Commentary on the Klamath Basin Restoration Agreement, And Suggested Actions to Facilitate NEC Support
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The Klamath Basin Restoration Agreement relegates salmon and the Klamath River ecosystem to the status of junior water users, while Upper Basin irrigators become the senior water users. This premise squarely places onto the salmon and the river ecosystem any risk inherent in the conclusion that flows contained in the Agreement will actually provide enough water for recovery of the species. Nowhere is this clearer than in the future allocation of water.

Quantitative goals for fish and the river ecosystem, conspicuously missing from the Settlement Agreement, are necessary to establish how much improvement (benefit) is required for restoration. While the WRIMS R32/Refuge streamflows would be an improvement over present annual flow regimes, the Settlement Agreement does not assure that these modeled streamflows can meet the Draft's stated goals. Simply listing and/or modeling benefits to salmon, attributable to WRIMS R32/Refuge modeled streamflows, does not constitute/assure that a viable restoration strategy is in place.

WRIMS R32/Refuge was not meant as an instream flow recommendation for restoring salmon populations in their native river environment below Upper Klamath Lake. Yet the closest language to an instream flow recommendation in Draft 11 of the Settlement Agreement (p.103) implies otherwise: "(3) Flow and lake level management should strive to meet the lake level and flow outputs from the WRIMS R32/Refuge run at the current location of Iron Gate Dam, as presented in Appendix E-5, recognizing such runs may or may not reflect overall water availability at any given time."

Iron Gate streamflows dominate what little substantive accounting of streamflows for salmon and the river ecosystem that exist in the Draft Settlement Agreement. Yet the real 'post-dam action' will be at Keno Dam, which will be the most-downstream remaining mainstem dam and therefore releases from Keno will greatly influence mainstem streamflows. The expectation of achieving the WRIMS 32/Refuge, Hardy Phase II, or any hybrid annual flow regimes at Iron Gate (without the dams) will be realized by Keno Dam releases + downstream accretion from tributaries and springs.

The apparent presumption, given its absence in the available analyses, is that instream flow needs between Keno and Iron Gate will be met by the modeled Iron Gate streamflows (WRIMS 32/Refuge). Beginning at Keno and heading downstream, streamflow accretion from tributaries and springflow (e.g., Boyles Springs) contributes to mainstem flows. We expect dam releases from Keno will factor into these flow sources when targeting a specific streamflow at Iron Gate. These accretion flows do not comprise as large a percentage of the mainstem flows at Iron Gate during wetter portions of the year, but what about drier portions, particularly during the snowmelt recession period and into fall during Chinook spawning? For example, if a targeted 1,000 cfs streamflow on October 1 at Iron Gate would be comprised of 250 cfs of accretion flows (originating between Keno and Iron Gate), would a release of 750 cfs at Keno meet restoration needs in the mainstem near Keno? With the dams out, many salmon will likely congregate below Keno (even with a good ladder system) rather than below Iron Gate. Is 650 cfs as good a spawning flow that will provide abundant spawning habitat, minimize redd overlap, and keep the risk of redd scour low? To our knowledge, mainstem habitat needs above Iron Gate have not been factored into the Phase II instream flow recommendations (and originally, were not intended to).

Daily streamflow gaging by the USGS just below Keno Dam reveals hydrologic chaos. Daily streamflows typically fluctuate wildly. Erratic daily flows are not conducive to restoring salmon populations or the river ecosystem. Two primary causes for the fluctuation are: (1) USBR operations affecting Keno Reservoir inflow/stage and (2) regulation to facilitate hydropower operations downstream to J.C. Boyle Dam. With dam removal, the second cause would be removed. This leaves USBR operations. U.S. Section D of the U.S. Department of Interior, Fish and Wildlife Service 10(j) Recommendations, Klamath Hydroelectric Project – FERC No.2082, pp. D-17 to D-18, states that:

"Flows received at Keno Dam are a combination of flows from Link River and irrigation return water from canals downstream from Link River that return water to Lake Ewauna. Reclamation and PacifiCorp have an agreement that PacifiCorp operate Keno Dam to hold Keno Reservoir within a variance of only 0.5 feet (see Figure 3). The steady reservoir elevation allows Reclamation to manage its irrigation water through its diversion channels from Keno Reservoir, and enables PacifiCorp to more effectively plan downstream load following operations at the J.C. Boyle powerhouse (PacifiCorp 2004c). Approximately 5,900 acre-feet of water storage is provided by the 0.5 foot variance in reservoir elevation, which equates to approximately 30 days of a flow of 100 cfs (Hicks, pers. comm.). Currently, this storage is being utilized to provide flow fluctuations in support of hydroelectric peaking operations at J.C. Boyle Dam, downstream, as shown in Figure 4. We recommend that this storage be used to dampen the unnatural flow fluctuations out of Keno Dam (see Figures 3 and 4) to support better fish habitat."

Without major reservoir storage, highly variable streamflows will be released below Keno Dam to maintain this narrow range in Keno Reservoir's surface elevation. Without the other dams, therefore, mainstem instream flows will be inextricably linked to maintaining the 0.5 ft reservoir stage differential. This major constraint might be adequate if it did not upset the vision for how the mainstem channel and its streamflows from Keno down to Iron Gate (and even farther downstream) will encourage restoration once the other dams are removed. Unfortunately, the Settlement Agreement provides no vision. Monthly flow predictions in WRIMS or Hardy Phase II mask what the daily streamflow releases at Keno Dam would look like.

Tasks to be Completed Prior to NEC's Consideration of Support of the Settlement Agreement

While there are other concerns, the NEC shouldn't support the Settlement Agreement until these specific concerns are addressed quantitatively (i.e., not simply worded as a line item in a future task for the Technical Advisory Team). I recommend the following tasks be accomplished and discussed *before* NEC considers reaching settlement on this issue:

Task No. 1: Compute annual daily average hydrographs (NOT flow duration curves) from WY1961 through WY2000 for (a) daily average Keno Dam releases using WRIMS, (b) daily average Keno Dam releases using the reported Hardy Phase II recommendation, (c) daily average Keno Dam releases using Hardy Phase II modified for the 50th percentile historical unimpaired 'ensemble' series habitat used by Hardy and Saraeva (rather than the lower 10th percentile used in (b)), and (d) daily average streamflows from the USBR Natural Flow model.

Task No. 2: Compute the same annual hydrographs ((1a) through (1d)) for another mainstem location below the J.C. Boyle Bypass Reach to account for daily Spencer Creek streamflows and Boyles Springs accretion.

While highly informative, the utility of accomplishing Task Nos. 1 and 2 will be greatly hampered without accomplishing this follow-up task:

Task No. 3: Assemble/take landscape photographs at 15 to 20 locations downstream of Keno Dam (but upstream of the Copco dams) over a 500 cfs to 3,000 cfs range of streamflows, particularly between 1,000 cfs to 2,500 cfs at locations capable of providing good fry, juvenile, and smolt Chinook rearing habitat.

I recommend applying task (3) as a preliminary, visual instream flow tool from which to make sense of Task Nos. 1 and 2. PacifiCorp's instream flow assessment also should be consulted, though it does not span the range of desired streamflows. All parties can interpret these river habitat photographs and make their own preliminary assessment of whether the Iron Gate WRIMS and Phase II streamflows presented/not presented in the Settlement Agreement have a reasonable capability of providing good habitat conditions above Iron Gate. For example, Thomas Dunklin took a number of such photographs for CalTrout as exhibits for the 2006 hearing (Dept. Commerce, NOAA, NMFS, Klamath Hydroelectric Project Docket No. 2006-NMFS-0001 FERC Proj. No. 2082) in which I testified.

The resource agencies can offer a preliminary instream flow recommendation (and an accompanying rationale for it) using the photographs and other evidence/data. Their recommendation may not be binding in the Settlement Agreement, but it must demonstrate to the Parties that the 'junior' users' flows will be enough to restore the fishery … or not. The agencies should present their criteria for 'what is enough?' in their logic for estimating annual instream flows. For example, providing good hydrologic years for salmon populations will be as, or more, important than preventing bad years (i.e., perhaps a more refined assessment mentioned in my first commentary, November 7, 2007). How will the agencies incorporate this important concept into their actual annual instream flow recommendations?

This preliminary instream flow assessment needn't take months or comprise a lengthy report. In large part, the timeframe would hinge on getting photographs in the range of 1,000 cfs to 2,500 cfs. The outcome of this assessment should become part of the Settlement Agreement, for example in an appendix, as a counterweight to extensive and detailed provisions allocating water use. Minimally, I recommend presenting these instream flow assessments in a similar bimonthly (daily preferred) format, and for the same water years, as Table 2 in Appendix E-5 of the Settlement Agreement for at least two upper Klamath River mainstem locations: (1) just below Keno and (2) just below Iron Gate. Other sites should be considered in the future, but would not be vital at this stage, e.g., select a site downstream of the Boyles Dam bypass mainstem reach and another just upstream of the Shasta River confluence. Table 2 presents modeled monthly or bi-monthly (during the snowmelt period) instream flows for WY1961 through WY2000 using WRIMS 32/Refuge. However, if Tasks (1) and (2) are accomplished, the format should provide annual daily average hydrographs and monthly streamflows. Several uncertainties should be explicitly addressed as capably as possible with the existing data/knowledge: (1) streamflows necessary to significantly reduce disease (thus quantitatively relating to water quality) and (2) how the remaining hydrologic variability of Keno streamflows would affect habitat quality and river productivity.

It is essential to assess whether the gap (in flow and flow timing) is wide, between what the fish need for restoration and what the water users are being allocated and the USBR is altering at Keno before agreeing to the settlement. How could resource agencies sign-on otherwise?

The WRIMS R32/Refuge flow regime at Iron Gate also becomes the Settlement Agreement's "strive to meet" target flow regime in TAT Guideline No. 3 for the mainstem Klamath River upstream. Streamflows at Iron Gate will be a direct product of the Keno release, real-time tributary inflow to the mainstem, and real-time spring accretion. By subtracting the modeled unregulated streamflow at Iron Gate from Keno (USBR Natural Flow Study), I estimated monthly tributary inflow and spring accretion between Keno and Iron Gate. This allowed me to compute the release at Keno necessary to meet a targeted streamflow at Iron Gate in any month between WY1960 and WY2000. For example, the WRIMS monthly streamflow at Iron Gate in May 2000 is 2,570 cfs. The modeled unregulated monthly streamflow for May 2000 at Iron Gate is 3,543 cfs and 2,105 cfs at Keno (USBR Natural Flow Study). Subtracting the two unregulated monthly estimates resulted in 1438 cfs of accretion flow between Keno and Iron Gate. Therefore, approximately 1,132 cfs would need to be released at Keno to achieve the WRIMS 2,570 cfs at Iron Gate (i.e., 2,570 cfs at Iron Gate minus 1438 cfs accretion equals 1132 cfs). A monthly unregulated May streamflow of 1132 cfs or less at Keno never would have occurred (i.e., if the dams and water withdrawals were absent) between WY1949 and WY2000 according to the USBR natural flow estimates (the month of May in WY1992 would have come close at 1146 cfs).

There seemed to be many inconsistencies in the estimated unregulated streamflows. I still consider (as stated in my first commentary) that the unregulated snowmelt hydrograph occurred later in spring than the estimates indicate (remembering monthly streamflows aren't the best for defining a snowmelt hydrograph).

What role does/would a 1,132 cfs (computed above) monthly May streamflow below Keno play in providing Chinook salmon habitat? The Spring Island side-channel (just below the Boyles Dam bypass reach) would require approximately 1,800 cfs to begin providing good Chinook fry and juvenile habitat. Refer to T. Dunklin's website (www.thomasdunklin.com/gallery/JCBoyle) and look at photographs of this side-channel in: JCB_Powerhouse_sidechannel_detail_tbd.jpg and JCB_Powerhouse_sidechannel_detail2_tbd.jpg (these photographs are also useful in considering Task No. 3). Adding 400 cfs for Boyles Springs and tributary inflow (as accretion from Keno down to Spring Island side-channel) targets a mainstem streamflow release at Keno of 1,400 cfs likely necessary to generate good habitat at this side-channel (i.e., at 1,800 cfs). From WY1949 to WY2000, an estimated 49 years out of 52 years (94%) might have generated good Chinook fry and juvenile habitat in May at the Spring Island side-channel under unregulated streamflows (remembering this is based on monthly average unregulated streamflows). Under the WRIMS R32/Refuge modeled flow regime, an estimated 26 years out of 40 years (65%) might have generated good habitat in May. This is a conservative estimate (i.e., streamflows needed to create good abundant habitat are likely greater than a 1,400 cfs release at Keno).

Following a preliminary analysis of available data/photographs, I estimated steady monthly flow releases at Keno Dam with unregulated flow accretion (and eliminate the chaotic streamflow releases from Keno Dam) that could provide good salmon habitat from Keno downstream to the Shasta River confluence:

	Water Year Type (monthly cfs)			
	Dry	BlwNormal	AbvNormal	Wet
Oct	900	1000	1100	1200
Nov	1000	1100	1300	1400
Dec	1100	1200	1400	1400
Jan	1100	1200	1400	1400
Feb	1100	1200	1400	1400
Mar	1100	1300	1400	1500
Apr	1200	1400	1600	1800
May	1300	1500	1800	2000
Jun	1100	1300	1400	1500
Jul	1000	1200	1200	1300
Aug	1000	1100	1100	1200
Sept	900	1000	1100	1100

These estimates should be considered one straw man for engaging a discussion on this critically important topic. Completion and analyses of

Tasks Nos. 1 through 3 likely would preclude these monthly estimates, or at least greatly refine them. These estimates will likely be considered unrealistic by many actively engaged in the Settlement Agreement negotiations that are much more versed on Keno flow operations. But if restoration of the fishery was the senior goal, my preliminary estimates are more likely too low rather than too high for many parts of the annual hydrograph. I am worried that not enough good years would be provided. I am also assuming that the chaotic nature of Keno releases will be rectified. These estimates were made with the expectation that dam removal would restore the mainstem to a more depositional and alluvial channel morphology below Iron Gate (as well as below Keno Dam by adding coarse bed material, which should be considered in the Settlement Agreement), and that this morphological improvement would create more habitat in the future than presently exists at the same streamflows. Borrowing graphs from my first commentary (November 07, 2007), these monthly flow estimates (above) can be plotted on the unregulated USGS Keno hydrographs in Figures 1 and 2 to visually gain a sense of how these streamflow estimates compare to unregulated streamflows at Keno.

Also note that a rectangular block of reserved streamflow, that has a base extending from January 15 through June 15 (totaling 150 days) and a height of 1,000 cfs extending from 1,800 cfs to 2,800 cfs, diverted from Figure 1 would equal approximately 300,000 ac-ft (i.e., 150 days * 1,000 cfs * 2 ac-ft/cfs-day). Annually, this block of water would be very difficult to achieve (divert), in all but the wettest years, without highly altering the river environment.