

**DRAFT - Meeting Summary Notes**  
**Lewis River License Implementation**  
**Engineering Subgroup**  
**April 8, 2008**  
**Interim Hydraulic Model Meeting Notes**

**Subgroup Participants Present: (11)**

Arnold Adams, PacifiCorp  
Frank Shrier, PacifiCorp  
Jeremiah Doyle, PacifiCorp  
Bryan Nordlund, NOAA Fisheries (NMFS)  
Jim Stow, USFWS  
Eric Kinne, WDFW  
Neil Turner, WDFW  
Dana Postlewait, R2 Resource Consultants  
Monty Nigus, Black & Veatch  
Lisa Larson, NHC  
André Ball, NHC

**LOCATION**

**This meeting was held at NHC's model laboratory, located in SeaTac, Washington.**

**ADMINISTRATIVE**

No administrative items. This meeting was an interim working meeting to report on action items from the last ES meeting (March 14<sup>th</sup>), provide an interim opportunity to view additional model results, and to help guide remaining modeling action items in order to obtain data prior to the next scheduled ES meeting to be held on April 28<sup>th</sup>.

These notes are provided to record meeting highlights by topic, modeling decisions made, and the next modeling steps. No comments are requested, a formal meeting record will be developed at the next ES meeting.

**General Meeting Handouts:**

Distributed via email on March 25, 2008 by Dana Postlewait:

- Meeting agenda for the April 8 model meeting
- Entrance Weir Hydraulic Charts for 4', 5', and 6' wide weirs, PDF files

Distributed at March 14<sup>th</sup> meeting (paper copies):

- Same as above.

## MERWIN MODEL UPDATE

### Corner Entrance Weir Configuration (width, crest elevation, and control)

- The team reviewed the entrance weir charts, which greatly helped to explain how the trap entrances could be operated without a control gate to maintain a head drop of 1.0 to 1.5' over a fixed submerged weir, using a variable capacity attraction flow supply.
- The charts were accepted by the team as presented for the current modeling program needs. During final design, it may be desirable to fine tune the hydraulic calculations using a variable weir coefficient "c" for various depths, flows, and depending on the final design details.
- A manually adjustable weir sill, through the use of a permanent type stop log, would be desirable to fine tune the final hydraulics.
- After the discussion and viewing the model, the team identified the following entrance weir scenarios for ongoing discussion at the next ES meeting:
  - 400 cfs entrance, 4' wide fixed weir, crest elevation 38.0, no entrance gate.
  - 600 cfs entrance, 6' wide fixed weir, crest elevation 38.0, no entrance gate.
  - Provide necessary attraction flow to meet the 1.5' head drop over the submerged weir, as shown on the tables.
  - A 500 cfs entrance could be accommodated with a 5' wide fixed weir, crest elevation 38.0, and no entrance gate. However, a 5' wide slot for 400 or 600 cfs doesn't match the goals well for either flow. Therefore, for the desired flows, the 4' wide or 6' wide configurations are preferred.
  - The ultimate entrance weir could be constructed to 6' wide, with inserts to reduce the width to 4' wide.

### Corner Entrance Weir, Projection and Bottom Elevation

- Model runs were conducted with the corner entrance projecting into the flow at the 70° angle from the powerhouse face. This configuration was noted to:
  - Produce a flow pattern that guides flow across the front of the powerhouse face, from left to right. This pattern is seen as desirable, as it provides a guiding flow for fish towards the entrance for fish that are in the area immediately downstream of the powerhouse face. Review of the additional ADV data with Run 6 confirmed that the entrance protrusion creates these flow patterns.
  - Induce the local eddy immediately downstream of the entrance. This was noted as a concern at the last ES meeting, and is discussed further below.
- At the last meeting, the weir box was constructed to extend all the way to the floor of the existing intake floor (EL 29.4). As the weir crest is being set at EL 38.0, the interior of the box can be set higher than 29.4 within the turbine flow path and the existing wall profile. The team examined whether or not opening the bottom of the weir box up to turbine flow, by raising the exterior floor up to EL 36.0, would help to reduce the local eddy.

- Upon running the model with both weir box configurations, raising the bottom of the weir box (thus opening up the bottom area to turbine flow under the entrance) did not noticeably change the eddy flow patterns.
- After review on video and in the lab, it was decided that how the bottom of the weir is configured can be left to the discretion of the design team during final design, as it would not have a significant impact on the eddy or predominant flow patterns.

### **Left Bank Local Eddy**

- Model runs were conducted with video and dye tests to examine the specific strength and characteristics of the local eddy located immediately downstream of the entrance.
- As noted above, the bottom of the weir box (open or closed), did not have much if any impact on the eddy.
- The eddy is predominant in this area at high turbine flow (full generation), with flow returning downward right along the powerhouse wall. Spot velocities in the range of 4 fps were measured in the model using NHC's Nixon propeller meter immediately adjacent to the wall. The velocities reduced rapidly as the meter was moved away from the wall.
- The area is well defined, with corner entrance flows of 400 or 600 cfs, and appeared to be of the same size, shape, and magnitude with either flow. There is also a well defined transition zone between the eddy flow and the predominant entrance flow which moves downstream toward the rock outcropping.
- As the generation flow is reduced, the tailwater drops and the eddy weakens significantly. It is also more dependent on running Unit 1, as this flow seems to create the predominant pattern that sets up the eddy.
- Adding several plates to fill the area, or modify the eddy pattern, did not have much effect, but did change the flow patterns.
- After viewing the eddy more closely, and considering the biology, the team did not have as much of a concern relative to the eddy causing fish passage delay as originally thought. If the modeling efforts can show any ideas to reduce the eddy, we should present them at the next ES meeting for further discussion.

### **Pump Bay Entrances**

- Dye tests were run at the Pump Bay Entrances (PB2 and PB3), as follows:
  - 170 cfs, 4' wide weir, crest El 46.2
  - 170 cfs, 3' wide weir, crest El 43.7
  - 330 cfs, 4' wide weir, crest El 40.7
  - 330 cfs, 3' wide weir, crest El 37.2
- The team reviewed video, and observed the high and low flows in the model with each weir configuration.
- Hydraulically, the flow patterns from PB2 are more defined, and influence the tailrace more. Flow from PB3 is diverted towards the left, and dissipates more quickly due to the large eddy along the right bank.

- The 4' weirs induce flow patterns that carry further into the tailrace, and the flow from the deeper, narrower (3' wide) weirs breaks up more quickly.
- It is difficult to select a preferred location or weir width/depth based solely on hydraulics, as fish behavior may have more influence at the PB entrances.
- Based on the phased approach under consideration, a PB entrance would be constructed in the future after there was fish behavior data available. However, for the design team it is desirable to select the best entrance now to move forward with design. As long as the design could be changed to the other PB entrance in the future, the team can do it's best to select a preferred entrance.
- Jim and Bryan felt that PB3 had advantages, as any fish near PB2 could likely find the corner entrance.
- Frank felt that PB2 had advantages, as the eddy pushes flow towards that entrance anyway. He also expressed concern about potential pump noise from the attraction flow pump station being more likely to affect behavior at PB3 than at PB2.
- The team will consider more dye runs, and will plan on making a decision on the preferred PB entrance location at the next ES meeting.
- The weir width/depth could be made adjustable for the final design based on the above dimensions.

### **Design Ramifications, Phased Approach Considerations, and Total Attraction Flow Needs**

- The team felt that the following upper limit flow constraints were reasonable and feasible for the two entrance locations:
  - Corner Entrance – max  $Q = 600$  cfs.
  - PB Entrance – max  $Q = 330$  cfs. (Note that Monty and Dana expressed some concern about the 330 cfs limit, due to diffuser area. The actual maximum flow may be more like 300 cfs based on physical constraints to be explored further during final design).
- If each entrance were constructed to the above limits, this would set the constraints for total flow at each entrance, and the individual entrance designs could progress. Not considering the flow supply limitations, this would result in a total flow capacity of  $600 + 300 = 900$  cfs.
- How the flow limits are phased, and split between the entrances is a separate issue from the design of each entrance. Upper total flow limits and distribution is a function of the pump and intake limitations, conveyance pipe, and valving needs. This can be worked out later; therefore, the entrance configuration designs can likely proceed after the next ES meeting.
- The current pump intakes under consideration (the turbine pumps) have an upper flow limit of about 200 cfs each in the 3 bays. PacifiCorp based their previous phased approach flow proposal based on these limitations.
- Higher flows would require larger pumps (not sure if this is possible based on existing infrastructure physical constraints), a separate pump station, or gravity flow.
- PacifiCorp does not want to impact to their generation capacity (which was preserved by the Settlement Agreement), and would prefer not to provide the attraction flow from the forebay as this would result in lost generation.

- Bryan noted that the model has been very helpful to address the trap entrance configuration and flow needs that he is coordinating with Michelle Day, and intends to come to the next ES meeting with more input on NMFS's response to the phased approach proposal.

### **Intake Rack**

- The flow patterns don't have much impact on the intake rack configuration.
- The design team is thinking that the smaller rack structure would be best at this point, as angling the rack won't have much affect.
- The model will be used to examine any turbine flow recirculation patterns (from Unit 3 into the intake) that could draw water with air into the pump intake. Velocity measurements may also be taken along the rack at various depths to quantify the magnitude of any cross velocities that are present which may impact pump performance.

### **Next Model Steps**

- Provide a comprehensive list of all model runs, and data available (charts, plots, velocity vector data, video) for the next meeting.
- Distribute the ADV data to the team via email (done with this email).
- Run dye tests as shown in Table 1. A final table with test identification will be provided by the next ES meeting.
- Document general tailrace flow patterns at 3 depths, to about 20' downstream of bridge. Intent with downstream limit is to capture the eddy by the left bank of the bridge. Dye patterns will be noted at 3 depth: above the draft tube, in the draft tube, and below the draft tubes. Examine full generation, and other limiting flow patterns (likely 3 or 4 iterations).
- Look at any means to minimize the local eddy near the corner entrance.

### **Attachments**

- PDF file with all ADV velocity vector data for Runs 1-6.

Meeting was adjourned at 1:15 PM.

**Table 1. Next Model Tests**

Test ID	Corner Entrance	PB 2	PB 3	U1	U2	U3	Data	Notes
	4' w @ 1.5' Head Drop	0	0	1200	3790	3890	Dye	
		0	0	2700	3790	3890	Dye	
		0	0	3790	3790	3890	Dye	Done
	6' w @ 1.5' Head Drop	0	0	1200	3790	3890	Dye	
		0	0	2700	3790	3890	Dye	
		0	0	3790	3790	3890	Dye	Done
	4' w @ 1.5' Head Drop	0	0	2700	2700	0	Dye	
		0	0	2700	0	2700	Dye	
		0	0	0	2700	2700	Dye	
	6' w @ 1.5' Head Drop	0	0	2700	2700	0	Dye	
		0	0	2700	0	2700	Dye	
		0	0	0	2700	2700	Dye	
	4' w @ 400 cfs	3'-330	0	3790	3790	3890	Dye	
	4' w @ 400 cfs	3'-330	0	2700	2700	0	Dye	
	4' w @ 400 cfs	4'-330	0	3790	3790	3890	Dye	
	4' w @ 400 cfs	4'-330	0	2700	2700	0	Dye	
	4' w @ 400 cfs	0	3'-330	3790	3790	3890	Dye	
	4' w @ 400 cfs	0	3'-330	2700	2700	0	Dye	
	4' w @ 400 cfs	0	4'-330	3790	3790	3890	Dye	
	4' w @ 400 cfs	0	4'-330	2700	2700	0	Dye	

**Table 1. Next Model Tests (continued)**

<b>Test ID</b>	<b>Corner Entrance</b>	<b>PB 2</b>	<b>PB 3</b>	<b>U1</b>	<b>U2</b>	<b>U3</b>	<b>Data</b>	<b>Notes</b>
	4' w @ 400 cfs	3'-170	0	3790	3790	3890	Dye	
	4' w @ 400 cfs	3'-170	0	2700	2700	0	Dye	
	4' w @ 400 cfs	4'-170	0	3790	3790	3890	Dye	
	4' w @ 400 cfs	4'-170	0	2700	2700	0	Dye	
	4' w @ 400 cfs	0	3'-170	3790	3790	3890	Dye	
	4' w @ 400 cfs	0	3'-170	2700	2700	0	Dye	
	4' w @ 400 cfs	0	4'-170	3790	3790	3890	Dye	
	4' w @ 400 cfs	0	4'-170	2700	2700	0	Dye	