BAKER RIVER PROJECT RELICENSE

Technical Scenario Teamlet Meeting

June 6, 2003

10:00 a.m. – 2:00 p.m.
Dial in: (866) 280-6429
Guest #: 144995
Louis Berger Office
12011 Bellevue-Redmond Road, Suite 200, Bellevue

AGENDA

1) Welcome, Introductions Review Notes (briefly) and Agenda	10:00 – 10:15
2) Sensitivity Analysis Discussion	10:15 – 11:45
3) Prep for Soft Constraint Ranking Discussion	11:45 – 12:00
4) Lunch: Review Outstanding Action Items	12:00 – 12:20
5) Preliminary Draft Constraint Ranking	12:20 – 1:45
6) Input/Output Format Review	1:45 – 1:50
7) Set Agenda for June 13 teleconference	1:50 – 2:00

June 4, 2003

BAKER RIVER PROJECT RELICENSE

Technical Scenario Teamlet

June 6, 2003
10:00 to 2:00
Louis Berger Office at 12011 Bellevue-Redmond Road, Suite 200
Bellevue, WA

FINAL DRAFT MEETING NOTES

Teamlet Leader: Paul Wetherbee, 425-462-3746, paul.wetherbee@pse.com

PRESENT: Paul Wetherbee, Joel Molander, and Tony Fuchs (PSE), Ruth Mathews (The Nature Conservancy), Margaret Beilharz (USFS), Gary Sprague (WDFW), Mark Killgore, Rob Mohn and Brian Mattax (The Louis Berger Group), Stuart Beck and Phil Hilgert (R2), Stan Walsh on phone (SSC), and Lyn Wiltse, facilitator (PDSA Consulting, Inc.).

INTRODUCTIONS

We welcomed Tony Fuchs, Team Leader for the Terrestrial Working Group. He attended today to represent Terrestrial and Recreation interests.

FUTURE MEETING DATES

Note: The June 13 meeting was cancelled.

June 27 (IN PERSON) from 10:00 to 2:00 at Louis Berger Office at 12011 Bellevue-Redmond Road, Suite 200, Bellevue. Phone: 425-451-7400.

Teleconference meetings: July 11, July 25 from 10:00 to noon at PSE's new Bellevue Office at 10885 NE 4th Street, Bellevue.

Driving directions to Louis Berger Office:

Heading SOUTH on 405: Take Exit #13B and take the NE 8th East ramp, and merge onto NE 8th. Turn left onto Bellevue-Redmond Road. The office is at 12011 Bel-Red Rd. on the south side of the road just beyond Barrier Motors and on the second floor.

Heading NORTH on 405: Take Exit #13B and keep right at the fork in the ramp. Merge onto NE 8th. Turn left onto Bellevue-Redmond Road. The office is at 12011 Bel-Red Rd. on the south side of the road just beyond Barrier Motors and on the second floor.

To attend these meetings by conference call: Dial 1-866-280-6429. Enter participant code 144995#.

DRAFT AGENDA FOR JUNE 6, 2003
10:00 – 2:00 at Louis Berger Office at 12011 Bellevue-Redmond Road, Suite 200, Bellevue
Box lunches will be provided.

10:00 – 10:15	Welcome, Introductions Review Notes (briefly) and Agenda
10:15 – 11:45	Sensitivity Analysis
11:45 – noon	Prep for Discussion of Ranking of Soft Constraints
Noon – 12:20	Lunch: Review Outstanding Action Items
12:20 – 1:45	Play Results Comparison
	Create Preliminary Draft Ranking of Soft Constraints
1:45 – 2:00	Set Agenda for June 13 Meeting
	Confirm additional future meeting dates and times
	Evaluate the meeting

NEW ACTION ITEMS

- Mark: Analyze the four years selected by Phil for their reasonableness in supporting economic analyses. Identify additional periods of analysis if necessary. These years cover the hydrologic variation. Mark needs to ensure they are not biased in terms of high or low flows. He will also be looking for economic neutrality (within a small percentage of the long-term averages).
- Brian: Email post processor request to Phil.
- Phil: Check with Sue re: suite of statistics to use for post processing. Send out draft proposal to teamlet members (Ruth, Margaret, Brian, Mark, Paul). Incorporate their feedback into revised proposal to send out by June 23 to all team members. We will discuss this at our June 27 meeting.

REPORT ON OLD ACTION ITEMS

- Paul: Made sure we have input/representation from Terrestrial, Cultural, and Recreation resource interests for ranking session on June 6 by inviting Tony Fuchs to attend. Tony buttoned up with Andy Hatfield to make sure he could represent Recreation as well as Terrestrial interest at out meeting today. Aquatics interests are already well represented.
- Paul: Integrated Ruth's comments into 5/21 draft minutes and sent out as final.
- Paul: Sent out sensitivity analysis of soft constraint ranking on example flow regime in preparation for the June 6 meeting.
- All: Checked email on Wednesday for email from Paul. Reviewed these in preparation for the June 6 meeting.

- Phil: Generated new time series for unregulated flows for the Baker River. Included updated area-volume curves for both reservoirs and historic hydrologic data including flows and reservoir elevations. Made these data available on CD for those interested.
- Phil: Prepared memo outlining when SCL fisheries settlement was actually implemented. Reviewed and revised if necessary the rankings of the biologically-based ratios for selection of periods of analysis.
- Lloyd: Talked with Gary about why power prices jump around so much in 2006 and 2007 (according to Appendix K).
- Paul: Sent out list of all HYDROPS technical information available on the website.
- Paul: Checked back with Powel to see when they could update and distribute HYDROPS demonstration PowerPoint slides.
- Paul: Analyzed sensitivity of spawning/incubation flow calculation method, prepared short brief and presented to TST at next meeting.
- Paul: Completed example model run request form using Margaret's changes, distribute to group, and discuss at the next meeting.

FLOOD CONTROL

PSE is talking with Skagit County about how we might integrate an assessment of the adequacy of existing levels of flood control into the relicensing process. They will be meeting to discuss this on June 9 and they will give an update at the Economics Working Group meeting. The important thing to consider is that if there is a formal request to include any additional flood control in the new license, it will be incremental and not embedded. This means that this will not change any of our analyses that are based on the 74K acre-feet that PSE is obligated to provide (by congressional mandate). For now, we will assume that this will not change.

INSTREAM FLOWS TECHNICAL WORKING GROUP UPDATE

Phil reported that the June 3 Instream Flow Technical Working Group meeting was moved to June 30. Most of the hydrology has been updated. They are looking at putting together a follow-up memo looking at spawning and incubation flows under unregulated conditions at the Baker River Gage. They are analyzing different ways of calculating statistics for different time periods. This memo will be out next week and will be discussed at the June 30 meeting.

R2 MODEL(S) UPDATE

They are also working on the habitat models. They have been developing stage discharge relationship curves for each of the 24 transects. They are also looking at a critical flow with regard to Ramping in the Skagit River.

They are developing two models:

- Hourly routing: Doing this first. They hope to have it complete mid July
- Daily physical habitat simulation model: Hope to have that complete thereafter.

HYDROPS STATUS REPORT

Paul reported that he and Mark are continuing to test the model, especially for forecasting. We expect to be able to report that the model is tried and true by our June 27 meeting.

SENSITIVITY ANALYSIS

Mark walked us through the draft PowerPoint presentation he put together comparing two runs with different rankings so we could get an idea of how sensitive the model was to these differences. The years were defined at August 1 through July 31. Note: If constraints must be violated to ensure feasible operations, the HYDROPS model will violate them in reverse rank. It is possible to give two constraints the same ranking, as he demonstrated in Run 40. In this case, HYDROPS looks to optimize the run from an economic standpoint. You can also turn soft constraints off by not giving them any ranking.

After you do a run, you can call up a HYDROPS Sensitivity Constraint Report to get a summary table of the total number of hours of constraint violations for each soft constraint. For example, 47 violations of minimum levels at Baker Lake translated to nearly two days.

Mark reported that since they are still fine tuning/debugging the forecasting capabilities of the model, the runs illustrated in his presentation were made in the deterministic mode. He also noted that in these examples, lake levels were generally met. It is possible to override minimum flow allocations for the short term if they are ranked low enough. The model is being updated to support an enhanced ramping function.

A more standardized price schedule is also being developed by PSE as has been discussed at the Economics/Operations Working Group meetings.

PREP FOR DISCUSSION OF RANKING OF SOFT CONSTRAINTS

We are trying to come up with a standardized comparative analysis. We have chosen four energy years to evaluate. We will have defined our year as from August 1 to July 31. The constraints we generally vary per run include reservoir levels, ramping rates, minimum instream flows, and powerhouse releases. We will be changing the physical magnitude of these constraints as we conduct different runs using default ranking of soft constraints. This will give us the ability to compare runs. Ultimately the preferred alternative may have different constraint rankings than the recent conditions.

PRELIMINARY DRAFT RANKING OF SOFT CONSTRAINTS

We started by acknowledging the interests of the Terrestrial and Recreation Working Groups. We called these out specifically since the majority of the members of this team represent aquatics interests.

Recreation: They are concerned with keeping reservoir levels high from late May (Memorial Day weekend) through early September (Labor Day weekend). They would like to see full pool for this time period. Unless they modify boat ramps, a reservoir level of 715 feet is required for the ramps to be operational.

Terrestrial: For Baker Lake, they are concerned with keeping the reservoir level below 710 feet during certain seasons. For Lake Shannon, they want the reservoir level to be below 425 feet. Note: They also cautioned that short-term water levels the upper 10 feet of the reservoir can provide falsely suitable habitat for amphibian breeding, resulting in stranding, etc. In the fall,

terrestrials are concerned with forage availability. Therefore, they want to see the reservoir level no higher than 715 feet.

We best guessed the following ranking of soft constraints, taking into consideration the interests of each of the resource areas. Then we came up with a suggested overall ranking considering which violations we would want PSE to try hardest to avoid. See table below.

SOFT CONSTRAINT	ECON/ OPS	CULT/ HIST	REC/ AESTHETIC	TERRES.	AQUATIC	OVERALL
Min. Instr. Flow	0	0	0	5	35	1 (30)
Ramping	0	0	0	0	35	1 (30)
Min. Res. Level	10	50	100	0	25 (20?)	3 (10)
Max. Res. Level	40	50	0	95	5 (10?)	2 (25)
Min. Pwr Hse Rel	50	0	0	0	0	3 (5)

We clarified the following soft constraints:

- Minimum Instream Flow is the target instream flow set up for fish that will ultimately be in the Settlement Agreement
- The Maximum Reservoir Level included flood control and spill considerations.
- The Minimum Powerhouse Release is only critical in drought years, and also for peak hour operations.

INPUT/OUTPUT FORMAT REVIEW

This was tabled for discussion at our next meeting, June 27.

DRAFT AGENDA FOR JUNE 27, 2003

10:00 – 2:00 at Louis Berger Office at 12011 Bellevue-Redmond Road, Suite 200, Bellevue
Box lunches will be provided.

10:00 – 10:10	Introductions, Review Notes (briefly) and Agenda
10:10 – 10:15	Action Items
10:15 – 11:00	Discuss Suggested Input/Output Format
11:00 – 11:45	Perform Comparison Runs using the Preliminary Draft Ranking of Soft Constraints we developed at June 6 meeting
11:45 to 12:15	Lunch
12:15 – 1:00	Continue Comparison Runs
1:00 – 1:45	Begin to address other issues
1:45 – 1:50	Set up August TST meeting dates
1:50 – 2:00	Set Agenda for July 11 Meeting (at PSE's new Bellevue Office at 10885 NE 4th Street, Bellevue) and evaluate the meeting

MEETING EVALUATION

Well Dones:

- Nice to meet face-to-face!
- Appreciate Louis Berger hosting us!
- We are providing a necessary forum for analysis and interpretation
- We have come up with a preliminary draft ranking for soft constraints

Do Differently:

- Got out late.

FUTURE ISSUES TO ADDRESS

- Standard Outputs
- Dependable Capacity
- Fisheries Definition: Tie to R2 outputs format (flow sections from A24)

PARKING LOT

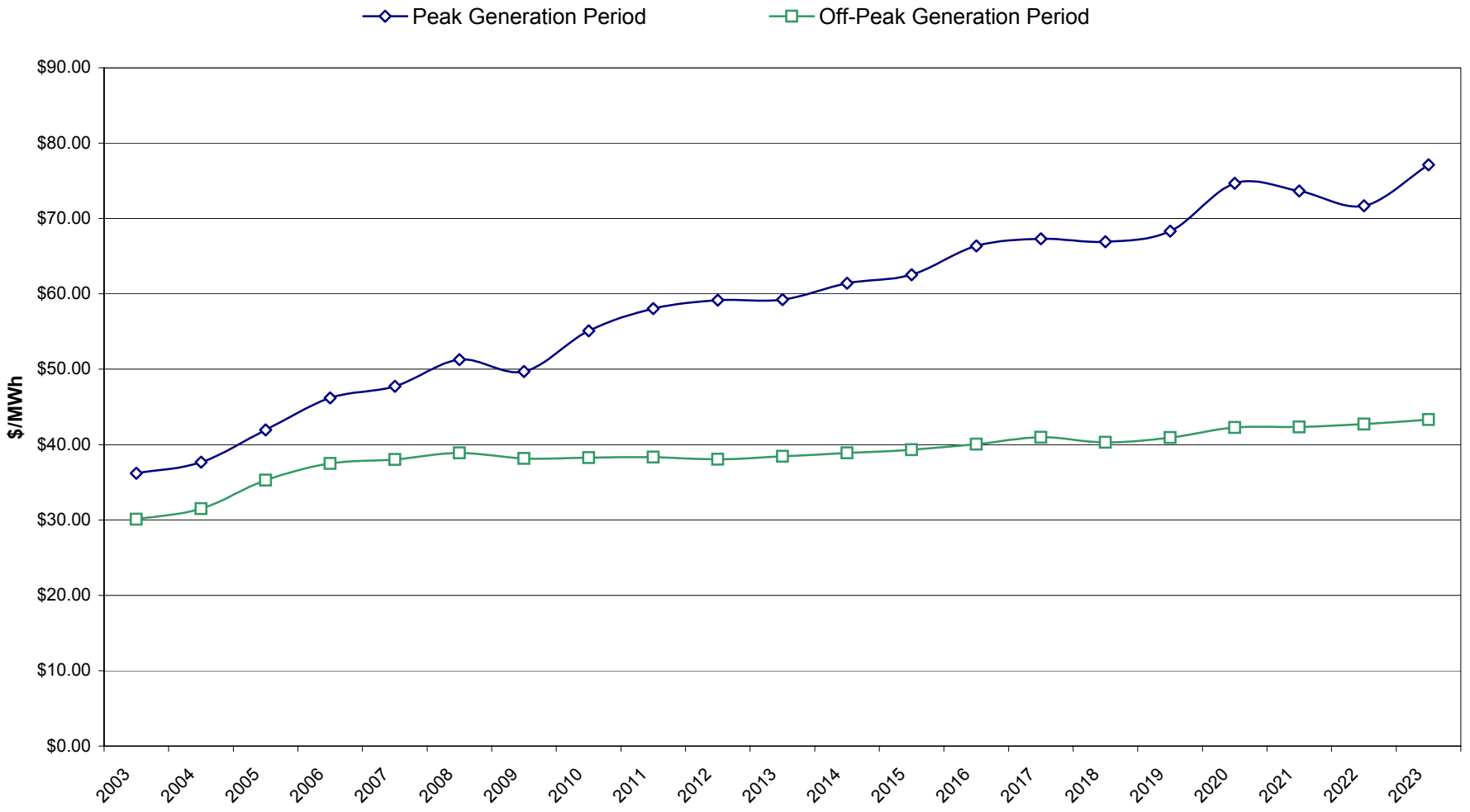
- The Capability to construct artificial periods by selecting seasons within selected/different years for analysis purposes.

PUGET SOUND ENERGY

AURORA MARKET POWER PRICE FORECAST

SOURCE: DRAFT LEAST COST PLAN (CASE I)

March 31, 2003



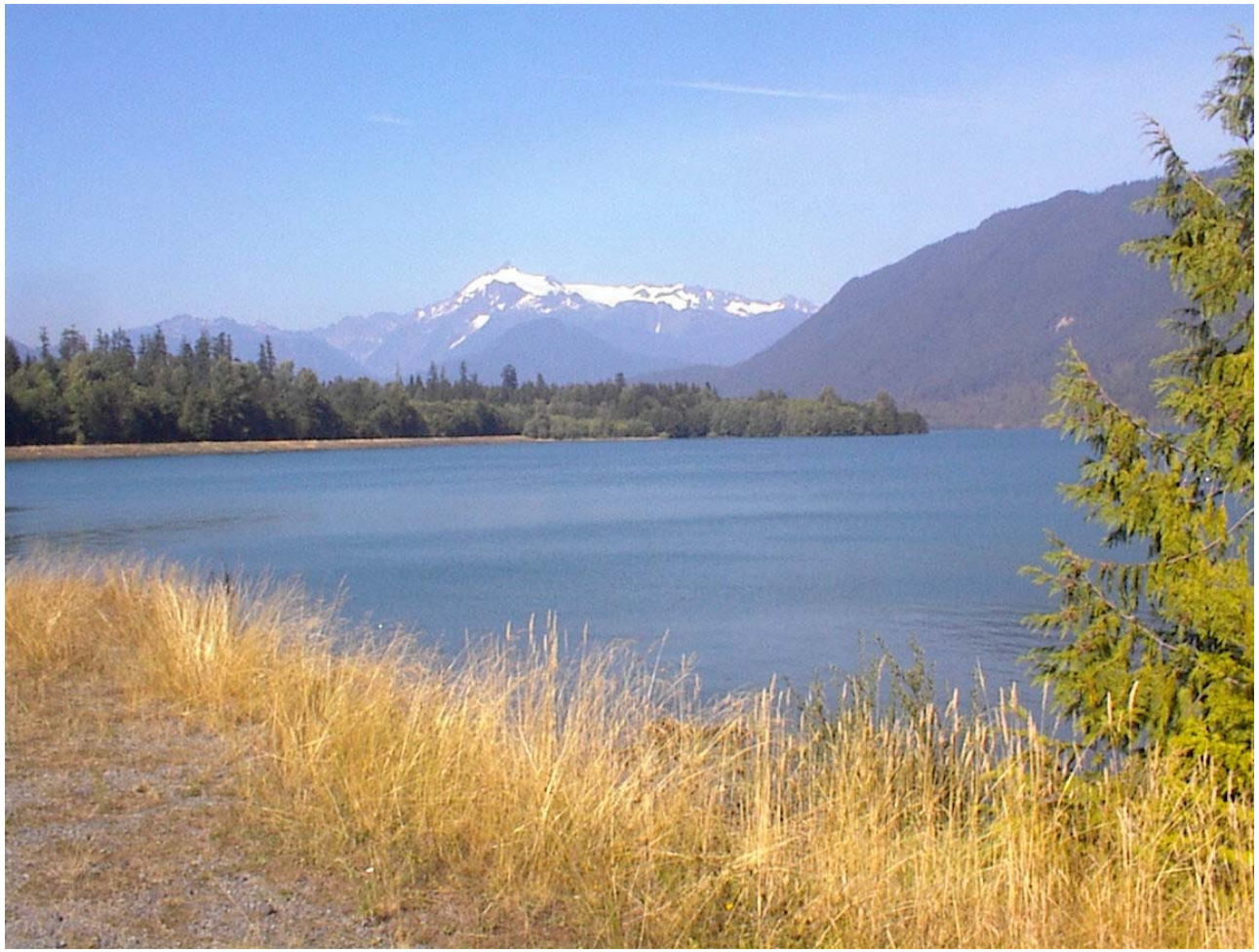
Constraint Prioritization

Please complete the yellow area in the table below by assigning relative points to each operational constraint category, Out of 100 total points, assign the highest rank the highest points. It is possible to assign no points to a category.

Constraint	Relative Points
Flow Ramping	
Minimum Instream Flow	
Minimum Reservoir Levels	
Maximum Reservoir Levels	
Minimum Powerhouse Release	
Maximum Spill	
Total Points	***0***
Points must total 100	

The Use of Ranked Soft Constraints in HYDROPs Modeling

June 6, 2003 TST Meeting, Bellevue, WA



The following material supports copyrighted products by Puget Sound Energy in support of the Baker Relicensing. The material presented is in draft form.

The next two slides show how the soft constraints were ranked in two scenarios (Run 38 and Run 40). Run 38 favors a low level water quality soft constraint in Lake Shannon and minimum instream flow below Lower Baker (both at rank 1) while Run 40 changes these two parameters to rank 4 and moves minimum Upper Baker Powerhouse flows to rank 1.

HYDROPS RANKED CONSTRAINTS - EMPHASIS WQ & FLOW (RUN 38)

Ranked Constraints

Ranked Constraints

The following list indicates the rank of soft constraints that will be applied in the optimization.
If a constraint must be violated to ensure feasible operations, the soft constraints will be violated in reverse rank.

Rank	Constraint	Location	Time Period & Value
1	Min Level	Lake Shannon	n/a
1	Min Release	Baker R. at Gage	n/a
1	Max Level	Baker Lake	n/a
2	Flow Ramping	Skagit R. at Baker R.	Jan 01, 1980 12:00 AM - Dec 31, 2003 12:00 AM, 12:00 AM - 11:00 PM Daily, -2000 cfs/hr
2	Flow Ramping	Lower Baker PH	Jan 01, 1980 12:00 AM - Dec 31, 2003 12:00 AM, 12:00 AM - 11:00 PM Daily, -2000 cfs/hr
3	Min Level	Baker Lake	n/a
4	Max Level	Lake Shannon	n/a
5	Min PH Discharge	Upper Baker PH	n/a

HYDROPS RANKED CONSTRAINTS - EMPHASIS POWER (RUN 40)

Ranked Constraints

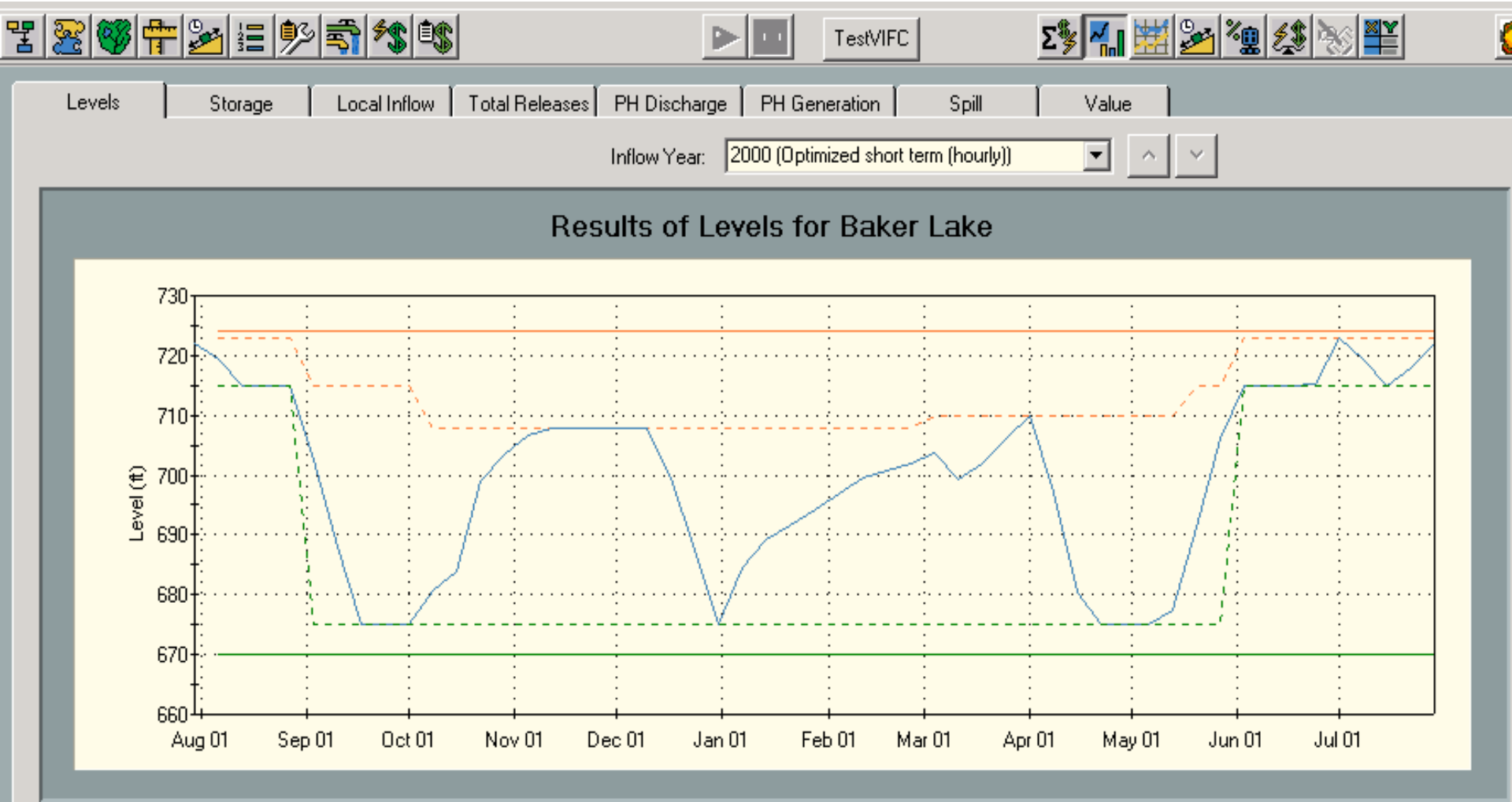
Ranked Constraints

The following list indicates the rank of soft constraints that will be applied in the optimization.
If a constraint must be violated to ensure feasible operations, the soft constraints will be violated in reverse rank.

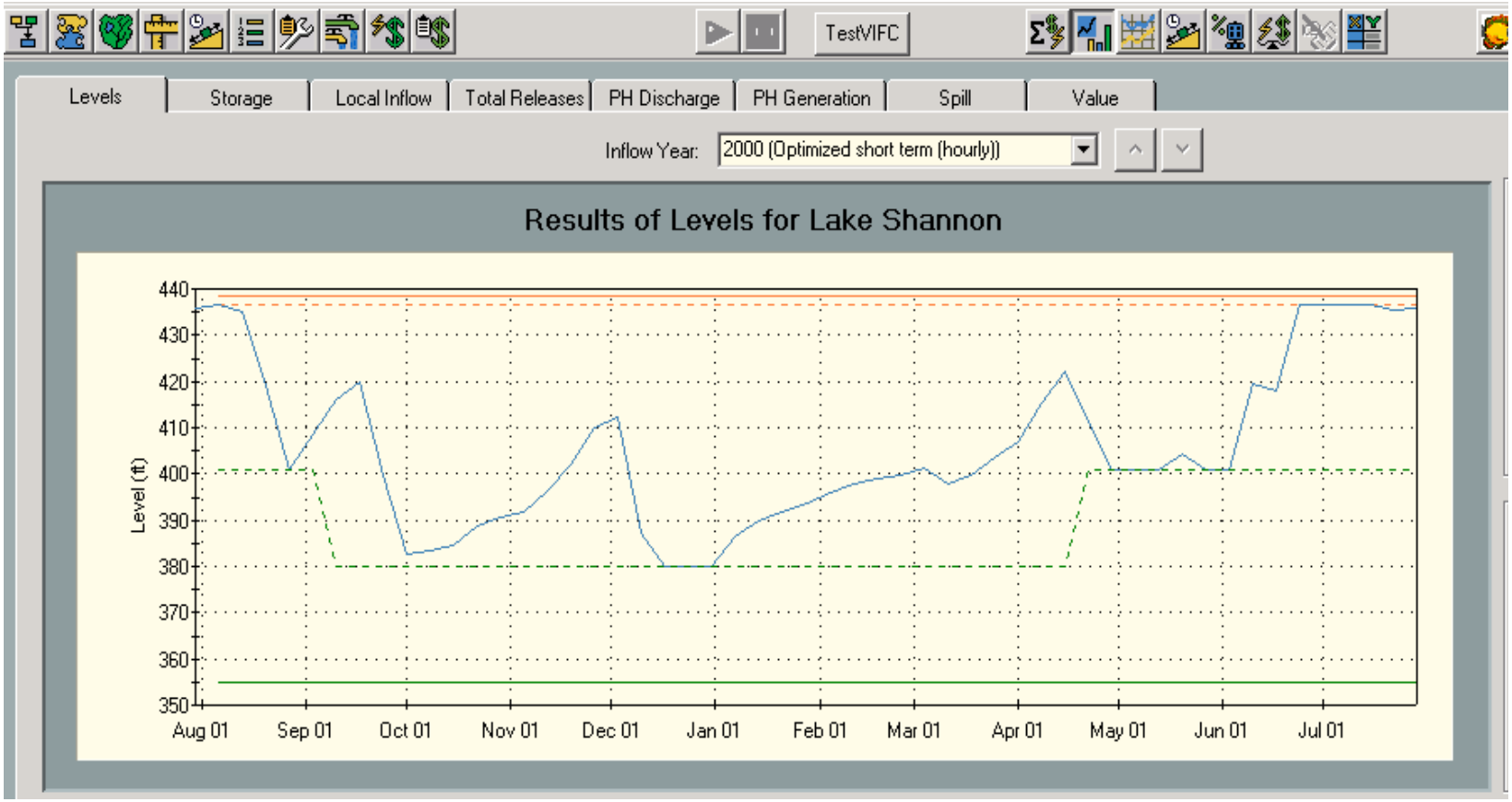
Rank	Constraint	Location	Time Period & Value
1	Min PH Discharge	Upper Baker PH	n/a
1	Max Level	Baker Lake	n/a
2	Flow Ramping	Skagit R. at Baker R.	Jan 01, 1980 12:00 AM - Dec 31, 2003 12:00 AM, 12:00 AM - 11:00 PM Daily, -2000 cfs/hr
2	Flow Ramping	Lower Baker PH	Jan 01, 1980 12:00 AM - Dec 31, 2003 12:00 AM, 12:00 AM - 11:00 PM Daily, -2000 cfs/hr
3	Min Level	Baker Lake	n/a
4	Min Level	Lake Shannon	n/a
4	Min Release	Baker R. at Gage	n/a
5	Max Level	Lake Shannon	n/a

The next four slides show how the reservoir levels were set by HYDROPs at both projects. Note that the results are identical for both runs and changing the order of constraints did not impact reservoir levels in this case.

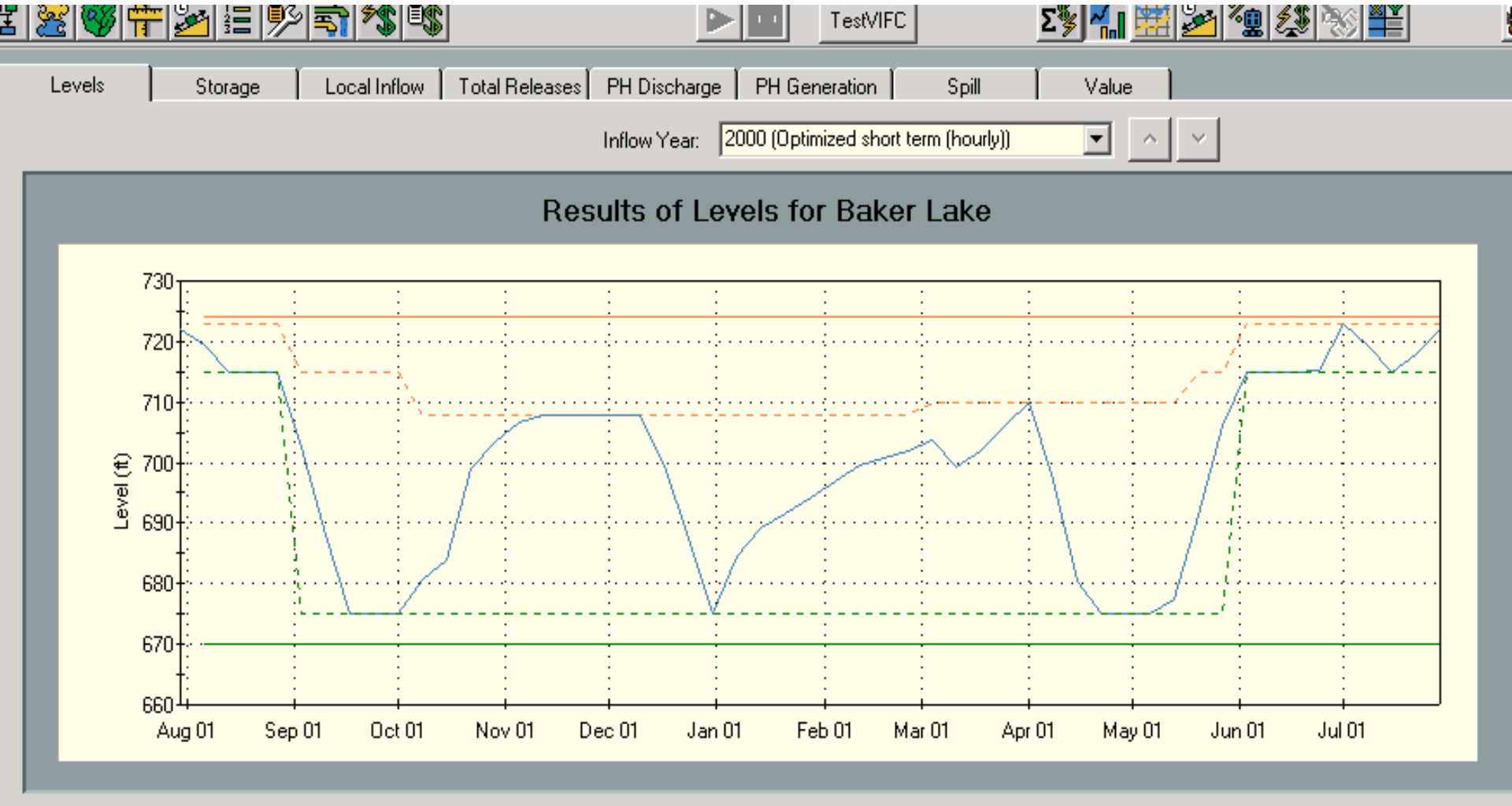
HYDROPS UPPER BAKER LEVELS WQ FLOW (RUN 38)



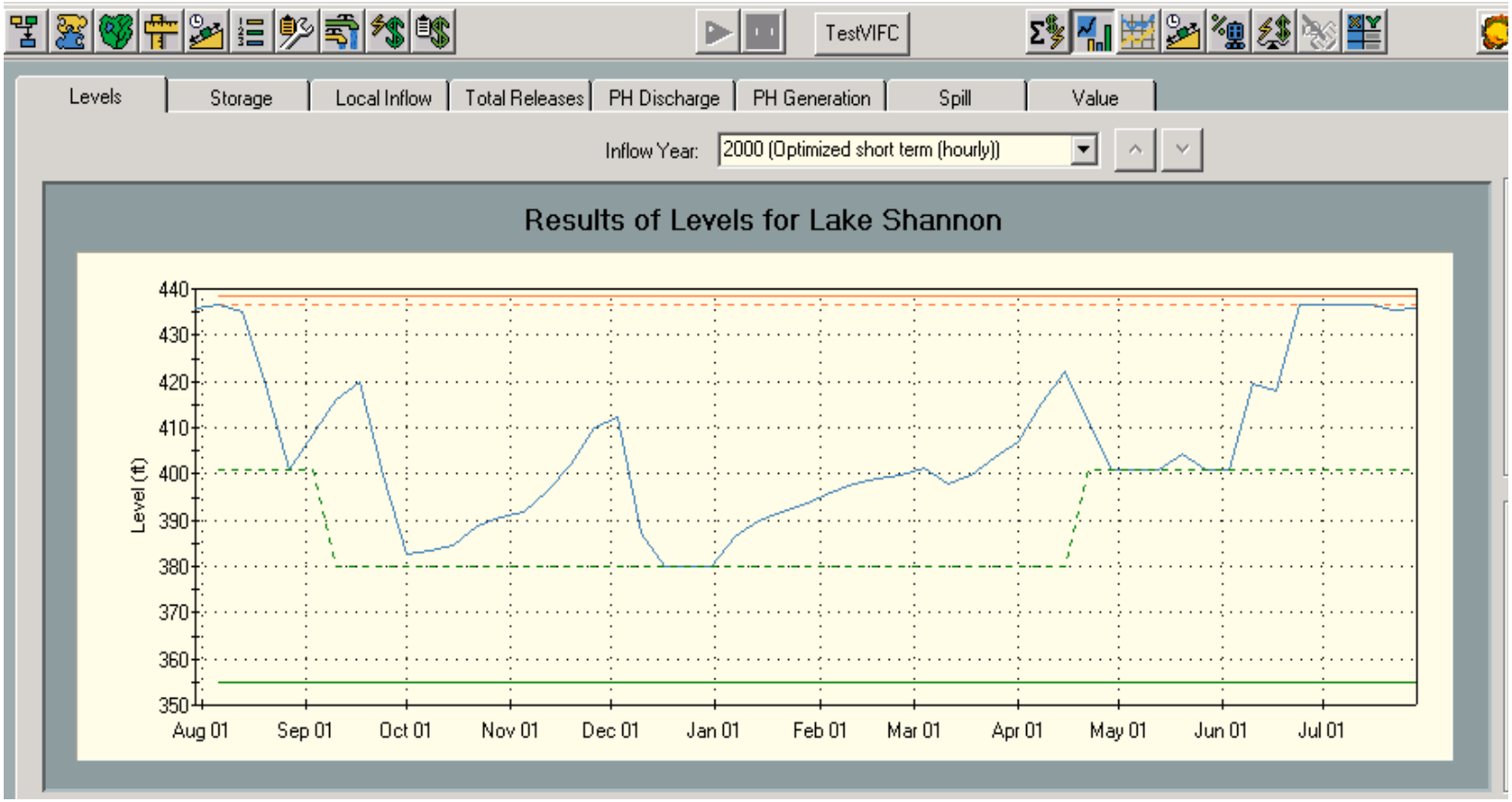
HYDROPS LAKE SHANNON LEVELS - EMPHASIS WQ FLOW (RUN 38)



HYDROPS UPPER BAKER LEVELS - EMPHASIS POWER (RUN 40)



HYDROPS LAKE SHANNON LEVELS - EMPHASIS POWER (RUN 40)



The next two slides show some standard reports on constraint violations from the HYDROPs model. Note that minimum Baker Lake constraints were ranked 3 in both - so there was no change. Note that run 40 shows 18 hours of instream flow constraint violations while run 38 shows none.

HYDROPS SENSITIVITY CONSTRAINT REPORT

Baker River Project

HYDROPS Study Model Summary Output

Scenario Title: Run 38 like 37 w/401 LB & PH #5
Run No: 1340
Requested By: Administrator
Created: Jun 03, 2003 03:15 PM

Soft Constraints Violation Frequency Summary For Year Starting Jul 30

Start Date	Rank 1 Min Level at Lake Shannon	Rank 1 Min Release at Baker R. at Gage	Rank 1 Max Level at Baker Lake	Rank 2 Flow Ramping at Skagit R. at Baker R. ConstraintID:1*	Rank 2 Flow Ramping at Lower Baker PH ConstraintID:2*	Rank 3 Min Level at Baker Lake	Rank 4 Max Level at Lake Shannon	Rank 5 Min PH Discharge at Upper Baker PH
2000						47		
Total						47		

* See listing report for details of constraint definition.

HYDROPS SENSITIVITY CONSTRAINT REPORT

Baker River Project

HYDROPS Study Model Summary Output

Soft Constraints Violation Frequency Summary For Year Starting Jul 30

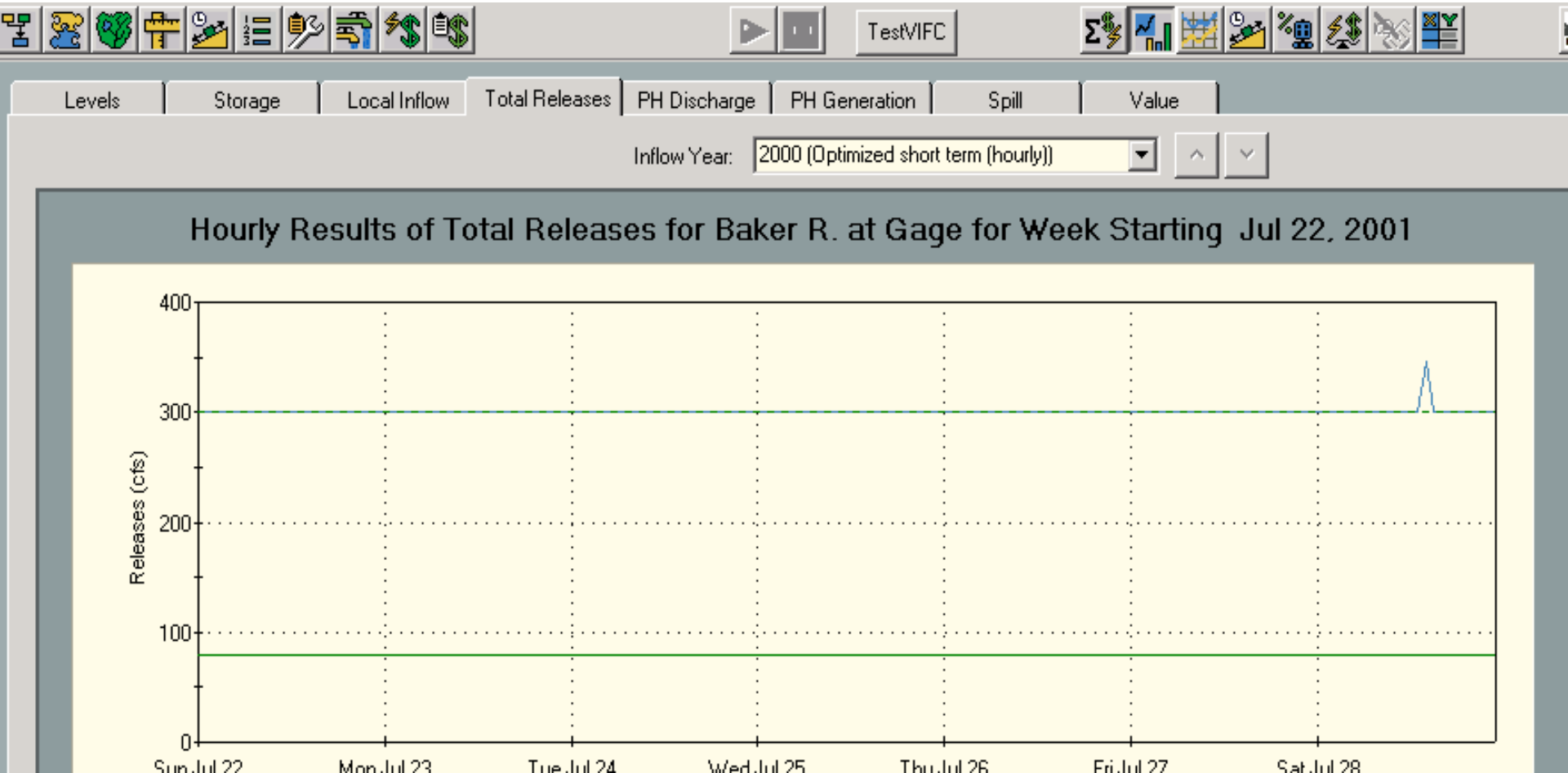
Scenario Title: Run 40 like 39 with QPH #1
Run No: 1342
Requested By: Administrator
Created: Jun 03, 2003 03:59 PM

Start Date	Rank 1 Min PH Discharge at Upper Baker PH	Rank 1 Max Level at Baker Lake	Rank 2 Flow Ramping at Skagit R. at Baker R. ConstraintID:1*	Rank 2 Flow Ramping at Lower Baker PH ConstraintID:2*	Rank 3 Min Level at Baker Lake	Rank 4 Min Level at Lake Shannon	Rank 4 Min Release at Baker R. at Gage	Rank 5 Max Level at Lake Shannon
2000					47		18	
Total					47		18	

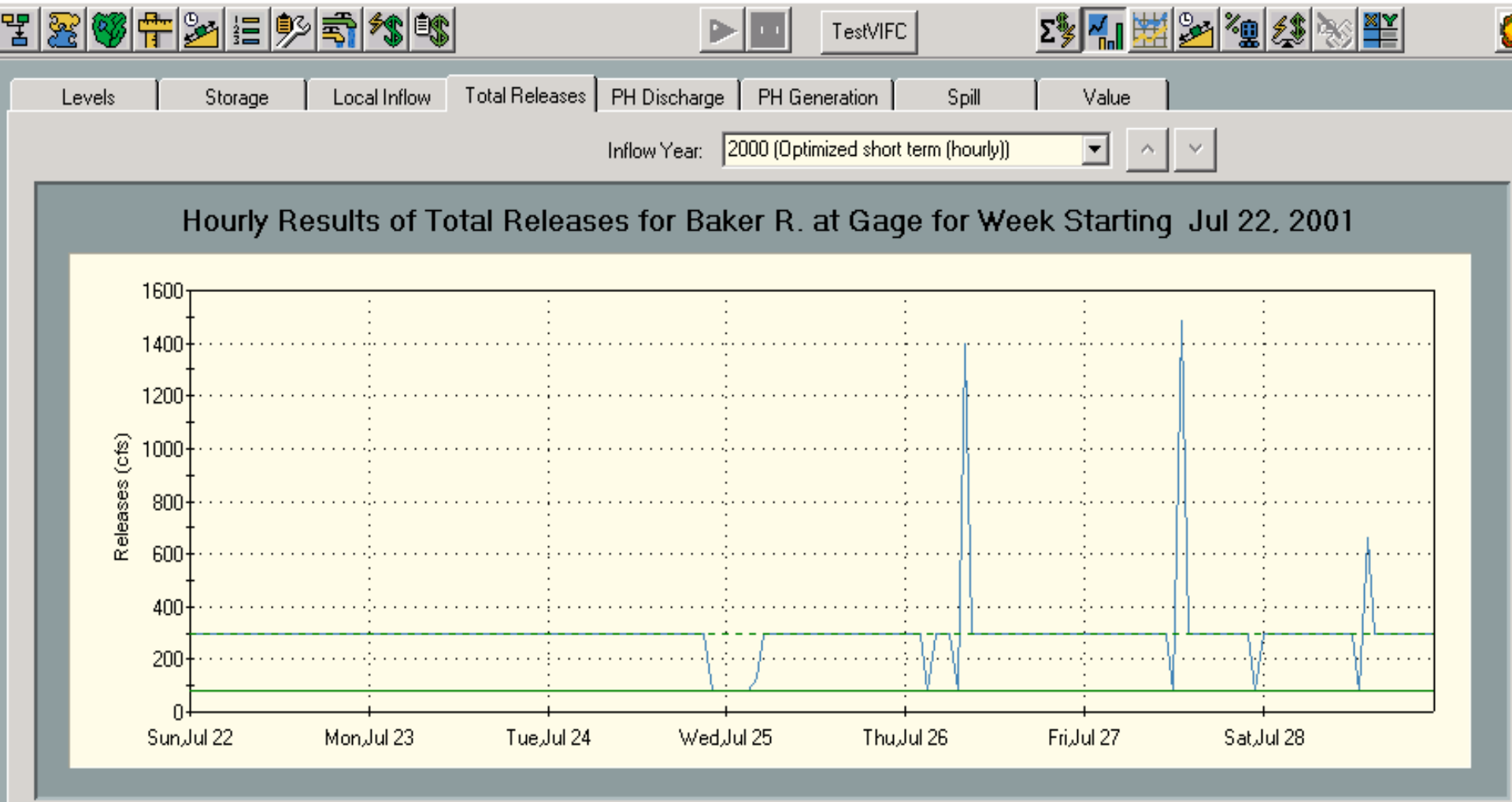
* See listing report for details of constraint definition.

The next two slides show time series plots during late July 2001 for flows below Lower Baker Powerhouse. Run 38 shows no violations, while Run 40 shows several hours were not in compliance.

HYDROPS MIN FLOW VIOLATIONS (NONE) EMPHASIS WQ FLOW (RUN 38)

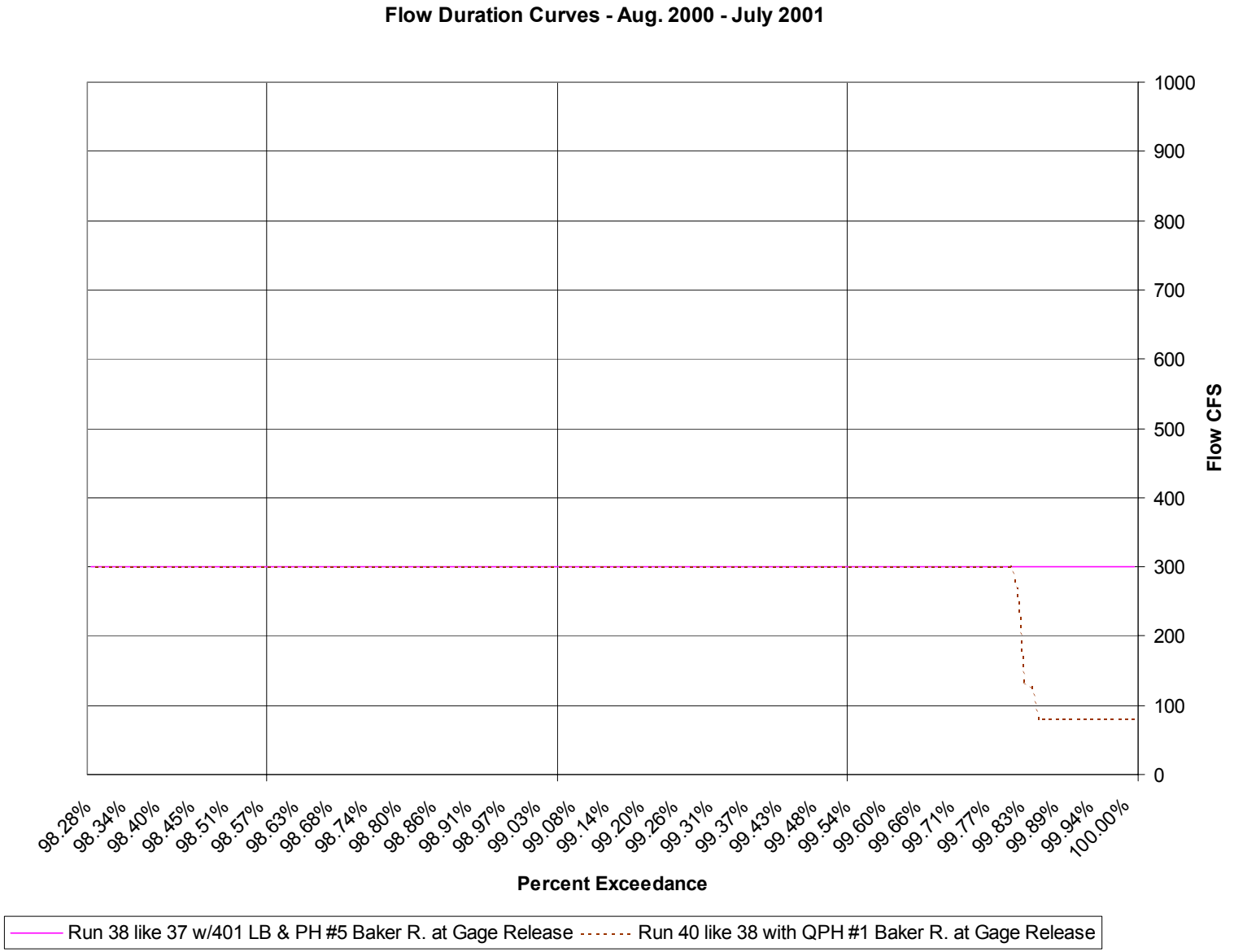


HYDROPS MIN FLOW VIOLATIONS EMPHASIS POWER (RUN 40)



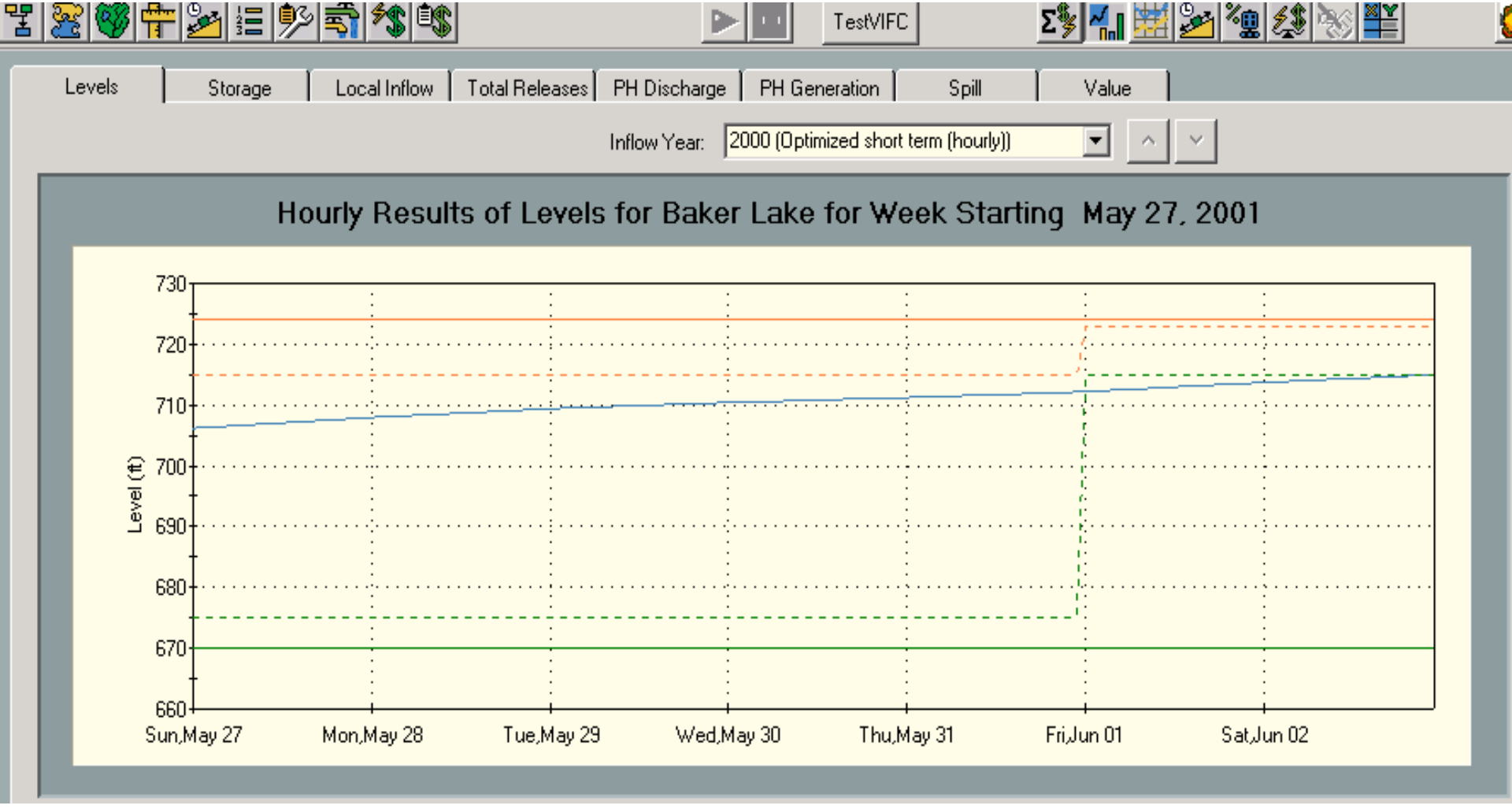
The next slide shows the far end of the flow duration curves for Run 38 and Run 40. Again note the non-compliance in Run 40 with the 300 cfs target flow.

HYDROPS MIN FLOW LOWER BAKER



The next slide shows the nature of the minimum lake level violation at Baker Lake. It occurs during an abrupt transition. Such violations could likely be overcome by specifying a smoother transition or by making sure the constraint was set at the end of the previous week.

HYDROPS MIN LEVEL VIOLATIONS - EMPHASIS WQ FLOW (RUN 38 - 40 IS SIMILAR)



SOME CONCLUSIONS

- Lake levels soft constraints are set in the long-term optimization
- Lake levels generally met except at abrupt transitions
- Minimum flow allocations - though set in long-term may be over-ridden in short-term if soft constraint ranked low enough

SOME CAVEATS

- Model being upgraded for more robust ramping function
- These runs were made in deterministic mode. Forecast mode is being debugged and might change results
- A more standardized price schedule is also being developed by PSE as has been discussed in the Econ/Ops Workgroup

R2 Resource Consultants, Inc.

15250 NE 95th Street
Redmond, WA 98052-2518
Phone: (425) 556-1288
Fax: (425) 556-1290
E-mail: mail@R2usa.com

Memorandum

Date: June 6, 2003 Project Number: 1380.07

To: Paul Wetherbee, PSE

From: R2 Resource Consultants

Subject: Baker River Project Relicensing, Representative annual periods for hourly analysis of mainstem Skagit River flows based on ratios of fall flows (salmon spawning) to winter flows (salmon incubation) using updated daily flow records

Target Years for Analysis

An initial step to evaluating project alternatives often involves identifying various hydrologic periods that demonstrate a range of anticipated flow conditions. Sometimes, specific years are selected because they display the range of low, medium, and high volume of annual runoff. Additional years may be selected to describe the seasonal range of dry, average, and wet conditions. However, for the Baker Project, the relationship between flows during the fall salmon-spawning season and those during the following winter incubation season are a primary consideration for evaluating the environmental effects of hydropower operations. Consequently, it is important to also evaluate periods that reflect the hydrologic variability affecting flows during the salmonid spawning and subsequent incubation periods.

Recognizing that operation of the Skagit River Project was recently modified during FERC relicensing, we restricted our preliminary selection to daily flow records for the years 1991 through 2002. We developed three hydrologic indices to aid in selecting specific years; two of the indices relate to the relationship between flows during an assumed salmon spawning season and those during a subsequent incubation season, and the third index provides an indication of overall water availability. The indices are:

1. R1 - The ratio of the average river flow (cfs) during the months of September through November (assumed spawning period) to the average river flow during the months of December through February (assumed incubation period) for each energy-year.

2. R2 - The ratio of the average river flow (cfs) during the month of October (assumed peak chinook spawning period) to the minimum 7-day rolling average river flow during the months of December through February (assumed incubation period) for each energy-year.

3. R3 - Ratio of mean annual flow for each water-year to the mean annual flow for the period of record.

Several of the analyses were conducted using annual hydrologic periods extending from August 1 through July 31. This period is referenced as an "energy-year" for calculating hydropower production, and also encompasses the spawning and subsequent incubation periods for fall spawning salmonids. Energy-years are referenced as the year containing the July records; that is, energy-year 1991 extends from August 1, 1990 through July 31, 1991. Calculations of the third index used water-years, which extend from October 1 through September 30, and are referenced as the year containing the September records; that is, water-year 1991 extends from October 1, 1990 through September 30, 1991.

Synthesized flow records for the "Baker River at Concrete" USGS gage site (RM 0.7) under unregulated conditions (energy years 1990-2002) were used to describe the Baker River flow regime. The daily flow records used in the analyses reflect updated reservoir storage-elevation relationships based on 2001 topographic data. Our analyses of the Baker River flows indicate that energy-year 1995 describes a low risk condition for fall spawning and incubating salmonids, and energy-years 1996 and 1993 represents a moderate to high-risk condition for spawning and incubating salmonids (Table 1). Water-year 1993 (89% exceedance), 1995 (52% exceedance) and 1996 (11% exceedance) also reflect a range of dry, average and wet Baker River conditions when comparing mean annual flow for the water-year to the mean annual flow for the period of record (1975 to 2002).

A similar analysis of the three indices was conducted using actual daily flows at the "Skagit River near Concrete" USGS gage (No. 12194000) for the period 1991-2002 to describe regulated conditions in the mainstem Skagit River. Flow conditions at this gage site during this period reflect operation of the Baker River and Skagit River hydroelectric projects and natural runoff patterns in unregulated watersheds, such as the Sauk River. Our analyses of mainstem Skagit River flows indicates that energy year 1995 describes a low risk condition for fall spawning fish, energy-year 1996 describes a moderate risk condition, and energy-year 2001 reflects a high risk condition for fall spawning and incubating salmonids (Table 2). Water-years 2001, 1995, and 1996 reflect a range of dry, average and wet Skagit River conditions when comparing mean annual flow for the year to the mean annual flow for the period of record.

Based on these analyses, we suggest that energy-years 1995 and 1996 are obvious choices, while 2001 reflects an extreme condition under regulated Skagit River conditions and 1993 reflects an

extreme condition for unregulated Baker River flows. These four years also provide a range in hydrologic variability for project alternative evaluation. This evaluation does not consider any specific anomalies in the operation of either the Skagit River Project or the Baker River Project. Anomalies, such as extended outages during major maintenance, could affect selection of representative years for the mainstem Skagit River.

The results of these analyses suggest that there is little correlation between the flow conditions during the fall and flow conditions during the subsequent winter and early spring. This lack of correlation is partially due to the overriding influence of storm events on runoff. The effects of snowpack melting are exhibited as sustained high flow levels in May and June and do not significantly affect winter flows. These analyses were only intended to identify target years to conduct initial HYDROPS runs and generalized assumptions regarding salmon spawning and incubation were used for planning purposes. More detailed analyses of the relationship between spawning and incubation flows for specific species will be conducted as part of Aquatics Study A-09 Instream Flow Management.

Table 1. Indices of salmonid spawning and incubation flows and mean annual flow using synthesized, unregulated flows for the Baker River at USGS site (RM 0.7). Daily flow data were calculated using reservoir storage

Ranked by Ratio R1

Degree of Risk	Energy Year	mean Q (Sep-Nov)	mean Q (Dec-Feb)	Ratio
high	2000	3,118	2,089	0.67
	1993	1,900	1,336	0.70
	1998	3,040	2,280	0.75
	2001	1,653	1,283	0.78
	1991	4,214	3,320	0.79
	1996	4,163	3,456	0.83
	1990	2,836	2,464	0.87
	1997	2,406	2,928	1.22
	1999	1,964	2,901	1.48
	1992	1,884	2,902	1.54
	1994	1,171	2,489	2.13
low	1995	1,451	3,530	2.43

Ranked by Ratio R2

Degree of Risk	Energy Year	mean Q (Oct)	min 7-day ave (Dec-Feb)	Ratio
high	1996	3,132	903	0.288
	2001	2,058	607	0.295
	1991	3,598	1,104	0.31
	1998	3,844	1,187	0.31
	1993	1,620	543	0.34
	2000	2,632	974	0.37
	1997	2,795	1,171	0.42
	1994	1,411	826	0.59
	1990	1,746	1,072	0.61
	1995	1,361	1,089	0.80
	1999	1,208	1,279	1.06
low	1992	930	1,293	1.39

Ranked by Ratio R3

Annual Flow	Water Year	annual mean Q	Ratio
high	1991	3,448	1.32
	1997	3,387	1.29
	1996	3,108	1.19
	1999	3,100	1.18
	2000	2,827	1.08
	1990	2,801	1.07
	1995	2,531	0.97
	1998	2,403	0.92
	1992	2,297	0.88
	1994	2,262	0.86
	1993	2,110	0.81
low	2001	1,846	0.71

highlighted years are proposed for initial HYDROPS runs

Mean Annual Q = 2,626 cfs
90% exceedance Q = 2,079 cfs
10% exceedance Q = 3,188 cfs
Period of record: 1975 to 2002

R1: Ratio of the average daily flow during the months of September through November (assumed spawning period) to the average daily flow during the months of December through February (assumed incubation period) for each energy-year

R2: Ratio of the average daily flow during the month of October (assumed peak chinook spawning period) to the minimum 7-day rolling average river flow during the months of December through February (assumed incubation period) for each energy-year.

R3: Ratio of mean annual flow for each water-year to the mean annual flow for the period of record (1975-2002).

Table 2. Indices of salmonid spawning and incubation flows and mean annual flow using daily flow records (cfs) from the USGS gage site Skagit River near Concrete (No. 12194000). Records describe flow conditions regulated by operation of Baker River Hydroelectric Project (FERC No. 2150) and Skagit River Hydroelectric Project (FERC No. 553).

Ranked by Ratio R1

Degree of Risk	Energy Year	mean Q (cfs) (Sep-Nov)	mean Q (cfs) (Dec-Feb)	Ratio R1
high	2001	10,130	7,892	0.78
	1998	16,536	13,990	0.85
	1991	25,037	22,730	0.91
	2000	16,270	16,044	0.99
	1993	9,675	9,853	1.02
	1996	22,037	24,243	1.10
	1997	12,812	17,777	1.39
	2002	12,535	18,732	1.49
	1992	10,797	17,076	1.58
	1994	7,260	13,049	1.80
	2003	7,163	12,953	1.81
	1999	9,382	17,343	1.85
low	1995	8,902	19,269	2.16

Ranked by Ratio R2

Degree of Risk	Energy Year	mean Q (cfs) (Oct)	min 7-day rolling ave (cfs) (Dec-Feb)	Ratio R2
high	1998	20,219	9,889	0.49
	2001	10,954	6,456	0.59
	1997	13,710	10,030	0.73
	1991	17,089	12,786	0.75
	1993	8,536	6,481	0.76
	2000	12,310	10,920	0.89
	1996	15,005	13,514	0.90
	2002	10,447	9,691	0.93
	1995	8,050	8,343	1.04
	1992	7,385	8,459	1.15
	1994	6,646	8,504	1.28
	2003	4,315	5,957	1.38
low	1999	6,158	11,857	1.93

Ranked by Ratio R3

Annual Flow	Water Year	annual mean Q	Ratio R3
high	1991	21,273	1.41
	1997	19,472	1.29
	1996	18,924	1.25
	2002	17,929	1.19
	1999	16,872	1.12
	2000	16,305	1.08
	1995	14,038	0.93
	1998	13,778	0.91
	1992	12,589	0.83
	1994	11,950	0.79
	1993	11,357	0.75
low	2001	9,512	0.63

highlighted years are proposed for initial HYDROPS runs

Mean annual Q = 15,088 cfs
90% exceedance Q = 11,523 cfs
10% exceedance Q = 19,241 cfs
Period of record: 1925 to 2002

R1: Ratio of the average daily flow during the months of September through November (assumed spawning period) to the average daily flow during the months of December through February (assumed incubation period) for each energy-year

R2: Ratio of the average daily flow during the month of October (assumed peak chinook spawning period) to the minimum 7-day rolling average river flow during the months of December through February (assumed incubation period) for each energy-year.

R3: Ratio of mean annual flow for each water-year to the mean annual flow for the period of record (1976-2001).

R2 Resource Consultants, Inc.

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To: Paul Wetherbee, PSE
From: R2 Resource Consultants
Date: June 2, 2003
Subject: Baker River Project Relicensing
Representative periods for analysis of hourly flows in the mainstem Skagit River

Based on the attached response from Dave Pflug-Seattle City Light biologist working on the Skagit River Hydroelectric Project, and a brief independent review of daily flow patterns, we suggest that the period August 1, 1990 through September 30, 2002 be used to analyze hourly flows in the mainstem Skagit River. This provides us with a 12-year period of record using either Water Years (Oct 1 – Sep 30) or Energy Years (Aug 1 – July 31).

Since salmon spawning begins in late August or September and incubation continues through the following spring, we suggest that using annual periods starting August 1 through the following July 31 will provide an easy way to track year to year comparisons. These time periods coincide with 'energy years' and also reflect basin runoff patterns. The annual period will be referenced by the year containing the last month; that is, August 1, 1990 through July 31, 1991 will be referenced as Energy Year 1991.

(Note that contrary to Dave Pflug's e-mail, the Skagit River Project Fisheries Settlement Agreement was signed in April 1991.)

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-----Original Message-----
From: Dave Pflug [mailto:Dave.Pflug@ci.seattle.wa.us]
Sent: Thursday, March 20, 2003 1:59 PM
To: philgert@r2usa.com
Subject: Re: Skagit River Project operational history

Phil -  here is something that I hope responds to your request.

What follows are some periods of operation that are independent of each
other:

Prior to 1980 - we operated under the original license -  our
operational patterns are radically different now as you know.

Interim Flow Agreement Period -  from 1980 through 1989 we were
operating under the conditions of an interim agreement while doing
studies to help develop future license conditions.  This period
reflects some changes in minimum flow/max flow and ramping rates.  Not
the most accurate indicator of future operations.
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Final Agreement Period: (1990-present) The Fisheries Settlement Agreement was signed in 1990. We implemented it voluntarily until receiving our license in 1995. The changes during this period reflect an additional layer of change. This period is what I would consider to be the best indicator of future operations. Operational flexibility is built into the Settlement Agreement. Because of this, the range of operational flow patterns is much wider than for a project with set levels of minimum and maximum flows. For example, we operate differently during dry, normal and wet conditions. Finally, I would also say that the energy crisis has not measurably impacted our operations during the last couple of years. More accurately, the crisis has caused us to look more closely at voluntary actions. but has not prohibited us from taking them. I don't see this changing in the next few years...

Dave Pflug
Fisheries Scientist
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(206) 386-4574
dave.pflug@ci.seattle.wa.us

>>> "Phil Hilgert" <philgert@r2usa.com> 03/20/03 09:40AM >>>
Dave,

I am working with PSE to evaluate alternative operational scenarios for the Baker River Project. In addition to evaluating effects of Baker Project operations on reservoir pool levels and releases to the lower Baker River, we will want to route Baker River flows into the Skagit River and evaluate the effects of flow fluctuations on habitats in the middle Skagit River. Powel, Ltd. has developed a HYDROPS operational model of the Baker Project and will be running the power production/reservoir fluctuation side of the analyses. They have a long period of record for Baker and Sauk River flows and can obtain flow data for the Upper Skagit River as well. We will be routing the alternate Baker operational scenarios through habitat models developed for the middle Skagit River below the Baker confluence. Can you identify general periods or trends in Skagit River Project operations that would allow us to characterize years or periods with respect to potential future operations? For instance, my copy of the Skagit River Project fisheries settlement is dated April 1991, but I thought it was not signed until several years later - so the periods might be:

Pre - 1991 Pre-fisheries Settlement Agreement: minimum flows and ramping rates are less restrictive than identified in Settlement Agreement, seasonal and hourly flow patterns (Skagit River at Newhalem) are not indicative of future operations.

1991-1994 Interim Settlement Agreement Operations: minimum flows and ramping rates undergoing minor modifications, but generally follow Settlement Agreement, seasonal and hourly flow patterns are adequate indicator of future operations.

1995 - 2000 Post Settlement Agreement: minimum flows and ramping rates meet Settlement conditions, but Project may be operated to benefit habitat above that required by Settlement, seasonal and hourly flow patterns of this period are best indicators of future operations.

2001 - 2003 Post Energy Crisis: Minimum flows and ramping rates meet Settlement conditions, but extra environmental benefits are lower priority than energy production. Seasonal and hourly flow patterns are adequate but not preferred as indicators of future operations

If you have questions, call me at (425/556-1288).

Phil Hilgert
R2 Resource Consultants