BAKER RIVER PROJECT RELICENSE

Aquatic Resources Working Group
Technical Sub-committee on Instream Flows

May 2, 2003
9:00 a.m. - 3:00 p.m.

R2 Resource Consultants, Inc.
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(425/556-1288)

MEETING NOTES

Meeting Purpose: Develop a process to resolve flow-related issues for Baker River Project relicensing.

Fish Team Leader: Arnie Aspelund, 425-462-3442, aaspel@puget.com

PRESENT: Arnie Aspelund (PSE), Stuart Beck (R2), Sue Madsen (R2), Hal Beecher (WDFW), Brad Caldwell (Ecology), Cary Feldmann (PSE), Phil Hilgert (R2), Brian Mattax (Louis Berger Group), Gary Sprague (WDFW), Stan Walsh (SSC) Larry Wasserman (SSC), and Paul Wetherbee (PSE)

AGENDA

May 2, 2003
9:00 a.m. – 3:00 p.m.

R2 Resource Consultants, Inc., Redmond, WA

9:00 – 9:20	Introductions, review meeting objectives and agenda
9:20 – 9:30	Review Baker River relicense schedule
9:30 – 9:45	Status of Skagit River data collection and data analysis
9:45 – 10:30	Description and status of HYDROPS model / scenarios
10:30 –10:45	**Break**
10:45 - 11:30	HYDROPS post-processing analysis

HYDROPS (Q and pool levels) IHA daily flow
Modified IHA/hourly flow Skagit habitat models

11:30 – 12:00	**Working Lunch**
12:00 – 1:30	Hourly flow analysis
1:30 – 2:00	Daily flow analysis
2:00 – 2:10	**Break**
2:10 – 2:45	What is the process for using Skagit River habitat models to develop a draft PME flow schedule?
2:45 – 3:00	Schedule for action items and agenda for next meeting

MEETING HANDOUTS

- Meeting Agenda (page 1)
- Baker Relicense Long Term Planning Schedule (pages 2-3)
- Instream Flow Study, Status of Raw Data Analyses, PowerPoint (pages 4-7)
- Technical Scenario Teamlet Functional Flow Diagram (page 8)
- Introduction to Indicators of Hydrologic Alteration Analysis (IHA) (pages 9-10)
- Comparison of Traditional IHA and R2 IHA analysis (pages 11-13)
- Diagram of Middle Skagit River Fish Habitat Model (page 14)
- Middle Skagit River Fish Habitat Model, Hourly Flow Analysis, PowerPoint (pages 15-39)
- Hydrologic-based Analysis of Spawning:Incubation Flows, PowerPoint (pages 40-43)
- Size of Salmonids at Greatest Risk to Stranding (pages 44-46)
- Instream Flow Investigations Side Channel Status Report (pages 47-52)
- Maps (2 pages) of Mainstem Skagit River Instream Flow Study Transects and off-channel study areas, Baker River Confluence to Sedro Woolley

ACTION ITEMS

- Prepare a record of this meeting and distribute to attendees for review and comment, submit a copy of the record and all handouts to Margaret Beilharz-USFS and Thom Hardy-USFS contractor. (Arnie)

- Confirm assumptions regarding salmonid periodicity. R2 will submit a list of salmonid timing by lifestage and species and propose periods for instream flow evaluations. These will constitute working assumptions for comparing different operating scenarios. To assist in evaluating the proposed schedule, R2 has distributed draft study report A-09-b (Middle Skagit River Salmon Spawning Surveys) and will be distributing A-09c (Middle Skagit River Juvenile Salmonid Timing) along with the proposed evaluation periods. (Phil)

- R2 will overlay the HSI curves used for the lower Skagit River instream flows study (DES 1999) with available velocity measurements taken when fish on redds were observed during

the 2002 salmon spawning surveys before the group considers which HSI curves to use for the middle Skagit River instream flow study.

- R2 will work with Brad Caldwell to identify various assumptions used in the lower Skagit River instream flow study (DES 1999) in an effort to maintain consistency between the two studies.(Phil)

- Hourly Analysis-come up with stage discharge relationships for the 24 transects, look at varial zone analysis and spawning incubation analysis for fall 2002 –goal to have this done for June (Stuart)
- Calculate spawning flows under unregulated conditions for the Baker River at Concrete using the 10 highest days during the spawning period (average daily) and identify the timing, frequency, and duration of instances where minimum flows (average daily) were less than 2/3 of the spawning flow during the incubation period. If calculated over a sufficient period of record, the analyses could be used to define a target to compare future operational scenarios.

REVIEW MEETING OBJECTIVES AND AGENDA

MEETING OBJECTIVES

- Updates since the technical group last met (June 17, 2002).
- To review status of Baker Relicensing activities related to instream flow.
- Prioritize development of various habitat models.
- Review model calibration process and hopefully leave meeting participants with an adequate comfort level that appropriate procedures are being utilized during model development. R2 agreed to document assumptions and model calibration decisions – sufficient to allow the models to be recreated several years later (similar to efforts to re-run White River models six years after the original FERC submittal).

REVIEW BAKER RIVER RELICENSE SCHEDULE

Arnie Aspelund referred to the long-term relicensing planning schedule with significant dates mentioned for development and review of draft PMEs, PDEA and License application (see handout). FERC imposed relicense schedule is prompting the need to compress analysis schedule – but must not sacrifice quality of data processing.

STATUS OF SKAGIT RIVER DATA COLLECTION AND DATA ANALYSIS

Phil Hilgert gave PowerPoint on status of instream flow study (see handouts page 4-7). Field measurements taken fall 2003 and winter 2003 at 24 transects on middle Skagit between confluence with Baker River down to Sedro Woolley. Target measurements on the mainstem and secondary channel, and side channels and backwater sloughs were 7,000 cfs, 14,000 cfs and

21,000 cfs. Actual flow ranges of roughly 4,250 cfs, 11,500 cfs, and 24,500 cfs. Mainstem field measurement completed middle of March 2003. Acoustic Doppler current profiler (ADCP) data provided 10 days ago – raw data analyses proceeding. Phil described field methodologies utilizing ADCP data collected by Pacific International Engineering (PIE) for measuring velocities and depth for mainstem channel measurements taken by boat at each transect coupled with adjoining bank measurements of velocities and depth taken by shore crews (R2).

Output of measurements will provide mean column velocity profiles at each transect and flow condition. Substrate and cover codes used in the Lower instream flow study and adopted for use during this middle flow study were presented.

HYDROPS (Paul Wetherbee)

Paul gave an overview of the functions of the technical scenario teamlet (TST) convened to coordinate HYDROPS modeling requests by the relicensing resource workgroups (handout page 8). Analysis of 1990 to 2001 record of hourly flows will be used to evaluate effects of Baker Project operations downstream of the Baker River (incorporating SCL operations into the model).

Paul described how the HYDROPS model and Skagit River Habitat models interact. The TST has been meeting weekly and is working to define baseline conditions and the output parameters. Paul provided example output (handouts of example baseline conditions, constraints to the model, time series plots). Paul provided an outline of the USFS desire for HYDROPS and PHABSIM model output presentation (handout).

IHA Analysis (Sue Madsen)

Developed by the Nature Conservancy to provide standardized statistics of flow regimes to compare regulated and unregulated conditions in a river basin. The IHA package is currently based on daily flows (handout page 9-10), but an upcoming revision by the Nature Conservancy may include hourly statistics. R2 has used the general IHA approach in several other studies and has expanded the number of hydrologic statistics and allowed parameters to be modified to address specific project needs (e.g., 2-day low flows instead 1-day). R2 has already added hourly parameters to the standard IHA statistical package (see handout pages 11-13). The R2 modifications are not really a model, it has no predictive power, but rather it is a hydrologic statistical package. These analyses will be run independent and parallel to the Middle Skagit River Fish Habitat Model described below.

Middle Skagit River Fish Habitat Model (page 14)

The R2 model will be using the hourly flow hydrograph output from the HYDROPS to perform varial zone analysis and perform spawning evaluation at select transects and to compare operational scenarios during the incubation period. Daily flows derived from hourly flow hydrographs can be used to evaluate effects of alternate scenarios using other models, such as PHABSIM evaluations.

Hourly Flow Analysis (Stuart Beck, Power Point, pages 15-39)

Using hourly flow hydrograph from HYDROPS, R2 will route the hourly flow data through the middle Skagit to determine hourly flow hydrograph within the instream flow study reach and

then evaluate fish habitat, perform varial zone analysis, analyze daily fluctuations and evaluate ramping rates and perform spawning evaluation in the study reach.

Proposed period of analysis for hourly flows is 1990-2002; a longer period of record can be used to evaluate daily flows. Some evaluations performed for entire year using all segments (rearing), other analyses will focus on seasonal interests (spawning/incubation using transects supporting spawning).

Analyses performed at each transect will include developing depth and velocity profiles, water surface elevations, and discharge for each flow measurement to develop a stage/flow rating curve to allow for interpolation and extrapolation. Development of the unsteady flow model will use flow and stage recordings from USGS gages near Concrete and Mt. Vernon and will use 15-minute stage readings from temporary stage recorders R2 placed at 3 transects in the middle Skagit River last fall. There are 278 square miles of drainage area between the USGS gages at RM 54.1 and 22.3 compared to 297 square miles of drainage area in the Baker basin. While the Baker basin runoff per area is much higher than lower Skagit tributaries, there is still substantial accretion to incorporate into the model. Hourly tributary inflows (accretion flows) will be developed for all 24 transects by calculating ratio of drainage areas. SSC representatives mentioned that R2 might have to take into account that Salmon, Turner and Mud and Gilligan creeks contain diversions and will contribute less runoff per drainage area compared to other middle river tributaries.

Once the stage:flow relationships are developed for each transect, an initial analysis will be to recalculate redd dewatering flows for the 2002 redd measurements identified in the A-09c study report. Another early analysis will be to develop a curve of flow versus total wetted surface area in the study reach, accounting for tributary inflow downstream from Baker River, to identify a "critical flow". The critical flow will be calculated as the flow at which changes in wetted surface area becomes relatively insensitive to changes in flow. The 24 single transects will be used to identify a critical flow. Although a standard PHABSIM model will also calculate surface area, it is much more difficult to incorporate between transect accretion when using PHABSIM.

In response to a question from Hal Beecher, Stuart responded that the hourly flow data will also be used to identify the flow at which scour occurs – which highlighted the need to qualify each mention or use of the term "critical flow", since there may be critical flows identified for varial zone, spawning, scour and other mainstem parameters.

<u>Varial Zone Analysis</u>

Phil mentioned that the technical group will need to confirm assumptions regarding salmonid periodicity. R2 will submit a list of salmonid timing by lifestage and species and propose specific periods for instream flow evaluations. For instance, fry stranding may extend from mid-December through June to cover young-of-year from fall spawners, and a shorter period mid-February through May might be proposed to cover a defined percentage of the fry. These will constitute working assumptions for comparing different operating scenarios. To assist in evaluating the proposed schedule, R2 has distributed draft study report A-09-b (Middle Skagit River Salmon Spawning Surveys) and will be distributing A-09c (Middle Skagit River Juvenile Salmonid Timing) along with the proposed evaluation periods.

Stuart discussed the proposed approach for the varial zone analyses illustrating the difference between dry zone, varial zone and continuously wetted zone. The analysis would quantify the varial zone during the period of interest using hourly stage and wetted perimeter time series at 24 transect locations, analyze within day fluctuations determine daily range of flow, stage and wetted perimeter, evaluate ramping rates and within week fluctuations.

Spawning and Incubation Assessment

The hourly flow analysis is designed to evaluate effects of alternate operating scenarios on fry stranding and the frequency, timing and duration of varial zone fluctuations. However, the data will also be used to evaluate spawning flows and the frequency, magnitude and duration of flows that drop below the incubation levels (assumed to be 0.6 to 0.66 of the spawning flow) through the incubation period. These analyses will help identify the flow level during the spawning period that can be maintained with no more than a 1-foot stage drop through the incubation period. The analyses are similar to quantifying the varial zone – only the time periods will be changed. A rudimentary analysis of scour potential will also be conducted at transect locations that support salmonid spawning to assess the risk of dewatering/scour during incubation period.

Phil then discussed a hydrologic-based spawning:incubation analysis as an example of instream flow evaluations that could, and should be conducted in advance of obtaining the results of the middle Skagit River instream flow study (handout pages 40-43). While the middle Skagit River habitat models will help fine-tune the evaluations, he believes that examining the hydrology will give all parties a better understanding of potential protection, mitigation and enhancement (PME) flow regimes. Assuming that incubation flow requirements are 0.6 of the spawning flow, an initial step would be to identify the highest flow that can be maintained through the incubation season. During the winter, opportunities for flow augmentation are limited due to the need to maintain available flood control reservoir storage. In addition, if low flows occur in late winter, drawing the reservoir down increases the risk that the reservoir will not be refilled during the spring. Using an analysis of unregulated flows, he noted that flows in January dropped below 1,250 cfs for 7 days during a median year (handout page 43 – also Table 3-6 from A-24 Part 1). Assuming that a flow of 1,250 cfs could be maintained through the incubation period, spawning flows during the previous fall would have to less than 2,083 cfs to provide complete protection (2,083 cfs * 0.6 = 1,250 cfs). Examining the record of inflows during September 15 – November 15 (handout page 40) shows that inflow exceeds 178 KAF 78% of the time – or complete incubation protection would only occur 1 in 4.5 years.

If incubation flows could be maintained 1,723 cfs, spawning flows would have to be maintained at less than 2,500 cfs to obtain complete protection of redds. Inflow would have to be less than 274 KAF to avoid spill – and inflow exceeds 274 KAF about half the time, or 1 in 2 years on average. Phil suggested that hydrologic-based analyses such as this could be used to identify feasible spawning and incubation flow strategies. The HYDROPS model would be needed to confirm incubation flow levels and the timing, frequency and magnitude of spill events under various scenarios. Complete protection may not be realistic or may have unacceptable side effects (e.g., failure to refill the reservoir). Instream flow decisions would have to consider acceptable levels of risk among various flow release strategies. Hydrologic-based analyses can

allow all parties to begin to examine those trade-offs – although the HYDROPS and middle Skagit River habitat runs will still be needed to fine-tune the analyses.

Phil noted that one of the basic assumptions when evaluating spawning and incubation flow relationships is that flow levels during the incubation period cannot be predicted in advance. If flows during the fall spawning season are high, flows during the incubation period can be high or low. To illustrate this point, R2 examined the ratio of flows during assumed spawning periods to flows during assumed incubation periods. A table displaying the results of the analysis was included in the PowerPoint presentation, but a corresponding memo was inadvertently left out of the handouts (the memo is attached to this meeting record).

Evaluating spawning:incubation flow relationship requires a common definition of what constitutes a spawning flow. The Skagit River Project Settlement included a spawning flow definition as the average of the highest 10 daily flows during the spawning period. Stan Walsh suggested that the highest 8-hour flows are more biologically relevant than a daily average when looking at hydropower peaking. Using the highest 8-hours offers greater protection for fish spawning at the peaking flow as opposed to using an average of a peaking and non-peaking flow over a 24-hour period. The definition of spawning flows will be one of the decision topics when discussing salmonid periodicity.

DAILY FLOW ANALYSIS

Model inputs would be same as Hourly Analysis but computed as daily averages.

Weighted Usable Area

Phil suggested that in order to maintain consistency between the lower and middle Skagit River instream flow studies and in view of the impending relicensing schedule, the group might consider using the Habitat Suitability Index (HSI) curves from the lower river study (DES 1999). Phil noted that R2 collected some velocity measurements of fish on redds during the 2002 survey efforts, but they were uncomfortable using them as indicators of redd site selection. Spawning surveys were often conducted during periods of fluctuating flows and he believed the velocity measurements were indicative of flows that would not drive fish from redds rather than actual redd site selection. Only if antecedent flows were stable, or if the fish was observed actively digging could the velocity measurements be assumed to reflect redd site selection. Hal Beecher requested that any available middle Skagit River velocity measurements be overlaid with the lower river HSI curves before deciding whether to use the lower river curves.

Phil mentioned that, as discussed with Hal and Brad Caldwell last summer, substrate and cover field characterizations were consistent with the codes used in the lower Skagit River study (DES 1999). However, the reports for the lower river study did not provide sufficient detail to allow R2 to process the middle river data in a manner consistent with the lower river study. Brad agreed to answer questions and provide additional detail regarding data processing procedures outside of the meeting.

Side Channel and Backwater Slough Status Report (Sue Madsen, handouts pages 47-52)

Three side channels and six backwater sloughs habitats are being measured (R2 still has to collect high flow measurements at a couple of slough habitats. Sue described side channel types and flow patterns (see handout page 48)- and noted the apparent subsurface connection between mainstem stage and side channel stage. For the side channels, R2 intends to conduct PHABSIM-type analysis similar to the mainstem study over the range of flows with surface flow connections. They will quantify habitat changes associated with the influence of mainstem flows and subsurface connections using changes in surface area.

Backwater sloughs don't have significant velocities so R2 will not be able to do a traditional PHABSIM type analysis- but will quantify changes in surface area and depth in relation to mainstem flows to identify changes backwater slough habitats. Backwater sloughs appeared to support important rearing areas and potential spawning habitats when sufficient tributary or mainstem inflow provides acceptable velocities.

<u>What is the Process for Using Skagit River Habitat Models to Develop a Draft PME Flow Schedule (Cary Feldmann)</u>
Going to have to take a number of HYDROPS runs to see what we can physically do-have to find a way to craft a number of scenarios and will need the results from these runs plus the R2 analysis as soon as possible. Further discussions of flow schedules, etc. are needed and PSE will continue to have the relevant flow issues: instream, ramping, amplitude, cycling as placeholders in the 2nd round of PME development. Further discussion will follow in June.

Due to the relicensing schedule, it was requested that the group prioritize data analyses. Phil proposed that hourly varial zone and spawning/ incubation analyses be conducted first, followed by PHABSIM evaluations on mainstem and secondary habitats, backwater sloughs, side channels, and spatial niche analyses in that order. Larry Wasserman-SSC disagrees with bypassing necessary analyses in order to meet a licensing deadline when these analyses may have bearing over the term of a new license. Cary responded that some analyses have more importance than others. The intent is to conduct all of the required analyses, just want to agree on which ones to do now for the sake of meeting EA deadlines.

Larry asked if the County's request for additional flood control storage would be considered as part of the instream flow discussions, since additional flood control would further limit winter flow augmentation. Cary responded that this issue will be addressed as part of HYDROPS runs though the Technical Scenario Team.

Next instream flow technical meeting is scheduled for June 3rd 9-3 at a Seattle area location to be announced (USFS office in Mount Lake Terrace is one option being considered).

Meeting adjourned on time.