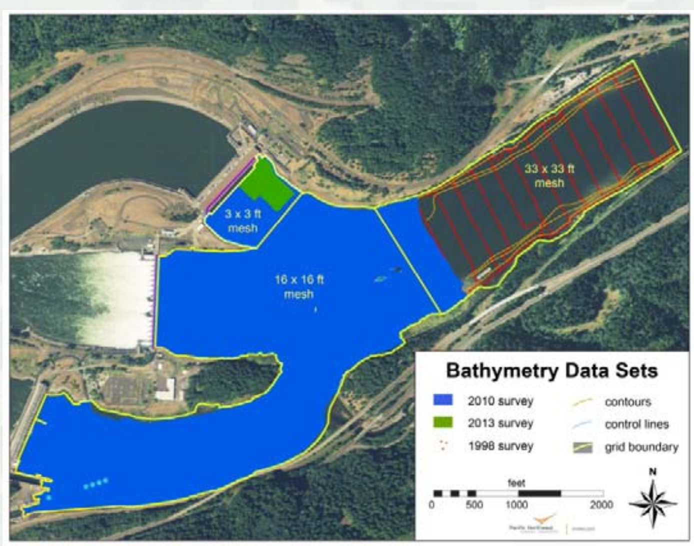
Top Alterative Investigation

Concept: Debris Diversion Wall Assumptions

- Draft 10-40 feet to minimize costs
  - Minimal biological impacts
  - Positively buoyant structures anchored together to form a wall
  - Berm may be used to improve sediment retention
  - Assumed to be low maintenance and easily repaired
  - Could be moved to support future dredging efforts
  - Minimize raked debris processing as it would be diverted to unit 18
- MIPR to PNNL to perform the modeling
- Used the recent bathymetric survey results from 2013
- Used STAR-CCM+
- Validated using field measured velocity data

CFD Analysis



Survey Data Map

CFD Analysis

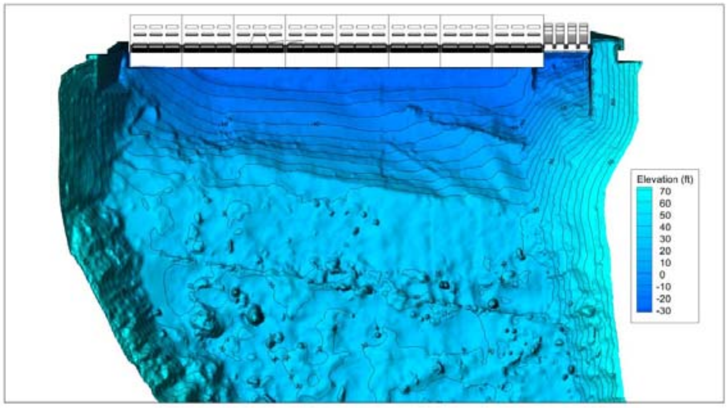


Figure 2.2. Bathymetric surface near B2.

CFD Analysis

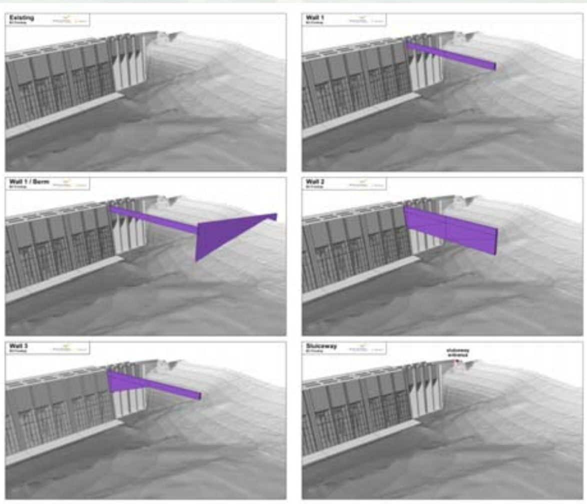


Figure 2.4. Wall Configurations Tested

Configurations Tested

CFD Analysis

Four Modeling Scenarios

1. Wall and Berm; wall draft is 10 ft.

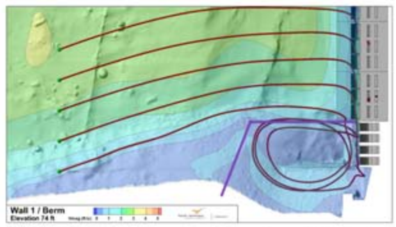


Figure 3.12. Wall 1 plus berm velocity contours with streamlines seeded at elevation 74 ft, parallel to the B2 powerhouse and upstream of the Washington shore eddy.

2. Wall only; wall draft is 40 ft

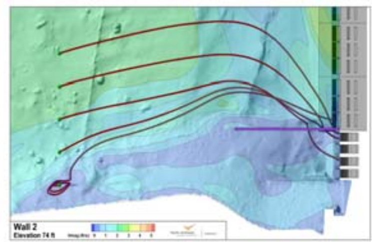


Figure 3.15. Wall 2 velocity contours with streamlines seeded at elevation 74 ft, parallel to the B2 powerhouse and upstream of the Washington shore eddy.

CFD Analysis

Four Modeling Scenarios cont.

3. Wall only; Wall draft is 40 ft deep at the powerhouse and tapering to 10 ft deep at the upstream end

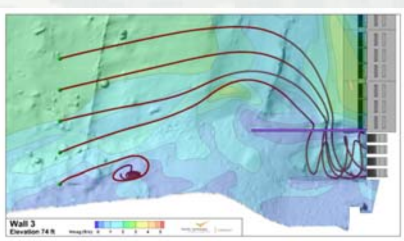


Figure 3.18. Wall 3 velocity contours with streamlines seeded at elevation 74 ft, parallel to the B2 powerhouse and upstream of the Washington shore eddy.

4. Simulated sluiceway flow using AFF water supply entrance

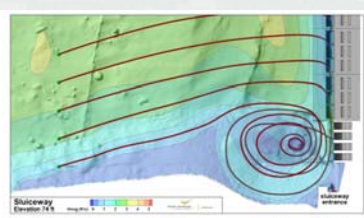


Figure 3.21. Velocity contours for an added sluiceway with streamlines seeded at elevation 74 ft, parallel to the B2 powerhouse and upstream of the Washington shore eddy.

CFD Results

- General results
  - In each scenario seeds from the unit 18 side of the flow diversion wall pass beneath the wall to the fish unit side. This suggests that the attempt to modify the flow and direct debris into unit 18 will be unsuccessful.
  - In the fourth case the simulated sluice way was unsuccessful in attracting surface debris prior to entering the fish units.
  - Without significant bathymetric changes in the forebay; the hydraulics set up by main unit flow will continue to create periods of, difficult to manage, high debris inflow.
  - The PDT decided, given this information, this alternative will not be pursued.

The next highest ranked alternative was the semi-automatic rake system.

The team decided not to pursue this alternative due to the following factors:
- Operations and Maintenance uncertainty.
- Experimental nature of implementing the system in a mechanically complex and challenging hydraulic environment

DDR Recommendations

- Use Existing Racks
  - Evaluate existing racks after new diffusers are installed and debris loads at the diffusers are understood
  - A new way to fabricate intake racks should be explored as current vertical bar construction creates problems with future rack bar and coating system repairs
  - Remove and clean intake racks once a year; inspect for structural problems
  - August ROV inspection of the racks concurrent with AWS diffuser inspection
  - Document water differential before and after raking and floating events
- More Frequent Raking
  - Raking should occur concurrent with VBS cleaning or at least once a week
  - Minor modifications to the rake should be performed to improve its ability to remove matted grasses
- Periodic Maintenance Dredging
  - Annual hydro survey for area in front of the fish units
  - Bi-annual maintenance dredging or as deemed needed by survey results
  - Exercise B diffuser gates to reduce sediment build-up