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November 9, 2007

Ms. Erica Terrence and Ms. Anna Schulz
Northcoast Environmental Center
1465 G Street
Arcata, California 95521

Subject: Independent Model Review for Klamath Settlement Negotiations
Klamath Independent Review Project (KIRP)

Dear Erica and Anna:

The following letter was prepared pursuant to our Scope of Work dated August 20, 2007 and the solicitation entitled, "Scope of Klamath Settlement Independent Review Proposed by NEC" dated July 20, 2007. The main objectives of my review focused on two primary areas: 1) the adequacy/accuracy of WRIMS model assumptions, boundary conditions, input files and model limitations and 2) an evaluation of WRIMS model simulation output with an emphasis on identifying and investigating the technical advantages and disadvantages of the proposed Settlement Agreement flow conditions. KIRP reviewers were also directed to review selected sections of the Draft Settlement Agreement and provide critique and recommendations. A comprehensive list of the documents and files I've obtained and reviewed are attached at the end of this letter. The findings of my review with respect to model assumptions, model results/output and draft settlement agreement language are presented below followed by a summary of recommendations. In providing an overall impression, it is my opinion that if the spirit and intent of the Settlement Agreement is implemented, the most significant ecological change that will occur in the Upper Klamath River basin is a large gain in salmonid habitat area realized through removal of the dams. Another benefit to salmonids will be operations that notably increase (almost double in some months) the historic river releases from Iron Gate Dam during March through July of most year-types. However, the Settlement Agreement will also result in significant decreases in interim and long-term releases to the river at Iron Gate during the September through February period of most year types. In addition, until the full 100K AF expansion in storage and annual increase in inflow of 30K AF is realized at Upper Klamath Lake, lake water levels will generally be 0.5- to 1.5-feet lower than historical levels (1961-2000) during and through the May to October period.

1.0 CRITIQUE OF WRIMS MODEL ASSUMPTIONS

As a hydrologist, the focus of my review of the assumptions integrated into the WRIMS modeling was on the accuracy and feasibility of water supply and demand expectations. The areas of greatest concern to me relate to the ability of the project to actually achieve: the 100K AF expansion of water storage within and around Upper Klamath Lake; the 30K AF augmentation of inflow to Upper Klamath Lake (UKL) associated with agriculture retirement in the upstream "out-of-project" area; and reliance on groundwater supplies to augment projectwide water demands during interim and drought periods and the reliability of 1961-2000 period to represent baseline hydrologic conditions. I elaborate on each of these concerns below.

1.1 Increase of UKL Storage by 100K AF

Based on review of background materials and WRIMS model output, the long-term acquisition and conversion of lands in and around UKL to gain the 100K AF of storage is a key element for obtaining successful and long-term ecological benefits in the watershed. From my limited involvement in the KIRP, it is my perception that the full area and volume of increased storage has not been identified – I could be uniformed on this subject. Having had experience on several large-scale ecosystem restoration projects that include property acquisition and considering planning and design, I am concerned that the successful implementation of the Settlement Agreement hinges on a conceptual plan which has no guarantees of being achieved within a specified amount of time – time does not appear to be on the side of Klamath River salmonids.

From a technical planning and implementation standpoint, it appears that the WRIMS model identifies some parcels of land and incorporates representative stage-area-volume[1] relationships into lake storage and project water budgeting. I have not had the chance to critically review or verify these data. Nor have I had the chance to review the water loss (evaporation and evapotranspiration) and water budget accounting methods and assumptions that verify that the estimated storage and water supply will be available as anticipated. Given the shallow nature of UKL and sensitivity to evaporation and the dependence placed on estimated water storage gains associated with land acquisition, I would like to see the results of a more rigorous water budget analysis that confirms and verifies that extra water will be stored and available to meet project demands. Such water budget analyses would be very specific and unique to any added storage area, which is either lake expansion or an adjacent water body that, for all intents and purposes, can be considered an increase in UKL storage.

1.2 Augmentation of Annual UKL inflow by 30K AF

The successful implementation of the Settlement Agreement also requires an annual 30K AF increase of inflow to UKL. Some of the literature I've reviewed states this can be achieved by conversion of approximately 18K to 25K acres of "off-project" area land from agriculture use to wetland (Water Watch of Oregon, citations 13. and 21a.). This translates to an estimated annual UKL inflow increase of 1.7 AF of water per acre of land. If I were responsible for implementation of these actions, I would want to review the water budget assumptions and calculations associated with these estimates and also identify specific measures to actually verify and track the net increase in water made available through land conversion. The implementation and verification of these gains will be further complicated by recent and future demands and development in both surface and ground water resources in the upper basin and outside the Klamath Project boundaries. The mechanism to enforce and protect the water supply gains acquired through upper basin land conversion will also be a long-term challenge with respect to water rights.

[1] A stage-area-volume relationship for a reservoir is usually a table of incremental values that describe the surface water area and storage volume associated with a given reservoir water level, where water level is referred to as stage.

1.3 Groundwater Availability

Probably the biggest single concern I have with respect to the modeling and successful implementation of the Settlement Agreement revolves around the development and use of groundwater. The single largest component of water storage in the upper Klamath River watershed is groundwater aquifers. It is typically the hardest water budget variable to quantify and regulate. There is also a very strong interaction between groundwater and surface water flow rates in the upper Klamath River basin above Iron Gate dam. Most streams in the upper basin receive a significant portion of their flow from groundwater, especially in summer. Studies within the basin have found that the travel time of water through the hydrologic cycle (rain, infiltration, groundwater recharge, groundwater flow, and discharge to stream/river) can influence stream flows for up to five (5) years. The groundwater aquifers of the upper basin should be viewed and treated with the same level of scrutiny and importance as Upper Klamath Lake or any other large water storage body. However, groundwater storage has and is not accurately tracked in any of the historic or current water operations models (WRIMS included). Omitting groundwater storage from the water budgeting and operational modeling can result in fundamental and far-reaching errors in predicting river flows and inflow/storage to UKL as it results in an incomplete accounting of water in the basin.

The 2007 UGSG report on groundwater conditions in the upper basin indicates that some aquifers are being pumped faster than they can recharge, resulting in depleted groundwater storage (also termed groundwater overdraft). Much of the overdraft conditions evolved since 2001 as groundwater use in the upper basin increased by 50-percent. This increase in groundwater pumping undoubtedly has reduced the rate of discharge to streams, theoretically resulting in lower stream flows. If the future groundwater withdrawal rates continue per existing (2001-2006) rates or, as may be more likely, groundwater withdrawal rates continue to increase, the average inflow to UKL may be reduced if much of that water is consumed. If groundwater pumping is lowering surface water flow rates, the existing IEI statistics for UKL inflow/storage, developed using historic data from 1961-2000, do not reflect the actual current or future hydrology. In essence, the WRIMS IEI statistics may be overestimating the current and future water supply available to UKL and the Klamath River. I recommend that it would be beneficial to recalculate and evaluate UKL IEI statistics for the 2001-2006 period (normalized for any cumulative departure from median conditions) to identify any anticipated trends in decreased inflow to UKL.

It is my understanding that the USGS is currently developing a groundwater-based flow model of the upper basin. Such a tool may prove to be extremely important in addressing some of the data gaps alluded to above. Ideally, it would be best if the USGS groundwater-based model captures the entire upper basin surface water and groundwater watershed areas – these two watershed areas probably do not share the same surface area or "foot-print". It is important to understand that groundwater conditions outside and upgradient of the Klamath Project area have just as much influence on surface water hydrology as the groundwater conditions within the project area. It will also be helpful if the USGS model integrates groundwater and surface water flow so that the influence of groundwater conditions on surface water flow can be quantified (the groundwater model I assume the USGS is using [MODFLOW] has add-on numerical algorithms that can be used to quantify the transfer of water between surface and groundwater bodies). This modeling tool may provide a defensible approach towards establishing safe yield limits on groundwater withdrawals and quantifying inflow to UKL as well as identifying adverse impacts or deviations below a specified baseline or target condition. We've successfully used groundwater models to evaluate and quantify how changes in landuse (e.g., cessation of irrigation) and changes in vegetation cover affect groundwater recharge rates and underlying groundwater conditions. This approach could be used as one way to verify that out-of-project land conversions yield the necessary increases in inflow to UKL.

2.0 EVALUATION OF WRIMS SETTLEMENT AGREEMENT SIMULATION OUTPUT

My review of WRIMS simulated settlement water operation alternatives focused on: 1) evaluating how flows at Iron Gate would change over time in relationship to both natural (BOR estimated unimpaired) and historic (1961-2000) conditions and 2) evaluating how storage and UKL levels would change in relationship to historic conditions. Settlement Agreement operational scenarios that were most closely evaluated included the following.

- R32_Refuge (base case)
- R32_Refuge_drought
- R32_Refuge_climate-change
- R32_Refuge_interim
- R32_Refuge_NewStorage

It is my understanding that alternative R32_Refuge represents the base-case operational scenario. I was also particularly interested in the results of alternative R32_Refuge_climate-change, which yielded a net 2% increase in yearly flows and redistributed annual hydrograph (Escobar et al., 2007). My original hope was to use the R32_Refuge_climate-change results to represent altered hydrologic conditions (reduced UKL inflow) resulting from groundwater overdraft pumping since no such model simulation was completed. However, I do not feel the WRIMS "climate change" simulation reflects realistic groundwater overdraft conditions.

2.1 Flow at Iron Gate Dam

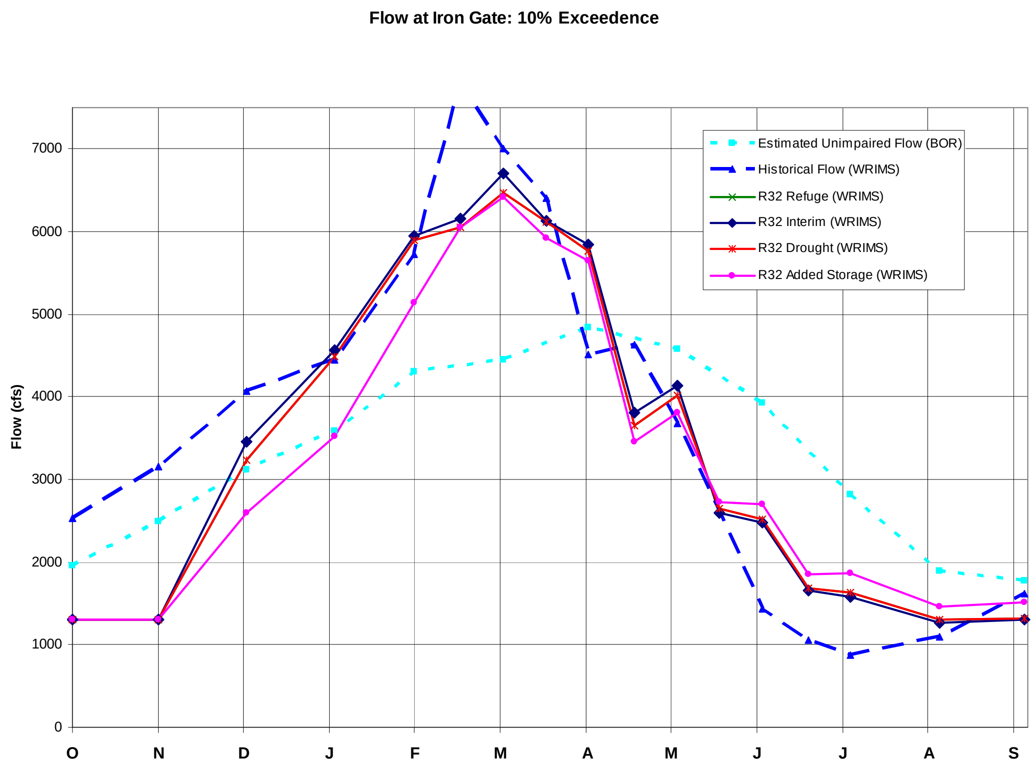
A comparison of WRIMS simulation results for flow at Iron Gate over a range of exceedance values are presented in the plots below. The primary conclusions deduced from these model results include:

- In general, WRIMS flows for the April through August period are higher than historic conditions in all year-types and closer to "natural" flow levels, suggesting improved conditions for salmonids if increased flow rates that are closer to unimpaired values yield improved habitat.

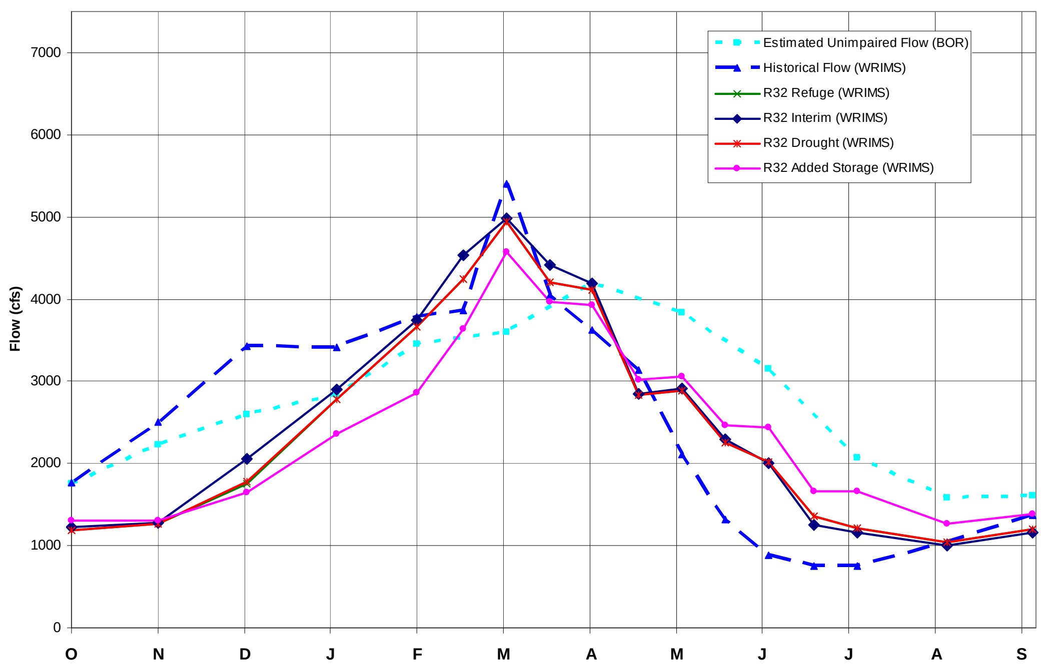
- To balance out the summer gains in flow, Iron Gate flows are significantly reduced in the September to February period of all years, well below historic (1961-2000) and natural conditions. Pending weigh-in by fisheries and aquatic ecologists, this reduction in flow may prove detrimental to Klamath River salmonids as it represents a further reduction from "natural" flow conditions than even those that occurred under the WRIMS historical base-line period (1961-2000).

- The "R32_Interim" and "R32_Drought" simulations have similar flow values, which implies that until the UKL added storage and/or out-of-project increased flows to UKL occur, the interim releases from Iron Gate will be similar to predicted future drought conditions. Due to the similar flow rates at Iron Gate and higher UKL levels under the drought run than those for the interim conditions run (see below), I assume the R32_Drought simulation includes the added 100K AF of lake storage and 30K AF annual increase in UKL inflow. If this is true, it would be very interesting to see how much Iron Gate flows and lake storage would be reduced under a drought during the "interim" period – a scenario that is probably more likely than not over the next ten (10) years.

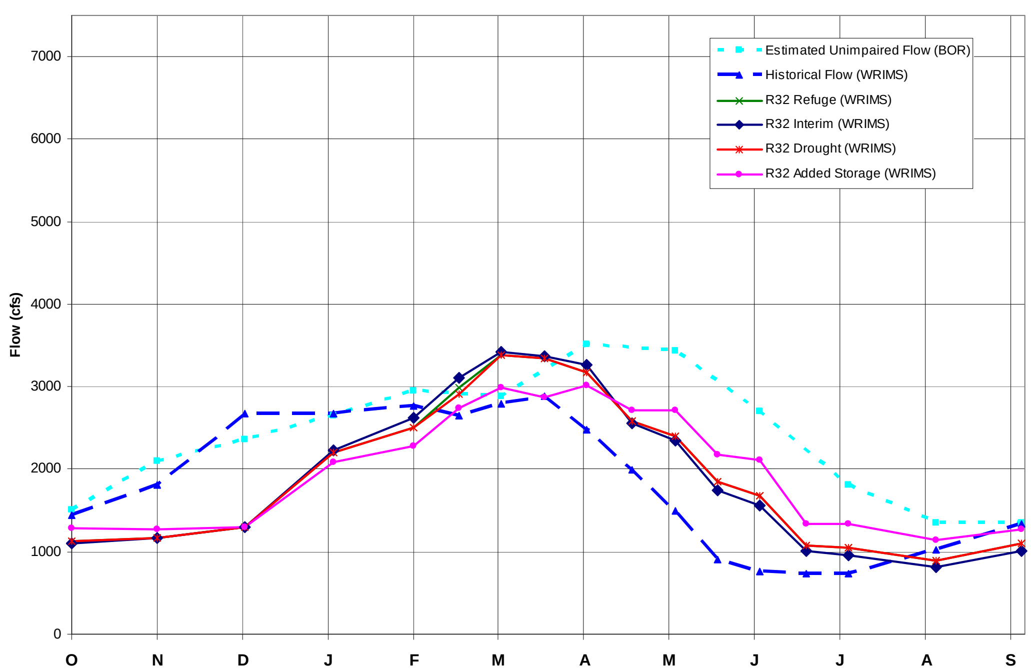
- An unexpected change observed under the R32_NewStorage simulation is the further imbalance of annual flow distribution relative to the base-case simulation (R32_Refuge). Although the "NewStorage" simulation results in increased flow rates in the April-August period, what was unexpected was a further decrease in flow rates during the September-February period when compared to other Settlement Agreement operational alternatives. These flow conditions further emphasize the imbalance in flow and likely, in turn, salmonid habitat quality between the winter and spring periods (a time of salmonid immigration and spawning) discussed in the first two bullets of this section.



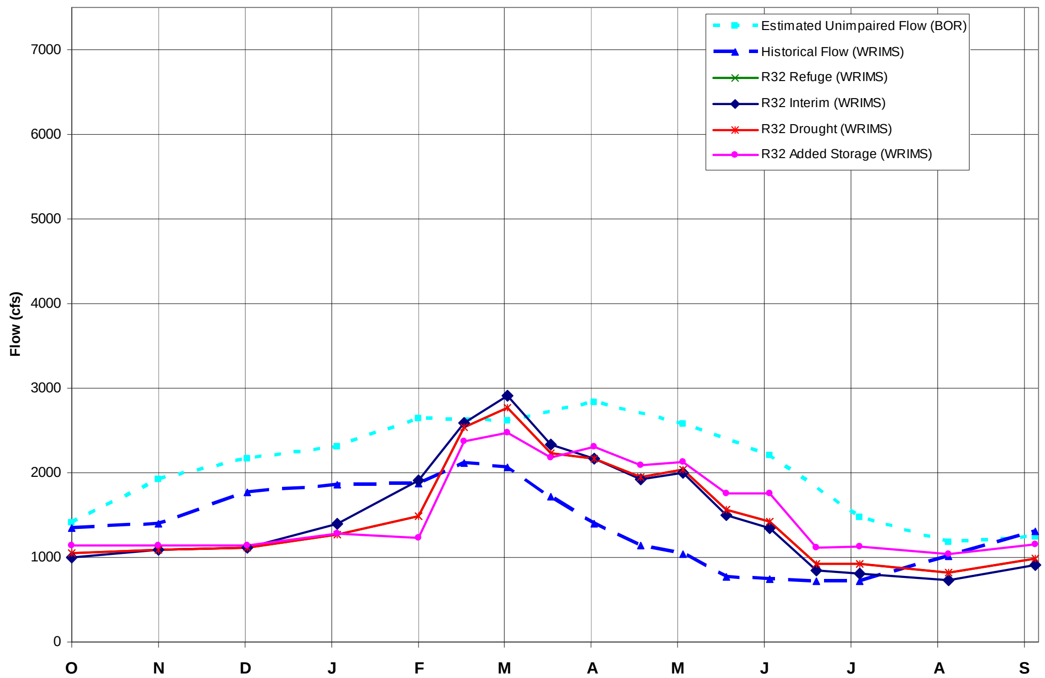
Flow at Iron Gate: 30% Exceedence



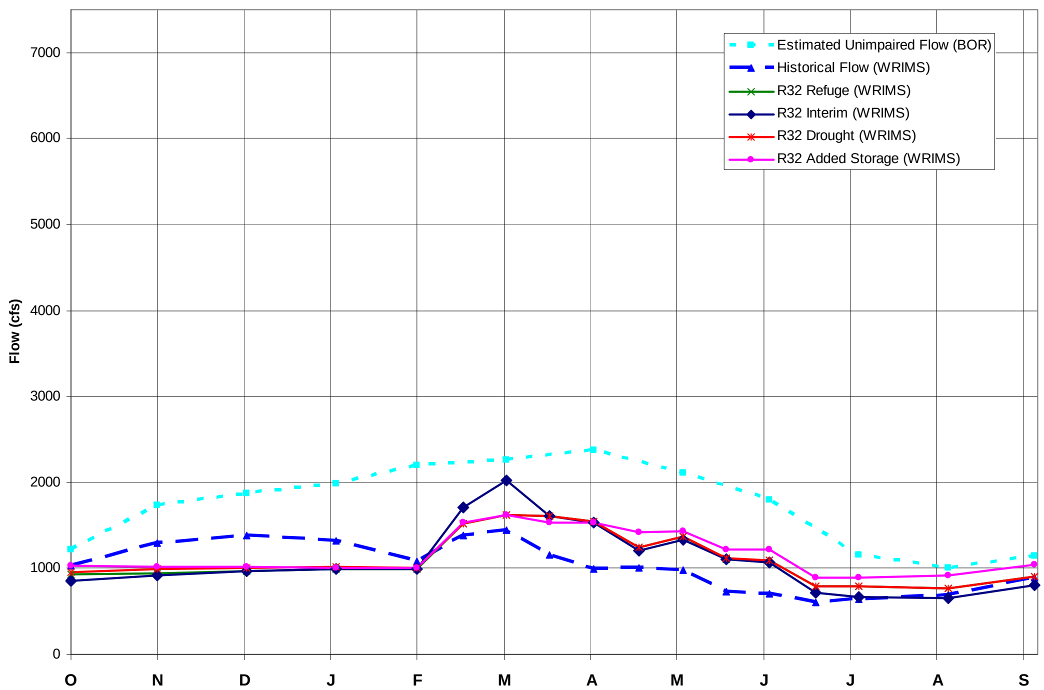
Flow at Iron Gate: 50% Exceedence

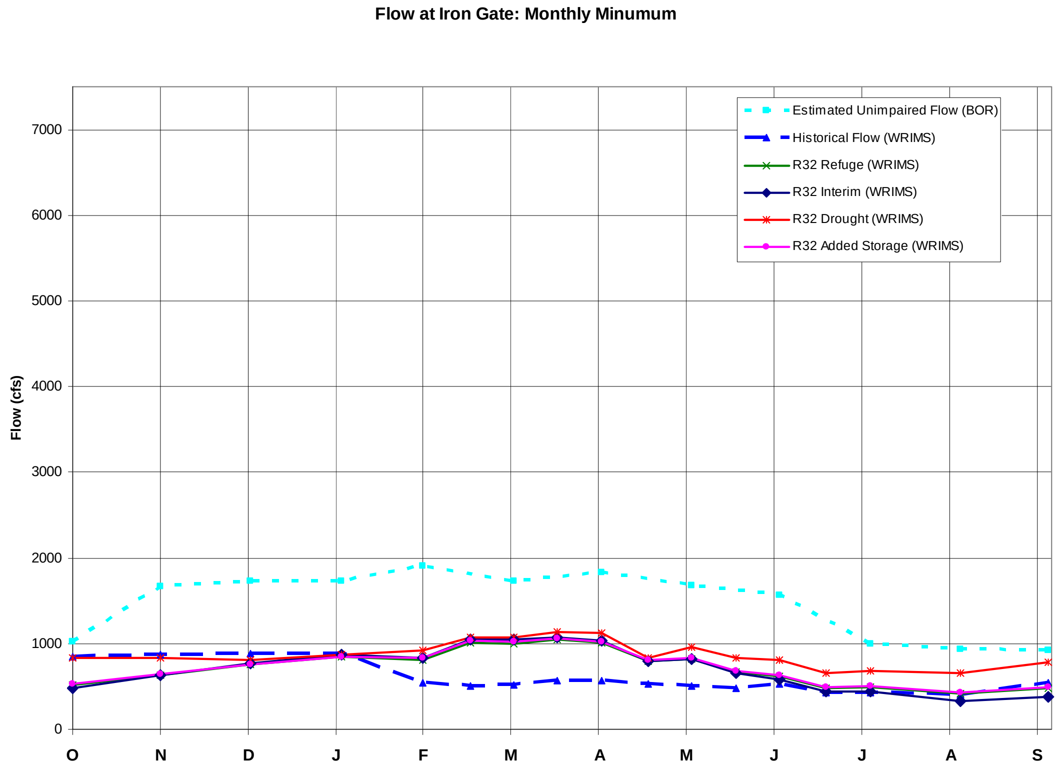


Flow at Iron Gate: 70% Exceedence



Flow at Iron Gate: 90% Exceedence





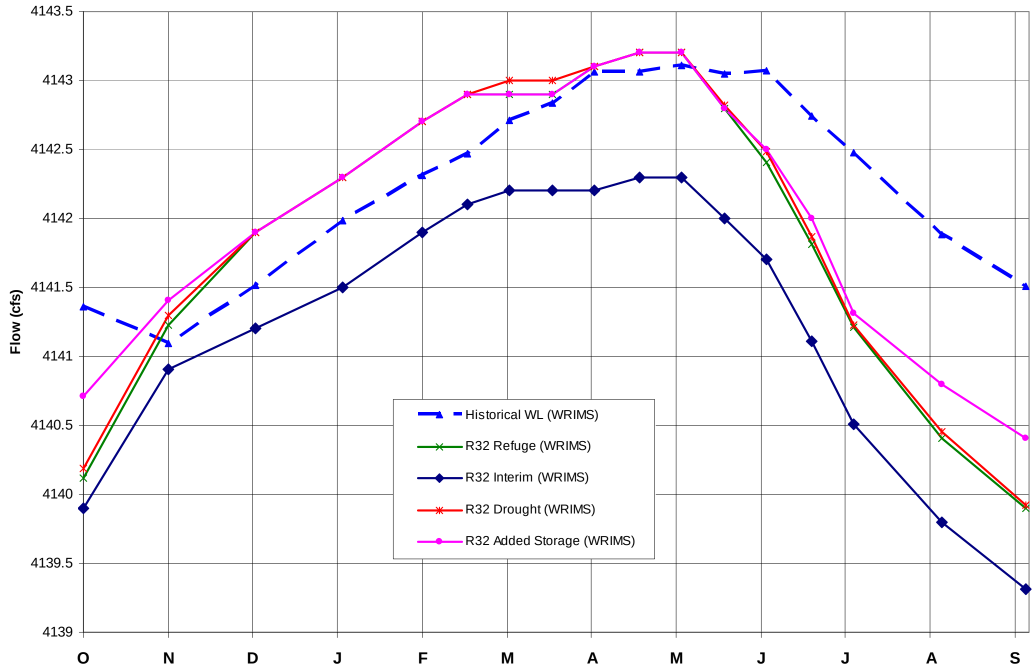
2.2 UKL Storage

A comparison of WRIMS simulation results for storage level in UKL over a range of exceedance values are presented in the plots below. The primary conclusions deduced from these model results include:

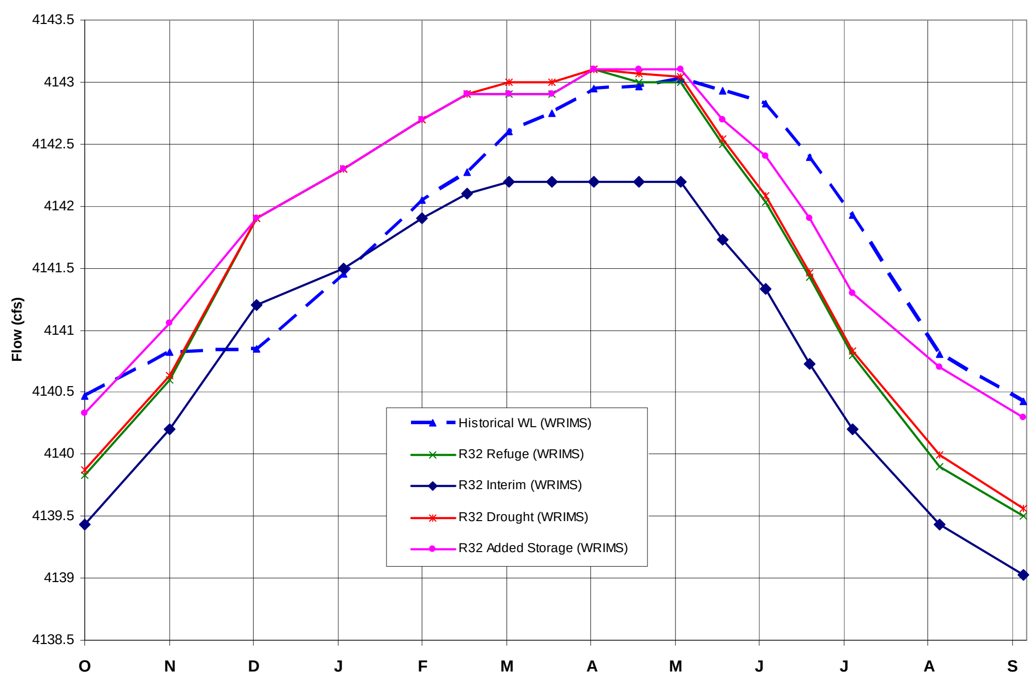
- There is a significant shift in the annual water level hydrograph in which the maximum lake storage peaks about one month earlier under most Settlement Agreement alternatives than historical conditions.

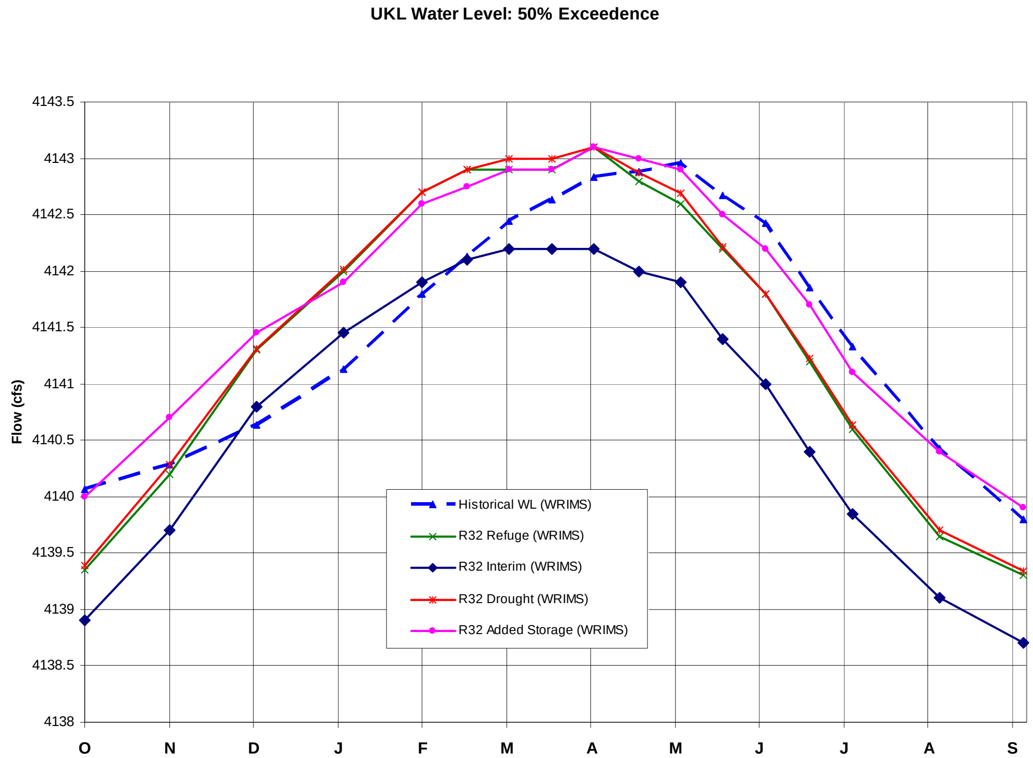
- The R32_Refuge_Interim simulation results yield the lowest lake levels and storage of all Settlement Agreement alternatives and also results in lower total annual lake storage than was experienced historically. When compared to flows at Iron Gate over the interim period, lake storage is being sacrificed (i.e. preferentially lowered) in order to maintain Iron Gate flows near the base-case condition. The impacts of the significant decrease in “Interim” lake levels on aquatic/wetland ecology and water quality should be evaluated by qualified persons knowledgeable about the interrelationship between lake hydrology, water quality and ecology.

UKL Water Level: 10% Exceedence



UKL Water Level: 30% Exceedence




UKL Water Level: 50% Exceedence
Flow (cfs)
4143.5
4143
4142.5
4142
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4141
4140.5
4140
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4139
4138.5
4138
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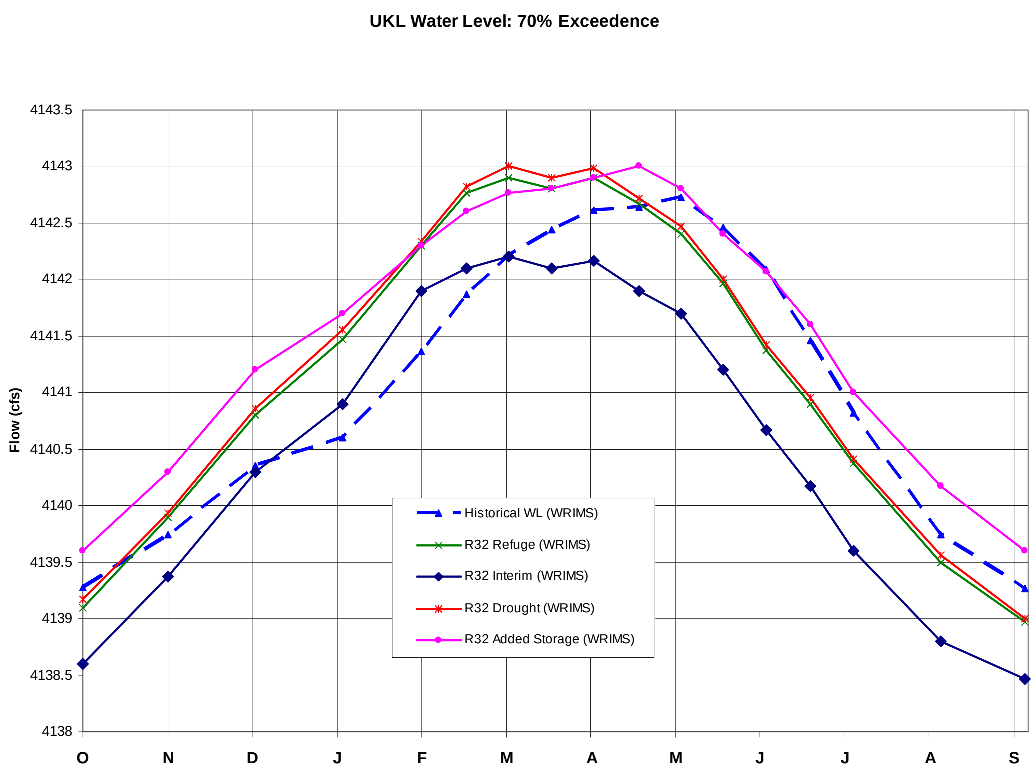
Historical WL (WRIMS)
R32 Refuge (WRIMS)
R32 Interim (WRIMS)
R32 Drought (WRIMS)
R32 Added Storage (WRIMS)


UKL Water Level: 70% Exceedence
Flow (cfs)
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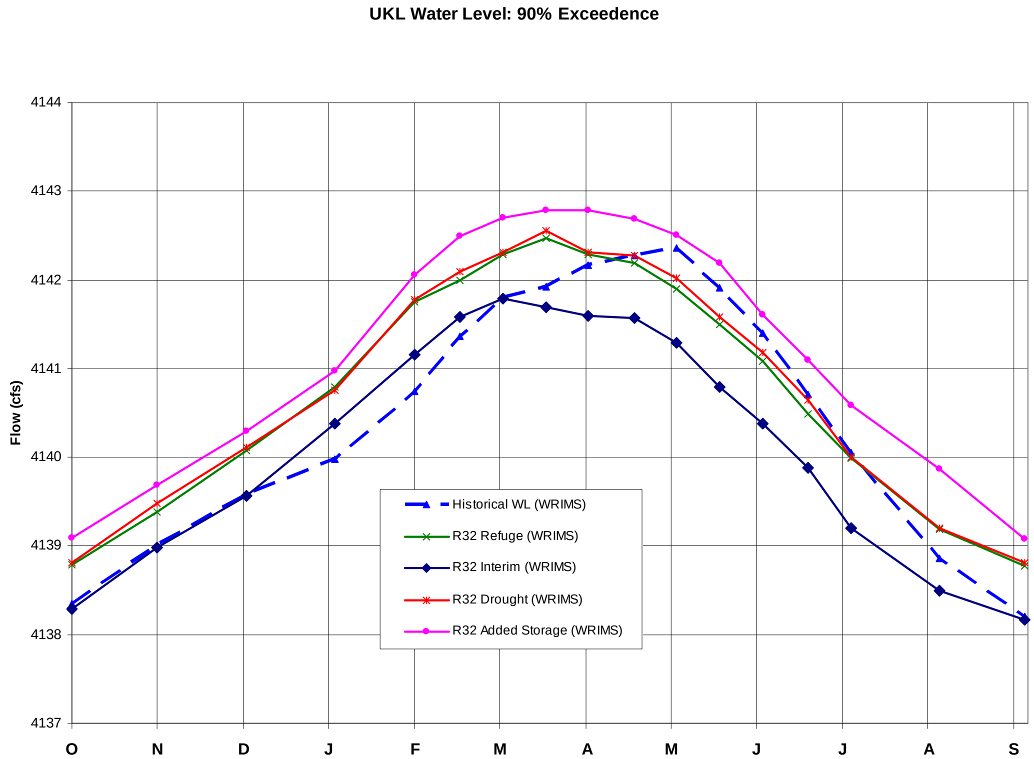
Historical WL (WRIMS)
R32 Refuge (WRIMS)
R32 Interim (WRIMS)
R32 Drought (WRIMS)
R32 Added Storage (WRIMS)


UKL Water Level: 90% Exceedence
Flow (cfs)
4144
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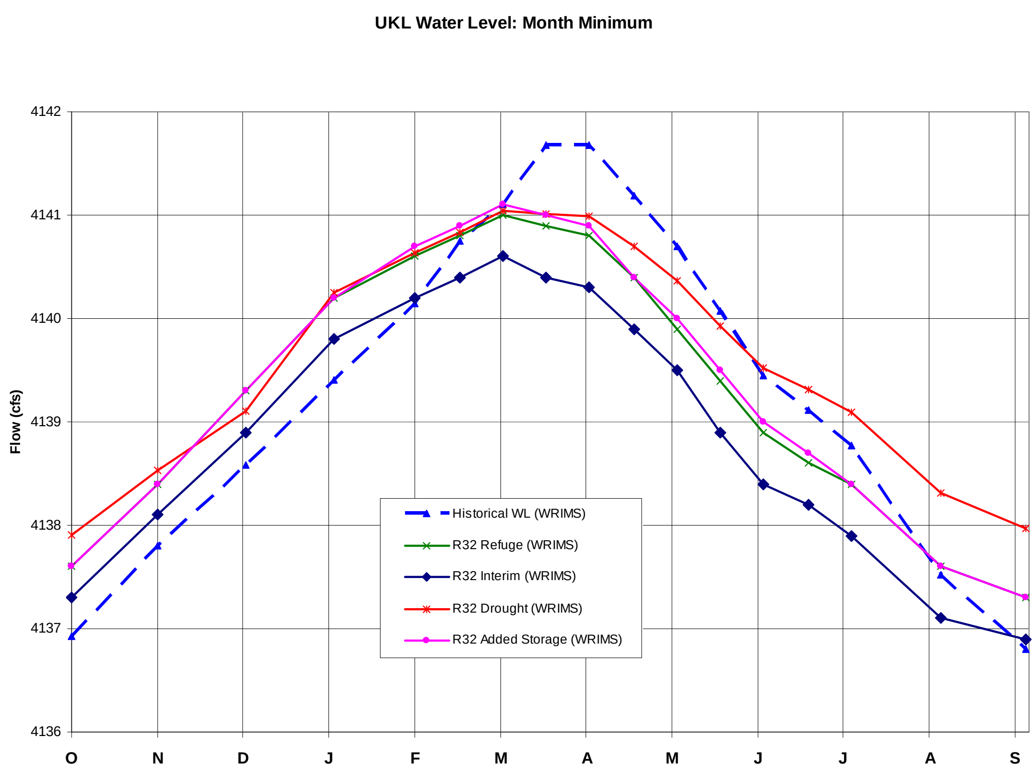
Historical WL (WRIMS)
R32 Refuge (WRIMS)
R32 Interim (WRIMS)
R32 Drought (WRIMS)
R32 Added Storage (WRIMS)


UKL Water Level: Month Minimum
Flow (cfs)
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Historical WL (WRIMS)
R32 Refuge (WRIMS)
R32 Interim (WRIMS)
R32 Drought (WRIMS)
R32 Added Storage (WRIMS)

3.0 REVIEW OF DRAFT SETTLMENT AGREEMENT

Another aspect of my review included reviewing Part IV. "Water Resources Program" of the Draft Settlement Agreement, dated October 10, 2007. Comments from this section of the Agreement are provided below.

3.1 Measures Related to Groundwater.

As discussed in section 1.3 above, the technical modeling analysis being completed by the USGS will address a major data gap in the understanding and regulation of groundwater resources and their interaction with surface water supplies in the upper basin. Funding to update and maintain the model as a real-time management tool should be incorporated into the Agreement.

The language related to groundwater pumping causing adverse impacts on river, lake and fisheries contained in the November 8, 2007 version of the Settlement Agreement (Section 15.2.4) is a great start at providing measurable and enforceable specific and quantitative thresholds. The USGS groundwater model/study is the logical choice as the mechanism by which adverse impact thresholds are evaluated. A concern I have is that the definition of adverse impacts is biased towards localized geographic areas and selected springs. I assume these springs are the main sources of inflow to UKL that is directly influenced by KIP. Ideally, I would like to see the definition of "adverse impact" apply to 6% reductions (below the 2000 baseline levels) of all or cumulative water sources feeding UKL, including major rivers and springs that are primarily supplied by areas outside of the KIP area.

3.2 Water Rights

It has been my experience on other projects that some land-owners will attempt to retain the water rights and water deliveries for resale when retiring lands for environmental purposes (e.g., Westlands Water District). Specific language should be contained in the Agreement to ensure that water deliveries associated with land conversion or retirement are retained for instream beneficial use.

3.3 Off-Project Water Users' Plan and Program

The Settlement Agreement should specify guidelines and protocols to verify that land retirement in the off-project areas is providing the desired annual increase in inflow (30K AF) to UKL. Two possible independent methods include: 1) flow monitoring and water budgeting of UKL performed by the USGS and/or other state resource agencies and 2) water budget tracking using the USGS groundwater-based model.

Under Section 16.1.4 (H.), replacing surface water irrigation with groundwater irrigation is not a true or justifiable mitigation. In my view, this is just a shell-game in which a water demand is simply being satisfied from a different line-item in the overall water budget, without really reducing the draw on the total supply. This same mitigation measure is also called for under Section 18.2.7 (D.) iii, which calls for relying on groundwater pumping to augment drought water supply.

The funding of wells to complete this mitigation, as suggested in this section, seems in conflict with language "not to fund" new wells in Section 15.2.4 (D.) of the Settlement Agreement. Also contained in Section 16.1.4 (H.) is language to fund conservation practices such as lining irrigation delivery ditches to increase irrigation efficiency. However, it should be realized that infiltration from the irrigation ditches may be going towards groundwater recharge and the true net benefits of this action need to be evaluated using a comprehensive and basin-wide water budget.

3.4 Drought Emergency Response and Adaptive Management Plans

Throughout the Settlement Agreement, there is loose mitigation and management language that calls for scientific review and revision of project operations during droughts or other environmental pressures. In general, I am an advocate for adaptive management plans, however the specifics of these plans are vague as spelled out in the Settlement Agreement and there appears to be a lot of faith that the details can be worked out in the future. I assume more details and specific criteria will be introduced during later versions of the Settlement Agreement.

4.0 SUMMARY OF RECOMMENDATIONS

The following is a summary of recommendations introduced above.

- Identify specific project areas that will provide the needed increase in UKL storage. Confirm that water supply gains are attained through water budget and evapotranspiration analyses. I would recommend that the USGS be solicited to ensure their groundwater-based model will be capable of modeling and accounting for these variables.

- Develop specific approaches (e.g., direct stream/spring flow measurements and integrated suface water-groundwater modeling) to verify that additional 30K AF of inflow to UKL will be realized through land conversion. Identify specific conversion lands and the regulatory avenues to maintain current levels of water use (surface and ground water) in the upper basin.

- Endorse and support the development and maintenance of a watershed-scale integrated surface water-groundwater model that can be used to: a) evaluate how changes in groundwater pumping impact the overall upper basin water budget; 2) evaluate how changes in groundwater pumping effect surface water flow and inflow to UKL; 3) evaluate how changes in landuse and vegetation effect the overall upper basin water budget and inflows to UKL; and 4) provide quantitative estimates of the above mentioned water budget variables that can then be used to establish specific safe-yield groundwater use requirements.

- Recalculate and evaluate UKL IEI statistics for the 2001-2006 period (normalized for any cumulative departure from median conditions) to identify any anticipated trends in decreased inflow to UKL.

- Determine impacts to salmonids due to decreased river flow rates during the September-February period, especially under the R32_NewStorage alternative conditions.

- Complete a hybrid model simulation that imposes a drought on the “Interim” Agreement period. This simulation would likely represent a worst-case dry-year scenario over the “Interim” Settlement Agreement period.

- Determine how the shifted UKL annual storage hydrograph and significantly reduced (from historic) “Interim” lake levels impact the aquatic/wetland ecology and water quality of UKL.

- Delete language in the Settlement Agreement that endorses the use of groundwater as a measure to augment surface water flow and irrigation until a complete and comprehensive analysis and understanding of associated impacts of the upper basin water budget are determined, likely from USGS groundwater modeling.

- The Settlement Agreement should contain specific language to ensure that water and water rights associated with land conversion or retirement are retained for instream beneficial use.

- Clarify the definition of “adverse impact” in the Settlement Agreement in Section 15.2.4 to include a 6% reduction (relative to the 2000 baseline condition) in the cumulative inflow to UKL. This includes springs and stream inflows from areas out-side of the KIP area.

- The Settlement Agreement should specify guidelines and protocols to verify that land retirement in the off-project areas is providing the desired annual increase in inflow (30K AF) to UKL. Two possible independent methods include: 1) flow monitoring and water budgeting of UKL and 2) water budget tracking using the USGS groundwater-based model.

- Develop more detailed, verifiable and enforceable drought emergency response and adaptive management plan language for the Settlement Agreement. Ensure that there are triggers in place that allow participants to revisit and modify operations if egregious allocations result during droughts or other situations.

If you have any questions or would like to discuss the contents of the this letter, please don’t hesitate to contact me.

Sincerely,

Greg Kamman
Principal Hydrologist

ATTACHMENT A
Documents Obtained and Reviewed

1. Tawil, Natalie. How Federal Policies Affect the Allocation of Water. The Congress of The United States; Congressional Budget Office. August 2006.

2. Dunsmoor, Larry., Klamath Tribes. Assumptions in the hydrological modeling (KPSIM) used for Jan 07 Klamath Settlement Framework, and reminder of work yet to be done. May 16, 2006 revision to May 04, 2007 version. Unpublished memorandum to: Klamath Extended Caucus.

3. Dunsmoor, Larry., Klamath Tribes (assumed author). Exceedance numbers for Upper Klamath Lake inflow/storage and Iron Gate flow. Unpublished spreadsheet.

4. Hicks, John, USBOR, Upper Klamath Lake inflow exceedance values for 1961-2000. Unpublished spreadsheet

5. Spain, Glen. Interim Downriver Flow Protections, Discussion Draft 1. July 2007

6. Spain, Glen. Specifying Anticipated Lower River Flows, Discussion Draft 1. August 08, 2007.

7. Schulz, Anna., Northcoast Environmental Center. Klamath Peer Review Project Work Plan. July 16, 2007.

8. Hoopa Tribal Fisheries, Water Division. Minimum Klamath Flow, Biological Needs and Run 31 Output. Draft. May 24. 2007.

9. Belchik, Mike; Williams, Scott. Guidelines for the Salmon and Sucker Water Implementation and Ecosystem Management (SWIM) Team. Draft 1. July 02, 2007.

10. Water Implementation and Ecosystem Management (SWIM) Team. Protocols for the Salmon and Sucker (and other species). Draft. July 13, 2007.

11. Settlement Group Tech Team Assignment X Flow Report. Draft. January 06, 2007.

12. Hicks, John., United States Bureau of Reclamation. Upper Klamath Lake Inflow Exceeding Values for 1961 – 2000.

13. WaterWatch of Oregon. Outline and Recommendations of Protection of Klamath River Flows and Lake Levels from Future Diversions & Protection of Saved/Purchased Water for Instream Benefits. May 23, 2007.

14. Dunsmoor, Larry., Klamath Tribes. Assumption in hydrological modeling (KPSIM) used for Jan 07 Klamath Settlement Framework, and reminder of work yet to be done. May 04, 2007. Unpublished memorandum to: Klamath Extended Causes.

15. Guidelines For Klamath River Basin Technical Water Management Team. July 2007.

16. Klamath River Settlement Agreement Restoration of Public Trust Resources and Sustainability of Affected Communities. Draft 1. September 07, 2007.

17. Dunsmoor, Larry., Klamath Tribes (assumed author). Table of model run names, purpose, comments and assumptions. Unpublished spreadsheet. Modified (assumed earlier) version of table contained in Dunsmoor's October 1, 2007 memorandum.

18. Settlement Agreement Attachment 3. Klamath River Flows as a Result of Proposal Settlement. Unpublished memorandum from LKD.

19. Dunsmoor, Larry., Klamath Tribes. Oct 01, 2007. Unpublished memorandum on modeling results to: Klamath Settlement Parties.

20. Gannett, Marshall K.; [and others], U.S. Department of the Interior. U.S. Geological Survey. Prepared in cooperation with the Oregon Water Resources Department. Ground-Water Hydrology of the Upper Klamath Basin, Oregon and California. Scientific Investigations Report 2007 – 5050.

21a. Brown, Lisa. Klamath Settlement water proposal analysis. October 02, 2007. Unpublished memorandum to: Bill Trush; Greg Kamman with cc to: Bob hunter; Erica Terence.

21b. WaterWatch of Oregon. Outline and Summary of Modeling Assumptions in the Klamath Settlement Water Proposals.

22. Parker, Nancy., Hydraulic Engineer, U.S. Bureau of Reclamation. Klamath Independent Review Project. September 27, 2007. Unpublished memorandum to: Greg Kamman, Michael Belchik and Anna H. Schulz with cc to: Larry Dunsmoor, John Hicks and Brian Joyce. Includes a number of electronic files summarizing and evaluating KPSIM model to WRIMS.

23. Parker, Nancy., Denver TSC, U.S. Department of the Interior, Bureau of Reclamation. Reclamation, Managing Water in the West; Klamath River Modeling for Planning and Operations. December 13, 2004.

24. Hardy, Dr. Thomas B.; [and others], Institute for Natural Systems Engineering, Utah Water Research Laboratory, Utah State University. Evaluation of Instream

Flow Needs in the Lower Klamath River, Phase 11, Final Report. Prepared for U.S. Department of the Interior. July 31, 2006.

25. National Maritime Fisheries Service. Biological Opinion; Klamath Project Operations. May 31, 2002.

26. Hardy, Dr. Thomas B.; Saraeva, Dr. Ekaterina. Response to comments prepared by: Bureau of Reclamation, Klamath Basin Area Office and its Consultants. April 02, 2007. Unpublished memorandum to: Bureau of Reclamation and its technical consultants as well as the National Academy of Science "Committee on Further Studies on Endangered and Threatened Fishes in the Klamath River".

27. Vogel, David A., Natural Resource Scientists, Inc. Salmon Rearing Habitats in the Main Stem Klamath River. February 2003.

28. Bureau of Reclamation, Klamath Basin Area Office and its Consultants. September 22, 2006. Technical Review of Evaluation of Instream Flow Needs in the Lower Klamath River, Phase II, Final Report.

29. Arroyave, Pablo R., U.S. Department of the Interior, The National Academy of Science, Environmental Studies and Toxicology Board, Water Science and Technology Board. Bureau of Reclamations Comments on the Evaluation of Instream Flow Needs in the Lower Klamath River, Phase II, Final Report. September 27, 2006. Unpublished memorandum to: Committee Members.

30. Hardy, Dr. Thomas., Utah Water Research Laboratory, Utah State University. Comments on Hardy Phase II Report. October 16, 2006. Unpublished memorandum to: Pablo Arroyave.

31. Dunsmoor, Larry., Klamath Tribes. Oct 07, 2007. Unpublished memorandum re: inflow exceedance index, to: Klamath Settlement Parties.

32. Rykbost, K.A.; Todd, R. Klamath Watershed in Perspective; A Review of Historical Hydrology of Major Features of the Klamath River Watershed and Evaluation of Hardy Iron Gate Flow Requirements.

33. California Department of Water Resources and United States Bureau of Reclamation. Description of Analytical Tools: CALSIM 11_CVP_SWP System Simulation Model; WRIMS (a.k.a.CALSIM)—Water Resources Integrated Modeling System.

34. Hardy, Dr. Thomas B.; Addley, R. Craig., Institute for Natural Systems Engineering, Utah Water Research Laboratory, Utah State University. Evaluation of Interim Instream Flow Needs in the Klamath River, Phase II. Final Report. Prepared for U.S. Department of the Interior. November 21, 2001.

35. Hecht, Barry.; Kamman, Greg. Review of Initial Bureau of Reclamation Hydrologic Model (KPOP) of the Klamath Watershed. Report prepared for: Yurok Tribe. Balance Hydrologics, Inc. April 9, 1998.

36. Hecht, Barry.; Kamman, Gregory R. Initial Assessment of Pre-and-Post Klamath Project Hydrology on the Klamath River and Impacts of the Project on Instream Flows and Fishery Habitat. Prepared on behalf of : The Yurok Tribe. Balance Hydrologics, Inc. March 1996.

37. Stene, Eric A. The Klamath Project (Seventh Draft). Bureau of Reclamation History Program. Denver, Colorado. Research on Historic Reclamation Projects. 1994.

38. Perry, Thomas., Hydrologist [and others]. Reclamation, Managing Water in the West, Natural Flow of the Upper Klamath River-Phase I. Prepared by: Technical Service Center, Water Resources Services. Prepared for: U.S. Department of the Interior Bureau of Reclamation Klamath Basin Area Office Klamath Falls, Oregon. November 2005.

39. Perry, Thomas., Hydrologist; [and others]. Undepleted Natural Flow of the Upper Klamath River, A Summary Report, Part 2; Natural Inflow to, Natural Losses from, and Natural Outfall of Lower Klamath Lake to the Klamath River at Keno. Draft. Prepared for Dave Sabo, Area Manager, Klamath Area Office. November 7, 2003

40. Escobar, Marisa; [and others], Stockholm Environment Institute-US Center. An Estimate of Changes in Hydrology in the Klamath River Basin Due to Climate Change. Technical Memo. October 2007.

41. Settlement Document. Draft 4. Klamath River Basin Settlement Agreement Restoration of Public Trust Resources and Sustainability of Affected Communities. October 10, 2007.

42. Lagomarsino, Irma., U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Letter to: Pablo Arroyave, Bureau of Reclamation with attached Working Drafts Parts 1 and 4 as pertaining to the Klamath Project. August 2007.

43. Lestelle, Lawrence C. Coho Salmon (Oncorhynchus kisutch) Life History Patterns in the Pacific Northwest and California. Prepared for: U.S. Bureau of Reclamation Klamath Area Office. Final Report. March 2007.

Model Output Files Obtained and Reviewed

1. R31_WRIMS
2. R31_WRIMS_drought
3. R32_WRIMS
4. R32_WRIMS_drought
5. R32_Refuge
6. R32_Refuge_drought
7. R32_Refuge_climate-change
8. R32_Refuge_interim
9. R32_Refuge_NewStorage
10. R32_Refuge_NewStorage_cliamte-change