

FINAL - Meeting Summary Notes
Lewis River License Implementation
Engineering Subgroup
April 28, 2008
Fish Passage Meeting Notes

Subgroup Participants Present: (9)

Arnold Adams, PacifiCorp
Frank Shrier, PacifiCorp
Bryan Nordlund, NOAA Fisheries (via conference call)
Jim Stow, USFWS
Curt Leigh, WDFW (via conference call)
Ken Bates, Kozmo
Monty Nigus, Black & Veatch
Dana Postlewait, R2 Resource Consultants
Dennis Anderson, Black & Veatch (via conference call)

ADMINISTRATIVE

Frank Shrier updated the Engineering Subgroup (ES) on the status of the FERC license. Todd Olson met with FERC last week in Washington DC. Progress is being made, and a draft of the Swift license was sent to the commission for review. Current estimates indicate a license could be issued as early as June 1st. If there are edits to the draft, this could be delayed, but the license issuance is expected this summer.

The meeting Agenda does not include discussion of the Swift Project. In the interest of time, the group will not review the Swift portion of last meeting's notes.

General Meeting Handouts:

Distributed via email on April 21, 2008 by Kim McCune:

- Meeting agenda for the April 28, 2008 subgroup meeting

Distributed via email on April 14, 2008 by Kim McCune:

- Copies of the draft April 8, 2008 subgroup interim draft meeting notes
- ADV Tests 1-6, PDF file

Distributed via email on April 4, 2008 by Kim McCune:

- Copies of the draft March 14, 2008 subgroup draft meeting notes
- Bryan Nordlund addendum to the March 14, 2008 subgroup draft meeting notes

Distributed at March 14th meeting (paper copies):

- Meeting agenda for the April 28, 2008 subgroup meeting
- Copies of the draft March 14, 2008 subgroup draft meeting notes
- Copies of the draft April 8, 2008 subgroup interim draft meeting notes

FUTURE MEETING DATES

Future meeting dates were planned as follows:

- June 4, 2008
- July 16, 2008
- **September 4, 2008 (note, new date – moved from August 28, 2008)**
- Kim McCune will distribute suggested dates for six-months following these dates, at approximately 6-week intervals.

OTHER ADMINISTRATIVE ITEMS

- Frank reported that WDFW has had organizational changes at the LRH Hatchery Complex. Eric Kinne has been moved to the Vancouver office, and Neil Turner will take over as the LRH Complex Manager. Eric will still be available to assist with the Lewis River projects, and will also be involved with the Cowlitz basin.
- Jim Stow noted he will be retiring from USFWS after the next meeting, so the subgroup will have a new representative.

MERWIN TRAP PROJECT

Handouts

- Model Test Run Index Table, dated 4/27/08

Presentations

- Model data presentation, reviewed multiple model run video clips in real time at the meeting. This also worked well over the web-meeting utility for those who attended via phone and internet.

Review of Previous Meetings' Merwin Action Items: See status summary table below.

No.	SUMMARY OF PENDING MERWIN ACTION ITEMS (remaining from March 14 th , 2008 Meeting)	STATUS
M81	R2 (Postlewait) – Coordinate review of sorting table revisions with Eric Kinne.	Pending, to be done during the next phase of design.
M82	Agencies (Nordlund, Stow, Kinne) – review model data and be prepared to discuss observations.	Done, today's agenda item.
M83	R2 (Postlewait) – Work with NHC to shade the water line on the 3-D plots, so the edge of water is more apparent.	Done.
M84	Design Team – schedule an interim model meeting to discuss observations and next steps with the model analysis.	Done, meeting was held on April 8, 2008.

Additional Comments on Last Meeting's Notes (March 24, 2008):

- No additional comments. Notes can be made final, with Bryan Nordlund's addendum to the notes attached.

Additional Comments on the Interim Meeting Notes (from April 8, 2008).

- The notes distributed were intended as a working document, to help document discussions and model observations. Jim Stow requested that the notes be edited to state that the meeting was held at NHC's model lab in SeaTac, WA. With this edit, these notes can be published as is, and no comments will be provided by ES members. These notes will also be utilized as a base document for a memorandum where model observations and decisions are recorded for attachment to these meeting notes (see attached).

MERWIN TRAP AGENDA TOPICS

Tailrace Physical Hydraulic Model

- Dana Postlewait described the run table matrix, and how it captures all of the model runs performed to date. This index is very helpful in comparing runs, and identifying what form of data the model work produced. Data provided is different for many of the runs, and was developed in full coordination with the ES. Data includes:
 - Still photographs of the model and data collection methods.
 - Acoustic Doppler Velocimeter (ADV) 3-dimensional velocity data.
 - Nixon Probe (propeller meter) data.
 - Video clips of dye releases.

- Hand sketches of flow patterns, with spot velocity readings taken with the Nixon Probe.
- Dana and Monty Nigus ran through the new model run data that was performed since the last meeting. Runs reviewed were as follows:
 - Tests 35-36. Dye tests were taken of the eddy area at the corner entrance, with and without a clay fillet intended to simulate filling this area to eliminate the eddy.
 - Tests 17-26. Corner entrance dye tests were conducted at various unit operating scenarios, with 4' and 6' entrance widths and their appropriate flow to achieve a 1.5' drop over the submerged entrance weir. Total unit flows were 5,400, 8,880, and 10,380 cfs representing combinations of 2 or 3 units operating at full generation, or 2,700 cfs, which represents a SA set point that corresponds to high unit efficiency.
 - Tests 27-34. PB2 and PB3 entrance dye tests were conducted with the corner entrance operating at 4' width and 1.5' head over the submerged weir. Two series of tests were run, one at full generation, and one with Unit 3 off, and Units 1&2 operating at 2,700 cfs.
 - Runs 1-6. Tailrace flow pattern sketches were started, and completed for Runs 1, 5, and 6 per the index. Intent with this preliminary work was to review the data presentation, and validate the method, level of detail, and means of presentation for the final data collection.
- The group discussed all of these runs, effectively as a follow-on discussion to the model observations at the interim April 8th meeting. Specific observations and decisions to date related to all of the runs are provided on the attached memorandum, titled Model Observations and Decisions Memo, dated May 2, 2008. This memorandum was based on the interim meeting notes, which were appended with observations from this meeting.
- Dana Postlewait noted that the design team would provide a DVD of the new modeling runs presented in today's meeting to the ES members.

Project Implementation, and Agency Response/Recommendations to Phased Approach

- Based on the model results, and biological evaluation plan to date, Bryan Nordlund worked with NOAA, USFWS, and WDFW representatives to develop a joint agency response to PacifiCorp's phased proposal. Bryan emailed an excel file with a draft of the overall response to Arnold Adams, who made copies and distributed them to the group (attached). Bryan noted that their response is intended to be a draft, and the agencies are willing to further develop the exact language and details with the ES and full ACC. Bryan also noted that the overall goal of their response was to have adaptive designs that could be implemented to modify the initial design if the ATE goals and passage times are not met. All parties indicated that it will take some time to review, and to incorporate any input from all of the stakeholders.

The group discussed the agency response as follows:

- Phase 1.
 - Bryan's intent with the "nominal" 420 cfs is consistent with the project development so far. The design team can formalize the exact amount of this flow based on

- physical and hydraulic constraints as the design progresses, for agency review. Monty noted that the 30% report utilized 30 cfs of ladder flow, and 370 cfs of Auxiliary Water Supply (AWS) flow, for a total flow of 400 cfs. Bryan indicated that the 400 cfs noted meets his intent.
- Monty and the team discussed the current intake limitations for the AWS rack. Bryan's intent is to provide a 1-fps fine trashrack across any AWS intake. If the intake were split into two separate pump stations, each one would need a 1-fps maximum velocity rack for its appropriate design flow.
 - o The group understood the intent and progression of Phases 2 – 5.
 - o ATE goals
 - The ATE goals and passage time noted will need to be reviewed by PacifiCorp, and also discussed by the ACC. This will take some time, and no immediate decisions are necessary.
 - o Operational changes
 - Jim Stow suggested that language be added to address how plant and fishway entrance operational changes within each phase of the phased approach can be accommodated based on ATE evaluations can be accommodated into the phases; depending on how “close” the results are to the ATE goals. The overall use of operational changes based on biological data would be desirable to tie to the timeline between phases, and how triggers would be defined for each phase. Bryan and the group agreed that this is desirable, and will take further input.
 - o AWS intake and water supply
 - Pump station limitations. Monty and Dana brought attention to the current 30% pump station design located in the existing Unit 4 substructure area, and expressed concerns as to whether this location can meet the maximum 800 cfs flow. The team understands the potential limitations, and discussed alternate sources of additional attraction flow as follows:
 - o Increase the pump capacity at Unit 4 pump station. The pump capacity indicated in the 30% report is based on Hydraulic Institute standards, using much of the available space within the existing turbine foundation. It may be possible that the 170 cfs capacity for each of the three pumps could be increased, if additional hydraulic analysis and/or modeling are performed for the pump design. This is one potential means to provide more flow, and it would take further study, work with pump vendors, and likely modeling to define how much additional flow could be achieved.
 - o Provide a separate 200 cfs pump station. There is not sufficient room within the existing Unit 4 bay to add a fourth 200 cfs pump without performing a major excavation within relative close proximity to the dam; however, the team could explore a separate pump station at another location within the tailrace, possibly either upstream or downstream of the powerhouse. In this case, it would have its own fine trashrack to match the approach velocity requirements of the pump capacity.
 - o A third potential source discussed at the last meeting is use of reservoir water from the existing penstock stubout at Unit 4. This is less desirable to PacifiCorp,

as this would result in more generation loss than a low-head pump back. The group discussed that flows above 600 cfs would only likely need to occur when project flows are high, above 6,000 cfs, and up to 11,400 cfs (i.e. full powerhouse generation). Not running a penstock tap, except when extreme high flows are utilized, is an option worth further consideration. This would likely be an easier method to implement than construction of an additional pump station.

- AWS flow distribution and siphon recovery
 - o In addition to the flow amounts, Bryan noted his desire for flexibility in distributing flow between the corner entrance and a pump bay entrance.
 - o Monty described how it would be desirable from a control and distribution perspective to set entrance flows as multiples of pump station flows. Such as, have two pumps to supply the corner entrance, and one pump to supply the pump bay entrance.
 - o Bryan noted he was thinking of a “bathtub” type of flow distribution, where pumps could feed a central sump, and then flow could be split via control valves to either of the entrances.
 - o Dennis Anderson explained how a bathtub approach, or distribution headbox, would limit or likely eliminate the possibility of using siphon recovery on the pumps, and would require more energy than the distribution approach identified in the 30% report.
 - o The group also discussed variable flow capability over the operating range of the fish entrances, and how there could be some jumps on the multi-pump operating curve to accommodate starting and stopping of the pumps. Bryan and Jim felt this was OK, pending review of the actual operation curves.
- Based on physical constraints (available space at the entrances, and diffuser area) the group agreed on the following design values, and required flow distribution, for the corner and pump bay entrances:
 - o Corner entrance: 400 to 600 cfs capacity
 - o Pump bay entrance: 300 cfs maximum
- Bryan also noted that we can take advantage of the pump station limitations and transitions between pumps by considering the operation of the entrance weir from 1.0’ to 1.5’ of drop across the submerged weir. In other words, we do not have to limit our operations to a 1.5’ drop. This provides quite a bit of flexibility and increased range of operation for each of the three or four pumps.
- o Design Flexibility
 - Bryan and Jim noted that in general the agencies like the conceptual design because it offers a lot of flexibility for flows, and flow distribution.

Model Report Outline

- o Dana showed a draft report outline for the Hydraulic Model Report on the projector, and the team discussed what is expected with the model report. The group agreed with the

outline, and discussed structuring the data presentation in a similar order to the run index table.

- This input was enough feedback to continue on with drafting the model report.

Next Steps

The group discussed the next steps as follows:

- Complete remaining tailrace flow pattern model runs.
- Bryan Nordlund requested that runs be conducted to assess how the flow patterns look with a 1-foot drop over the submerged entrance weir, as opposed to the 1.5 drop. A review of dye videos will help the team validate this concept. Runs with video of dye releases will be made as listed below, and provided on a DVD for distribution to the ES:
 - Corner Entrance:
 - 4’ width, Crest 38.0, delta H = 1.0’, Qfishway~330 cfs
 - 6’ width, Crest 38.0, delta H = 1.0’ Qfishway~500 cfs
 - Pump Bay Entrances
 - PB2, 4’ width, Crest 39.7, delta H = 1.0’, Qfishway~260 cfs
 - PB3, 4’ width, Crest 39.7, delta H = 1.0’, Qfishway~260 cfs
- Jim Stow requested that a few spot velocities along the corner entrance eddy area with the clay fillet be documented, for comparison with the existing condition. Concern is while the fill effectively eliminates the eddy, it also eliminates a holding/resting area immediately downstream of the entrance. If the velocities are too high, this may be a detriment to fish passage.
- As the model work is near completion, we need to decide on when to decommission the model. It appears that after the runs identified above are complete, we will be done with the modeling effort. A final decision on any further runs will be requested once the model data is distributed in draft form, likely in the next week or two.
- The group discussed what the appropriate level of design was for each phase. Frank Shrier noted that whatever is agreed upon, it must meet the language of the Settlement Agreement (SA). Frank will check on the SA language, and the design team will develop a proposal for review and discussion at the next ES meeting.

Action Items

The following action items were identified for the next meeting.

No.	SUMMARY OF PENDING MERWIN ACTION ITEMS (remaining from previous Meetings)	STATUS
M81	R2 (Postlewait) – Coordinate review of sorting table revisions with Eric Kinne, and Neil Turner.	Pending, hold for 60% design phase.

No.	SUMMARY OF NEW MERWIN ACTION ITEMS (from April 28 th , 2008 Meeting)	STATUS
M85	PacifiCorp (McCune) – Update the ES meeting announcement to move the August 28 th meeting to September 4 th , 2008. Coordinate meeting dates for 6 months of ES meetings following the September 4 th date at approximate 6-week intervals.	Done – 5/5/08
M86	Design Team (Postlewait, Nigus, NHC) – coordinate and conduct additional model runs noted above.	Pending
M87	Design Team (Postlewait, Nigus) – update run index table to reorganize per order of comparison utilized at the meeting, and include additional run data on the table.	Pending
M88	Design Team (Postlewait, Nigus, McCune) – Distribute model data DVD's to ES members, with updated run index and additional run data identified in these notes.	Pending
M89	Design Team – Review agency response, and prepare an approach with more specifics per discussion above that will meet the intent, while addressing additional AWS supply and distribution concerns.	Pending
M90	PacifiCorp (Shrier, Olson) – review SA language to help guide decisions on how far design should be taken for each phase.	Pending
M91	Design Team – prepare a proposal on how far to take the design (i.e., final plans and specs, full functional conceptual design, etc.) for the various phases. The proposal must meet the Settlement Agreement requirements.	Pending

Meeting was adjourned at 1:00 PM.

Attachments:

Model Observations and Decisions Memo dated 5/2/08

Model Test Run Index Table, dated 5/5/08

Lewis River Implementation Nordlund's Phased Approach, 4/28/08

Model Observation and Decision Memorandum, May 2, 2008
Lewis River License Implementation
Engineering Subgroup
(Attachment to April 28, 2008 Meeting Notes)

This memorandum documents the Engineering Subgroup (ES) observations and discussion points regarding the Merwin Tailrace Physical Hydraulic Model, from the April 8th and April 28th ES meetings. The memo is structured to address each of the design features of the new Merwin fish trap entrances. Decisions, where unanimous with the full ES, are also noted below.

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

a. Observations and Discussion

- 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.
 - Additional flexibility in operations is possible by operating the entrance down to 1.0' head drop over the submerged weir. Attraction flows that will provide this head drop will be less than the 400 or 600 cfs, and are indicated on the entrance weir charts.
 - 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 entrance weir could be constructed to 6' wide, with inserts to reduce the width to 4' wide.

b. Decisions

- The corner entrance weir will be configured as follows:
 - 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.

- The fixed crest will be set at elevation 37.0, with permanent style, smooth stoplogs provided to form a final crest elevation based on field observations.
- The entrance weir will be constructed at 6' wide, with inserts to reduce the width to 4' wide. Entrance inserts will be made to be replaced, so other configurations are possible in the future.
- Diffuser area and water supply will be provided for a maximum 570 cfs of AWS flow. The remaining 30 cfs to meet a maximum capacity of 600 cfs will be provided by fishladder flow.
- The water supply will have variable flow control within the capability of the turbines that drive the AWS pumps, to allow operation at intervals less than the maximum, to allow the flow to follow the 1.5' to 1.0' of head across the entrance weir at all project design flows.

2. Corner Entrance Weir, Projection and Bottom Elevation

a. Observations and Discussion

- 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.

b. Decisions

- 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.
- The interior bottom of the entrance pool within the turbine flow path and the existing wall profile will be set at EL 36.0. The exterior bottom elevation (to account for structural dimensions); will be determined during the final design.
- The design team will explore how to best configure the bottom elevation to accommodate maintenance bulkheads and facilitate construction.

3. Left Bank Local Eddy

a. Observations and Discussion

- 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.
- NHC performed model testing of filling the eddy area along the control room face immediately downstream of the corner entrance with a clay fillet. This approach does eliminate the eddy at high tailwater conditions. However, based on dye observations, it appears that eliminating the eddy may increase tailrace velocities leading up to the trap entrance. There is concern that eliminating the eddy may not be desirable from a biological perspective, as it may eliminate a potential resting/holding area immediately downstream of the entrance. Additional velocity data will be collected along the shoreline to supplement the video data of the dye releases, to help facilitate a decision on this issue.
- NHC will also document the clay fillet dimensions and volume, as filling this area could be held as a concept for future adjustment if the eddy is shown to be negatively affecting ATE for the trap.

a. Decisions

- No decisions on how to address this eddy at the higher tailwater elevations have been made to date. This will be a discussion item for the next meeting based on additional velocity data and further discussion.

4. Pump Bay Entrances

a. Observations and Discussion

- 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.
- Additional dye runs were made to examine the PB entrances with Tests 27-34 indicated in the Run Index Table (attached)
- The dye traces acted as anticipated, and there were no surprises from the runs. Ultimately, the decision on which PB entrance will be a judgment call based on both hydraulics and anticipated fish behavior.
- The design team noted that selecting one of the PB entrances for the initial final design is desirable, as the piping, valving, and fish transport channel will need to be developed.

b. Decisions

- Selection of a preferred PB entrance between PB2 or PB3 for Phase III will be a topic for the next ES meeting in June.

- Regardless of which PB entrance is selected, the final design will need to anticipate how the entrance could be moved to the other PB entrance if biological monitoring indicates a preference for the other entrance. How to phase this and the level of design necessary will need further discussion.
- The design team noted further dye penetration with the 4' wide entrance, as compared to the 3'. A similar adjustable width and crest elevation with stoplogs could accommodate both entrance configurations. A decision on weir crest elevation and insert widths will be discussed at the next ES meeting in June.

5. Design Ramifications, Phased Approach Considerations, and Total Attraction Flow Needs

a. Discussion

- 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).
 - Discussion at the April 28th meeting agreed to a 300 cfs maximum flow at the PB entrance.
- 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 their generation (which was preserved by the Settlement Agreement), and prefers 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.

- Bryan presented the coordinated agency response to PacifiCorp's phased proposal at the April 28th meeting, which identified five phases. See meeting notes for additional information and Bryan's attachment.

b. Decisions

- The team agreed to the following upper limit flow constraints for the trap entrance designs:
 - Corner Entrance, max Q = 600 cfs.
 - PB Entrance, max Q = 300 cfs
- PacifiCorp will review the 800 cfs maximum attraction flow proposal from the agencies. Additional research and design work would be necessary to expand the attraction flow from 600 to 800 cfs, based on the Unit 4 pump station conceptual design to date. Additional discussion is provided in the April 28th meeting notes. Alternate sources of water could include:
 - Expansion of the capacity for the three pumps in Unit 4 substructure
 - New 200 cfs pump station located elsewhere
 - Use of the Unit 4 penstock stubout, to use reservoir water, as opposed to pumpback flow from the tailrace (This would result in more energy loss to PacifiCorp.)

6. Intake Rack

a. Observations and Discussion

- The flow patterns do not 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 would not 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.

b. Decisions.

- The final design of the intake rake for the AWS pump station can move forward with a configuration similar to that modeled and/or shown on the 30% design drawings as long as the approach velocity and bar size/spacing are within NMFS guidelines.

Attachments

Run Index Table dated 5/2/08

Test Run Index Table

4/27/08

Test	Notes	Test Date	Operating Conditions					Pump Intake	Corner Fish Trap Configuration						Pump Bay Fish Traps						Data Collected	
			Tailwater El. ft	Total PH Flow cfs	Unit 1 Flow cfs	Unit 2 Flow cfs	Unit 3 Flow cfs		Weir Box	Angle deg	Flow cfs	Weir Width ft	Weir El. ft	Delta H over Weir ft	PB-2 Flow cfs	Weir Width ft	Weir El. ft	Delta H over Weir ft	PB-3 Flow cfs	Weir Width ft		Weir El. ft
ADV Method Validation, Preliminary Data Runs conducted to test method of using ADV probe along an arc to compare flow patterns with 400 vs. 600 cfs. These runs were repeated with Run 4 and 5 after ES agreed that the method was appropriate.																						
1	Corner Eval Method Validation	1/31/2008	53.2	11,470	3,790	3,790	3,890	400	Ext. Bot. 29.4'	70	400	4	38.0	1.5	--	--	--	--	--	--	--	ADV*
2	Corner Eval Method Validation	2/6/2008	53.2	11,470	3,790	3,790	3,890	600	Ext. Bot. 29.4'	70	600	6	38.0	1.5	--	--	--	--	--	--	--	ADV*
* Preliminary Trials, data not needed as runs duplicated in Tests 4 and 5.																						
Baseline Runs with no Corner Fishway compared to 400 and 600 cfs entrance (4' and 6' wide weirs) Runs conducted to document affects of protruding corner fishway entrance relative to existing conditions, and of corner entrance flow.																						
3	Baseline A Retracted, Exist	2/22/2008	53.2	11,470	3,790	3,790	3,890	--	Retracted	Match	Exist	Cond	--	--	--	--	--	--	--	--	--	ADV
6	Baseline B1 Projected, 29.4	3/25/2008	53.2	11,470	3,790	3,790	3,890	--	Ext. Bot. 29.4'	70	0	--	--	--	--	--	--	--	--	--	--	ADV, Dye Vid.
4	Corner Eval ADV 400 FG	2/21/2008	53.2	11,470	3,790	3,790	3,890	400	Ext. Bot. 29.4'	70	400	4	38.0	1.5	--	--	--	--	--	--	--	ADV, Nixon, Dye Video
5	Corner Eval ADV 600 FG	2/20/2008	53.2	11,470	3,790	3,790	3,890	600	Ext. Bot. 29.4'	70	600	6	38.0	1.5	--	--	--	--	--	--	--	Dye Video
Baseline Runs with no Corner Fishway Flow, and raised bottom of fishway entrance pool to exterior EI 34.0. Runs conducted to see if raising bottom of fishway allowed flow to reduce eddy along left bank immediately downstream of entrance. Did not eliminate eddy.																						
7	Baseline B2 Projected, 34.0	4/2/2008	53.2	11,470	3,790	3,790	3,890	--	Ext. Bot. 34.0'	70	0	--	--	--	--	--	--	--	--	--	--	Dye Vid, Nixon
Runs to examine eddy immediately downstream of corner entrance. Prepared for and discussed at interim 4/8/08 ES meeting. Eddy issue is observed to be less than originally anticipated.																						
8	Corner Eddy Dye 400cfs FG	4/2/2008	53.2	11,470	3,790	3,790	3,890	400	Ext. Bot. 34.0'	70	400	4	38.0	1.5	--	--	--	--	--	--	--	Dye Vid, Nixon
9	Corner Eddy Dye 600cfs FG	4/2/2008	53.2	11,470	3,790	3,790	3,890	600	Ext. Bot. 34.0'	70	600	6	38.0	1.5	--	--	--	--	--	--	--	Dye Vid, Nixon
10	Corner Eddy Dye 260cfs U1	4/2/2008	48.0	2,700	2,700	0	0	260	Ext. Bot. 34.0'	70	260	4	38.0	1.5	--	--	--	--	--	--	--	Dye Video
11	Corner Eddy Dye 260cfs U2	4/2/2008	48.0	2,700	0	2,700	0	260	Ext. Bot. 34.0'	70	260	4	38.0	1.5	--	--	--	--	--	--	--	Dye Video
12	Corner Eddy Dye 260cfs U3	4/2/2008	48.0	2,700	0	0	2,700	260	Ext. Bot. 34.0'	70	260	4	38.0	1.5	--	--	--	--	--	--	--	Dye Video
Runs to examine Fill to Eliminate Eddy immediately downstream of corner entrance. To discuss at 4/28.08 ES Meeting, Brute force method to elimtate the eddy space with fill.																						
35	Cor Eddy Dye 400cfs w/ Fillet	4/25/2008	53.2	11,470	3,790	3,790	3,890	400	Ext. Bot. 34.0'	70	400	4	38.0	1.5	--	--	--	--	--	--	--	Dye Video
36	Cor Eddy Dye 400cfs (=T8)	4/25/2008	53.2	11,470	3,790	3,790	3,890	400	Ext. Bot. 34.0'	70	400	4	38.0	1.5	--	--	--	--	--	--	--	Dye Video

Test Run Index Table

4/27/08

Test	Notes	Test Date	Operating Conditions					Pump Intake	Corner Fish Trap Configuration					Pump Bay Fish Traps					Data Collected				
			Tailwater El. ft	Total PH Flow cfs	Unit 1 Flow cfs	Unit 2 Flow cfs	Unit 3 Flow cfs		Weir Box --	Angle deg	Flow cfs	Weir Width ft	Weir El. ft	Delta H over Weir ft	PB-2 Flow cfs	Weir Width ft	Weir El. ft	Delta H over Weir ft		PB-3 Flow cfs	Weir Width ft	Weir El. ft	Delta H over Weir ft
Runs to examine Corner Entrance with Low Turbine Flows for Each Unit																							
For discussion at 4/28/08 ES Meeting																							
14	Corner Dye 230 U1 Only Low 4'	4/3/2008	46.7	1,200	1,200	0	0	230	Ext. Bot. 34.0'	70	230	4	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
15	Corner Dye 230 U2 Only Low 4'	4/3/2008	46.7	1,200	0	1,200	0	230	Ext. Bot. 34.0'	70	230	4	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
16	Corner Dye 230 U3 Only Low 4'	4/3/2008	46.7	1,200	0	0	1,200	230	Ext. Bot. 34.0'	70	230	4	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
Runs to examine Corner Entrance with Various Unit Configurations. 4'weir 400cfs compared to 6' weir 600 cfs																							
For discussion at 4/28/08 ES Meeting																							
U1 Low, U2&U3 High																							
17	Corner Dye U1 Low U2&3 High 4'	4/14/2008	51.9	8,880	1,200	3,790	3,890	350	Ext. Bot. 34.0'	70	350	4	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
19	Corner Dye U1 Low U2&3 High 6'	4/14/2008	51.9	8,880	1,200	3,790	3,890	530	Ext. Bot. 34.0'	70	530	6	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
U1 Med, U2&U3 High																							
18	Corner Dye U1 Med U2&3 High 4'	4/14/2008	52.6	10,380	2,700	3,790	3,890	375	Ext. Bot. 34.0'	70	375	4	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
20	Corner Dye U1 Med U2&3 High 6'	4/14/2008	52.6	10,380	2,700	3,790	3,890	560	Ext. Bot. 34.0'	70	560	6	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
U1&U2 Med, U3 Off																							
21	Corner Dye U1&2 Med U3 Off 4'	4/15/2008	50.0	5,400	2,700	2,700	0	320	Ext. Bot. 34.0'	70	320	4	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
24	Corner Dye U1&2 Med U3 Off 6'	4/15/2008	50.0	5,400	2,700	2,700	0	475	Ext. Bot. 34.0'	70	475	6	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
U1&U3 Med, U2 Off																							
22	Corner Dye U1&3 Med U2 Off 4'	4/15/2008	50.0	5,400	2,700	0	2,700	320	Ext. Bot. 34.0'	70	320	4	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
25	Corner Dye U1&3 Med U2 Off 6'	4/15/2008	50.0	5,400	2,700	0	2,700	475	Ext. Bot. 34.0'	70	475	6	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
U2&U3 Med, U1 Off																							
23	Corner Dye U2&3 Med U1 Off 4'	4/15/2008	50.0	5,400	0	2,700	2,700	320	Ext. Bot. 34.0'	70	320	4	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video
26	Corner Dye U2&3 Med U1 Off 6'	4/15/2008	50.0	5,400	0	2,700	2,700	475	Ext. Bot. 34.0'	70	475	6	38.0	1.5	--	--	--	--	--	--	--	--	Dye Video

Test Run Index Table

4/27/08

Test	Notes	Test Date	Operating Conditions					Pump Intake	Corner Fish Trap Configuration					Pump Bay Fish Traps					Data Collected				
			Tailwater El. ft	Total PH Flow cfs	Unit 1 Flow cfs	Unit 2 Flow cfs	Unit 3 Flow cfs		Weir Box	Angle deg	Flow cfs	Weir Width ft	Weir El. ft	Delta H over Weir ft	PB-2 Flow cfs	Weir Width ft	Weir El. ft	Delta H over Weir ft		PB-3 Flow cfs	Weir Width ft	Weir El. ft	Delta H over Weir ft
Runs to examine PB2 and PB3 Entrance Flows at 170 cfs. Prepared for and discussed at interim 4/8/08 ES meeting.																							
13.1	PB-2 Dye 3' 170cfs FG	4/2/2008	53.2	11,470	3,790	3,790	3,890	170	Ext. Bot. 34.0'	70	0	--	--	--	170	3	43.7	1.5	--	--	--	--	Dye Video
13.2	PB-2 Dye 4' 170cfs FG	4/2/2008	53.2	11,470	3,790	3,790	3,890	170	Ext. Bot. 34.0'	70	0	--	--	--	170	4	46.2	1.5	--	--	--	--	Dye Video
13.3	PB-3 Dye 3' 170cfs FG	4/2/2008	53.2	11,470	3,790	3,790	3,890	170	Ext. Bot. 34.0'	70	0	--	--	--	--	--	--	--	170	43.7	--	1.5	Dye Video
13.4	PB-3 Dye 4' 170cfs FG	4/2/2008	53.2	11,470	3,790	3,790	3,890	170	Ext. Bot. 34.0'	70	0	--	--	--	--	--	--	--	170	46.2	--	1.5	Dye Video
Runs to examine PB2 and PB3 Entrance Flows at 330 cfs. Prepared for and discussed at interim 4/8/08 ES meeting.																							
13.5	PB-2 Dye 3' 330cfs FG	3/13/2008	53.2	11,470	3,790	3,790	3,890	330	Ext. Bot. 34.0'	70	0	--	--	--	330	3	37.2	1.5	--	--	--	--	Dye Video
13.6	PB-2 Dye 4' 330cfs FG	3/13/2008	53.2	11,470	3,790	3,790	3,890	330	Ext. Bot. 34.0'	70	0	--	--	--	330	4	39.7	1.5	--	--	--	--	Dye Video
13.7	PB-3 Dye 3' 330cfs FG	3/13/2008	53.2	11,470	3,790	3,790	3,890	330	Ext. Bot. 34.0'	70	0	--	--	--	--	--	--	--	330	37.2	--	1.5	Dye Video
13.8	PB-3 Dye 4' 330cfs FG	3/13/2008	53.2	11,470	3,790	3,790	3,890	330	Ext. Bot. 34.0'	70	0	--	--	--	--	--	--	--	330	39.7	--	1.5	Dye Video
Runs to examine Corner Entrance 4' Weir with PB2 and PB3 at Higher and Medium Turbine Flows For discussion at 4/28/08 ES Meeting																							
Full Gen, PB2 and PB3 at 3' and 4' weir width																							
27	Corner 4' & PB-2 3'	4/15/2008	53.2	11,470	3,790	3,790	3,890	730	Ext. Bot. 34.0'	70	400	4	38.0	1.5	330	3	37.2	1.5	--	--	--	--	Dye Video
29	Corner 4' & PB-2 4'	4/15/2008	53.2	11,470	3,790	3,790	3,890	730	Ext. Bot. 34.0'	70	400	4	38.0	1.5	330	4	39.7	1.5	--	--	--	--	Dye Video
31	Corner 4' & PB-3 3'	4/15/2008	53.2	11,470	3,790	3,790	3,890	730	Ext. Bot. 34.0'	70	400	4	38.0	1.5	--	--	--	--	330	3	37.2	1.5	Dye Video
33	Corner 4' & PB-3 4'	4/15/2008	53.2	11,470	3,790	3,790	3,890	730	Ext. Bot. 34.0'	70	400	4	38.0	1.5	--	--	--	--	330	4	39.7	1.5	Dye Video
Full Gen, PB2 and PB3 at 3' and 4' weir width																							
28	Corner 4' & PB-2 3' U3 Off	4/15/2008	50.0	5,400	2,700	2,700	0	560	Ext. Bot. 34.0'	70	320	4	38.0	1.5	240	3	37.2	1.5	--	--	--	--	Dye Video
30	Corner 4' & PB-2 4' U3 Off	4/15/2008	50.0	5,400	2,700	2,700	0	560	Ext. Bot. 34.0'	70	320	4	38.0	1.5	240	4	39.7	1.5	--	--	--	--	Dye Video
32	Corner 4' & PB-3 3' U3 Off	4/15/2008	50.0	5,400	2,700	2,700	0	560	Ext. Bot. 34.0'	70	320	4	38.0	1.5	--	--	--	--	240	3	37.2	1.5	Dye Video
34	Corner 4' & PB-3 4' U3 Off	4/15/2008	50.0	5,400	2,700	2,700	0	560	Ext. Bot. 34.0'	70	320	4	38.0	1.5	--	--	--	--	240	4	39.7	1.5	Dye Video
Tailrace Flow Pattern Runs, for 3 Depth Sketches Layered interactive PDF File Provided to view these Runs																							
R1	TW Pattern, U1 U2 U3	4/21/2008	51.6	8,100	2,700	2,700	2,700	335	Ext. Bot. 34.0'	70	335	4	38.0	1.5	--	--	--	--	--	--	--	--	sketchs @ 3d
R2	TW Pattern, U1 same as T10	not done	48.0	2,700	2,700	0	0	260	Ext. Bot. 34.0'	70	260	4	38.0	1.5	--	--	--	--	--	--	--	--	sketchs @ 3d
R3	TW Pattern, U2 same as T11	not done	48.0	2,700	0	2,700	0	260	Ext. Bot. 34.0'	--	260	4	38	1.5	--	--	--	--	--	--	--	--	sketchs @ 3d
R4	TW Pattern, U3 same as T12	not done	48.0	2,700	0	0	2,700	260	Ext. Bot. 34.0'	70	260	4	38.0	1.5	--	--	--	--	--	--	--	--	sketchs @ 3d
R5	TW Pattern, U1 U2	4/22/2008	50.0	5,400	2,700	2,700	0	320	Ext. Bot. 34.0'	70	320	4	38.0	1.5	--	--	--	--	--	--	--	--	sketchs @ 3d
R6	TW Pattern, U2 U3	4/23/2008	50.0	5,400	0	2,700	2,700	320	Ext. Bot. 34.0'	70	320	4	38.0	1.5	--	--	--	--	--	--	--	--	sketchs @ 3d

PHASE I	<p>Phase I would be constructed as required by timing in the Settlement Agreement. The main design feature would be a nominal 420 cfs corner entrance with a removable 4 foot wide slot entrance set with invert at 38.0 feet elevation, with no flow control gate. Phase I would include construction of an AWS intake fine-trashrack capable of providing 800 CFS to the AWS, with an average through fine-trash rack velocity of less than 1 ft/s, and the capability to add AWS capacity up to 800 cfs. Initial AWS capacity would be 400 cfs, nominally.</p> <p>Telemetry studies for each species would be conducted over a two-year period to determine the level of compliance with the ATE. Based on the results of the initial two year test period, the initial design would be adjusted to Phase II or Phase III. If ATE is close to being achieved (between 92-98% passage with less than 32 hours total passage time for each species), telemetry work can be repeated for 2 more years to determine if ATE can be met, or can move to phase II. If ATE is poor (less than 92% passage or greater than 32 hours total passage time for any species), go to Phase III. Any handling/sorting injury mechanism would be rectified as soon as possible, no later than the next migration season. If ATE is accomplished for each species, no phase II would be required.</p>
PHASE II	<p>Phase II would be constructed by either year 3 (if ATE accomplishment does not seem possible based on Phase I telemetry) or by year 5 (if ATE is not accomplished for each species and repeatable in the 4 years of telemetry tests in Phase I). Phase II adds a third attraction flow pump bringing fishway flow to nominally 600 cfs, and replaces the 4' corner entrance with a 6' corner entrance. Phase II would be evaluated with a two-year radio-telemetry study, with the same type of "results" assessment as described for Phase I leading to either an adjustment to phase III or retesting Phase II.</p>
PHASE III	<p>Phase III would be constructed by year 7, if ATE is not accomplished and repeated in Phase I or II based on the results of telemetry studies, or by year 3 if Phase I yields poor ATE results. Phase III consists of adding a second fishway entrance along the face of the powerhouse, plus the fish ladder to link with the trap and hoist, plus bringing AWS capacity to 600 cfs (if phase II is skipped). Phase III splits 600 cfs attraction flow between a 4 foot wide corner entrance, along with a 4 foot wide powerhouse face entrance. Phase III would be tested for at least two years.</p>
PHASE IV	<p>Phase IV would entail the final adjustment available to the initial design, implemented after Phase III is tested if ATE isn't achieved. Phase IV adds flow (from forebay or via hydraulically optimized pumps) to provide 800 cfs attraction flow split between a six foot wide corner entrance and a four foot wide powerhouse face entrance. Phase IV would be tested for at least two years.</p>
PHASE V	<p>IF ATE is not accomplished with Phase IV, a design modification would have to be developed, possibly locating a third entrance below the bridge and constructing a ladder to the sorting facility, or locating a third entrance at another appropriate location as determined by telemetry results. Could also potentially further increase fishway attraction flow.</p>

The other spreadsheet tabs demonstrate how the four phases could be operationally implemented at the project. Any deviation from NMFS design standards is highlighted. Also, note that the powerhouse face entrance dimensions are for example only - I hope to have this clarified by results from the model.