Yurok Tribe
November 5, 2009

Response to Hoopa Valley Tribe's Questions About Adequacy of Interim Klamath River Flows under Klamath Basin Restoration Agreement Flow Management

Background: The Hoopa Valley Tribe (HVT) has raised technical questions about projected Klamath River flows under the Klamath Basin Restoration Agreement (KBRA). HVT has issued a series of papers; most have as their central feature, a color-coded matrix of WRIMS KBRA flows with cells color-coded to indicate where, purportedly, the KBRA modeled flows fall short of the Hardy 95% exceedance flows[1]. These papers appear to be designed to show that the flows expected under the KBRA in the interim period before dam removal will bring about conditions which are insufficient to maintain salmon resources. At this point, HVT's papers do not extend past that interim period; apparently HVT believes that the KBRA flows following dam removal will sustain salmon resources.

The fact is that the flows in the Klamath River under KBRA flow management will be sufficient to maintain the functional ecological health of the Klamath River until the dams are removed. HVT's claims are deeply flawed in several respects, which we point out here.

Because the issue papers distributed by HVT have changed over time, we respond to the latest one: *Update - Settlement Flows and Violations of Hardy II Subsistence Criteria HVT Tribal Fisheries Department – Water Division October 15, 2009.*

Summary:

The flaws in HVT's analysis can be summarized:

1. HVT fails to acknowledge that ESA and drought protections will alleviate many of the noted flow deficiencies. These protections have been discussed by the Technical Team[2] that helped design and evaluate the original WRIMS model runs associated with the KBRA. These protections have been pointed out to the HVT.
2. The model runs were designed to be "conservative" (i.e. underestimate, rather than overestimate) when estimating flows that would result from irrigation reductions and increased storage in Upper Klamath Lake. This conservative bias was not considered in HVT's analysis, even though it was discussed openly by the Technical Team with HVT.
3. HVT asserts that the "interim" period (when dams are in place, but reductions to irrigation have not been fully implemented) could last for over 20 years. The claim has no basis in fact nor is it a reasonable interpretation of either the KBRA or the Klamath Hydroelectric Settlement Agreement (KHSA). The settlement parties anticipate that the dams will be removed in 2020.
4. The assertion that the KBRA is "fatally flawed" because it contains no numeric fisheries goals is without scientific or policy basis. Flow and habitat effects cannot be reliably linked to specific responses in population abundance; quite simply, too many variables confound such

[1] In other forums, HVT has also compared KBRA flows with the current coho biological opinion.
[2] This technical team was composed of scientists from the Federal Government, California, Oregon, and the four Basin Tribes; HVT Valley, Karuk, Klamath, and Yurok.

relationships. Furthermore, the KBRA states its goals emphatically and simply: "in concert with Dam Removal, restore and sustain natural production and provide for Full Participation in Harvest Opportunities of Fish Species throughout the Klamath Basin." (Section 1.3).

5. HVT's analysis errs by overemphasizing the fall-winter flows and ignoring Technical Team flow recommendations that formed the basis of the KBRA WRIMS model runs. The Technical Team purposefully chose to store a portion of fall-winter flow, that time period when the upcoming hydrologic year type is unknown; fall-winter storage allows water managers to optimize water available for fry/juvenile salmonids the following spring, a critical time of year for the survival and ultimate productivity of these fish.
6. HVT asserts,that KBRA flows will violate Hardy 95% exceedances in fall and early winter. The facts are that those flows affect an average of only 6% of the fall run with average habitat provided under KBRA of nearly 90% of available habitat. The assertion that flow "shortages" at this time of year would threaten the survival of the Klamath River fall Chinook run is wrong; there is no scientific or factual support for the claim.
7. HVT asserts[3], again incorrectly, that flows under KBRA management will approach the levels seen during the fish kill of 2002. Again, there is no scientific or factual basis for the claim. Current WRIMS modeling predicts extremely low flows during extreme drought years similar to 1992 and 1994; those are the precise years that the settling parties chose as emblematic of an extreme drought, when the KBRA Drought Plan and ESA-mandated minimum flows would protect the fishery.
8. HVT's own analysis shows that during the crucial months of March, April and May, KBRA flows meet or exceed subsistence criteria. In fact, as HVT data reveals, during nearly half of all years, KBRA flows provide for over 90% of available habitat for Chinook fry near Iron Gate Dam. From a fish perspective, this means that nearly half the years will have flow conditions that provide for exceptional habitat conditions.
9. At first glance, the color coded "violations" in August and September in the table produced by HVT are alarming. However, a closer look at the WRIMS output shows that many of these years are fixable by redistributing higher July flows, something the model was not directed to do. Other purported "violations" are less than 2% from the identified criteria. Thus, it strains credibility to claim that these departures from the identified criteria will threaten the survival of select fish populations. Furthermore, the analysis repeatedly fails to mention the effects of a drought plan, ESA protection, and the conservative nature of the WRIMS output. The KBRA provides for a flow management team precisely to permit real-time management of water to meet fishery requirements; the month of August, for example, is one which we know will require attention from the flow management team.
10. Most recently, HVT alleges yet another new concern: that dam removal will release poor quality water containing no oxygen "killing everything for some unknown distance downstream". HVT cites no source or reference for this remarkable claim. Although the reservoirs do contain anoxic water at certain times of year (summer and fall months), the current projection is that dam removal will begin with reservoir drawdown after the lower layers of the reservoirs become replenished with oxygen. In any event, this claim will be part of the comprehensive scientific review conducted by Interior, leading up to the Secretarial Determination.

[3] Mike Orcutt, HVT Valley Tribe as quoted in the North Coast Journal: *The Klamath Settlement; Weighing the pros and cons of a proposal to end the crisis on our most important river* October 8, 2009.

Detailed Response to HVT Valley Tribe's Analysis

HVT's Analysis Fails to Consider Additional Protections from Drought Plan or ESA: When interpreting KBRA flows, it is extremely important to understand that the model runs were done without regard to drought plans (because no drought plan exists yet), and ESA protections (because it was unclear what future Biological Opinions might look like). Thus, the results exaggerate the extent and magnitude of low flows. This was understood by the technical team as they evaluated KBRA flows, but is ignored in HVT's analysis. This is a major systemic flaw in the HVT analysis, and results in an unrealistic and pessimistic view of future flows.

HVT's Analysis Fails to Take into Account the Conservative Nature of the WRIMS Model Run: The Technical Team, of which HVT was a member, openly discussed the parameters upon which the model run (WRIMS R32 Refuge) would be built. The team deliberately made the model conservative (more likely to underestimate flows and lake levels) because the Team was concerned that erring the other way might lead to acceptance of an agreement that was not protective of the fisheries resources in the Klamath River Basin. At HVT's insistence, the technical team did a subsequent WRIMS model run in which we made the rather unrealistic assumption that the Klamath Irrigation Project would use its entire allocation each and every single year to the acre-foot. Other conservative assumptions were made, such as deliberately overestimating evaporation from reclaimed areas of Upper Klamath Lake, and not accounting for water savings due to removed hydroelectric reservoir surface area associated with dam removal. These intentionally conservative analyses revealed that the projected flows would permit fisheries restoration, and identified circumstances in which the flow management team would be required to take steps to protect fisheries.

HVT's analysis failed to account for this conservative approach, one of several flawed components of their analysis.

HVT's Concern Limited to Interim Period: It is important to note that HVT's concerns are limited to the interim period prior to dam removal. HVT's analysis has defined the interim period as the period of time where 1) the dams are in place (one or more of PacifiCorp's mainstem Klamath Dams remains standing), and 2) the KBRA water allocation is in effect (agricultural water cap/guarantee implemented)[4]. HVT then exaggerates by speculating that this period may last "twenty years or more[5]". This is hyperbole; it is not based on any facts, or any reasonable reading of the two agreements. In fact, the two agreements anticipate that dam removal will occur simultaneously with the reductions to agricultural diversions to the Project maximum. Thus there will be little, or no period in which the dams are in place and the Project is taking its maximum allocation. HVT's assertion is based on no discernible evidence, and thus does not belong in a credible scientific analysis.

HVT Inappropriately Criticizes the Lack of Quantified Goals in the KBRA: HVT and others have asserted that the KBRA is flawed because it lacks quantified restoration goals. This assertion ignores current state-of-the-art fisheries science. Fisheries scientists now believe that one cannot credibly link management actions such as changing flows, removing dams, improving water quality, and large-scale river restoration with precise quantifiable fish population responses. Trends in

[4] HVT PowerPoint presentation to Klamath Riverkeeper. September 22, 2009.
[5] October 15 version of Settlement Flows and Violations of Hardy II Subsistence Criteria; paragraph 1.

population health can confidently be projected from such restoration activities, but numeric estimates lack reliability and credibility. The agreement does however have goals for the fishery that move far beyond the ESA avoidance-of-extinction protection currently afforded to the river.

The KBRA states that one of the goals of the Agreement is to "*restore and sustain natural production and provide for Full Participation in Harvest Opportunities of Fish Species throughout the Klamath Basin*" This standard moves far beyond a population viability goal such as is embodied in the ESA; it anticipates robust fish populations in order to permit harvest. We have maintained this position throughout the various flow study efforts on the Klamath and Trinity Rivers.

HVT's analysis overemphasizes the importance of fall and early winter flows:

The early fall and winter flows (October through February) are based on a flow analysis known as the "Alternative X-Yurok" flows developed by a federal-state-tribal technical team during settlement negotiations. HVT participated extensively on this team, and did not raise objection at the time, although it was understood that Alt-X-Yurok could eventually form the basis of model runs to determine the effects of the KBRA. Alt X-Yurok was a flow alternative that lowered late-fall flow releases while maximizing habitat in order to minimize the risk of flow shortfalls in the next spring from lack of stored water. From the Alt-X report:

> *"Alternative X-Yurok fall flows are the tech team's attempt to achieve both maximum benefit from instream flows for the biological needs of anadromous salmonids while maximizing water storage for future needs. For example, mainstem spawning habitat for Chinook is nearly maximized in wet water year types (e.g., 1393 CFS = 100% of maximum available habitat), while in dry water year types spawning habitat still exceeds 80% of maximum available habitat (e.g., 927 CFS = 86% of maximum available habitat). By maximizing spawning habitat to the greatest extent feasible, the Alternative X-Yurok recommendation ensures a high likelihood of reproductive success, thereby increasing the likelihood of survival through the early life history phase of salmonids when fish are at their greatest risk of mortality.*

In fact, fall and early winter flow releases affect a relatively small portion of the run (just those that spawn in the mainstem Klamath River), and the flows in the KBRA model runs show that in nearly all cases, flows exceed the 80% of available spawning habitat threshold used as a general guideline in the Hardy Phase 2 report (**Table 1)**.

Table 1: Percent of fall Chinook run from 1978[6]-2000 affected by fall and winter spawning and incubation flows, along with percent of maximum Chinook spawning habitat provided by KBRA flows for the Oct-Nov spawning period. Habitat values greater than the 80% threshold identified in Hardy Phase II are shaded green. The only months that fall below the 80% are from high flows (November 1985), and from years identified for drought-plan relief (1992 and 1994), as well as one other drought year that missed the criteria by less than 3%.

		Percent Maximum Habitat	
Year	Percent of run	October	November
1978	2.4%	87.5%	93.2%
1979	13.7%	86.6%	91.8%
1980	11.5%	91.1%	95.2%
1981	8.9%	88.4%	86.5%
1982	9.4%	84.9%	91.8%
1983	5.8%	95.8%	97.3%
1984	8.4%	98.0%	100.0%
1985	1.8%	98.0%	61.2%
1986	0.5%	94.7%	96.9%
1987	0.8%	94.4%	96.3%
1988	3.8%	91.4%	88.4%
1989	2.3%	85.7%	89.2%
1990	3.2%	94.7%	94.8%
1991	4.9%	90.8%	88.3%
1992	3.0%	77.7%	78.6%
1993	3.0%	52.3%	63.1%
1994	10.0%	91.8%	87.8%
1995	4.0%	54.9%	66.8%
1996	3.4%	86.0%	82.3%
1997	7.5%	95.0%	96.9%
1998	6.9%	97.0%	98.0%
1999	10.7%	96.9%	95.1%
2000	4.0%	98.0%	98.0%
Average	5.7%	88.3%	88.6%

Perhaps the best way to illustrate this point is to take a look at specific years in the recent past, specifically at the 1992-1993 fall Chinook run. The 1992 water year was one of the most severe drought years on record for the Klamath River Basin. August flows at Iron Gate Dam dipped below 400 cfs (less than one-half of Hardy identified 95% subsistence flow needs), and September, October, and November flows all failed to meet either Hardy 95% exceedance subsistence thresholds or Alt-X-Yurok thresholds. No drought plan or coho ESA BiOp was in place to afford any protections from low flow conditions as would be the case under KBRA management.

The fall run Chinook had to endure these extreme drought flows and water quality conditions[7]. Adult Chinook salmon migrated and spawned in these unacceptable conditions, and their progeny hatched out the next spring. By that time, the drought had broken. In fact, the spring of 1993 was one of the wettest on record and high flows persisted well into summer.

[6] 1978 was the year that detailed spawning counts began in the Klamath Basin.
[7] The August, September, October and November flows were 398, 538, 904, and 915 respectively in 1992.

In 1995 and 1996, the progeny of the 1992 fall-run Chinook which had spawned in drought and been raised in high flows, returned to the river. And they kept coming. In fact, 1995 was the highest spawning escapement returns of age-3 fish on record with returns (not counting harvest) approaching 200,000 fish; the following year the same brood produced a record run of age-4 fish. This indicates that fall flows are not the cornerstone of fisheries recovery and sustainability for the Klamath River. Yes, the fall/winter base flows identified in Hardy are important, but as this example shows, the spring rearing and outmigration is also an extremely important time of year. Based on this kind of past performance, the technical team believes that spring flows have priority when evaluating any flow regime.

The Flows under KBRA will not approach the low levels that caused the fish kill. Although HVT does not make this assertion in their latest analysis, they have made this claim in media announcements and in previous versions of their issues paper. So we point out that this too, is wrong.

According to the raw WRIMS output (which does not account for Drought Plan or ESA mandated minimum flows), the only years in which modeled flows at Iron Gate Dam were less than or equal to the flows experienced prior to and during the fish kill at Iron Gate Dam were 1992 and 1994. Those were two of the worst drought years on record in the Basin. The extreme drought conditions of those two years are expressly covered by the Drought Plan and ESA provisions of the KBRA.

The figures below graphically illustrate this point for both August and September.

Figure 1: R32 WRIMS flows compared to flows actually present at Iron Gate Dam during August of fish kill year of 2002 (660 cfs). This figure shows that under KBRA, the <u>only</u> years that would have fallen below this threshold are 1992 and 1994; years that are specifically targeted for drought plan relief.

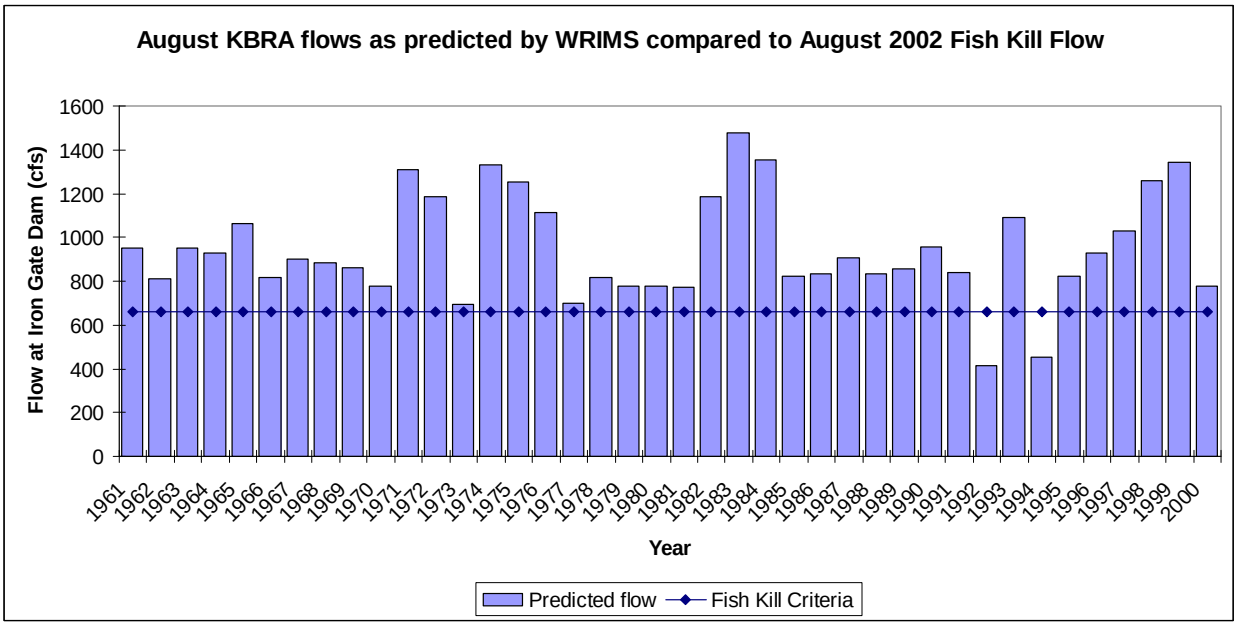
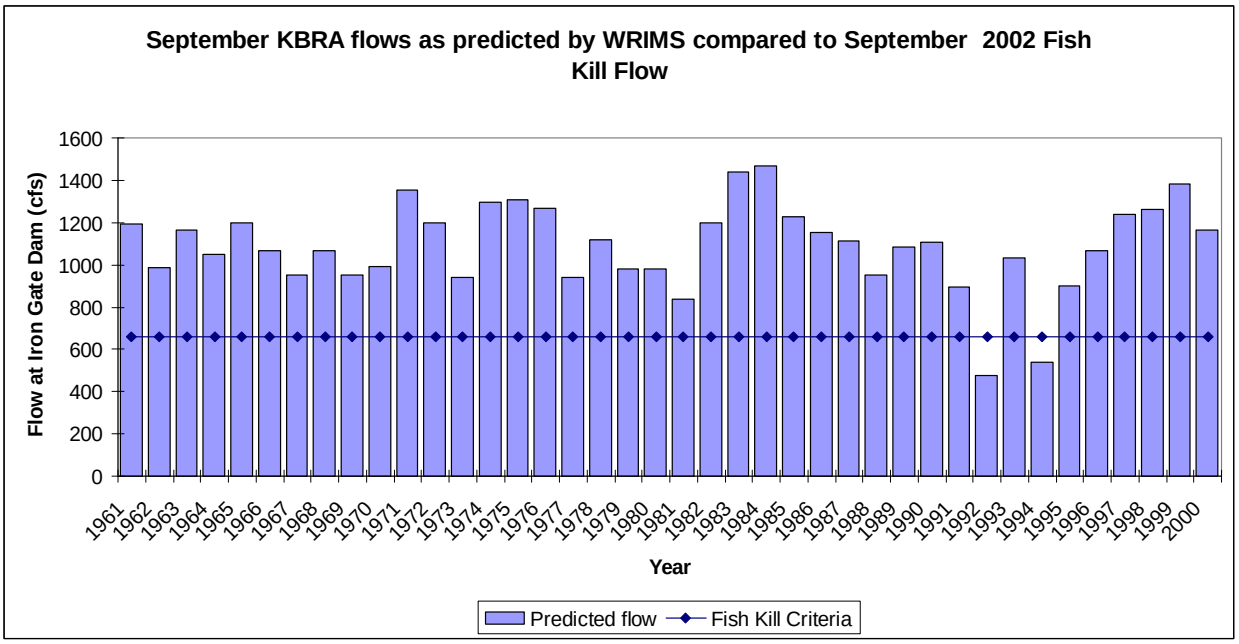


Figure 2: R32 WRIMS flows compared to flows actually present at Iron Gate Dam during September of fish kill year of 2002 (760 cfs). This figure shows that under KBRA, the only years that would have fallen below this threshold are 1992 and 1994; years that are specifically targeted for drought plan relief.



HVT's analysis shows that KBRA flows perform extremely well in the critical March-May time period. Inspection of HVT's analysis shows that during the critical spring months when Chinook fry from not only the Klamath, but from tributaries such as the Shasta and Scott Rivers are present in the mainstem Klamath, there are very few departures from the Hardy subsistence criteria. In fact HVT's own analysis shows that the KBRA flows perform very well during this critical time of year (see previous example of 1992 brood regarding the importance of flow during this time of year).

However, it is not enough to simply provide the fisheries of the Klamath with flow above, or barely above, some sort of subsistence minimum. Analysis of the Hardy Phase 2 flow-habitat curves show that 90% of all available habitat is present for Chinook fry at 2500 cfs, which also provides about 80% of coho fry habitat. The provision of 90% of all available habitat during every time-step[8] of the spring could be considered "excellent" rearing conditions for Chinook fry and juveniles.

During May, the Chinook fry are transitioning to a juvenile life phase, and are typically beginning their migration downstream. The June-July natural hydrograph usually consists of a long, slow decline to summer base flow.

[8] It is acknowledged that flows must be considered on a daily timestep, which they will be under KBRA conditions, however, the WRIMS model only provides monthly and semi-monthly averages.

Using 2500 cfs as a measuring stick[9], it is possible to analyze the KBRA flows to see which years provide for excellent Chinook fry rearing habitat for the entire March-May period. These could be thought of as "excellent" years. Out of the 40 year period of record, 17 of the years have "excellent habitat conditions provided throughout the spring rearing time, with an additional 5 years that miss by less than 10% in a timestep (characterized as "good" in Table 2). In other words, HVT's own analysis attests to the excellence of rearing conditions.

The Yurok Tribe's analysis of spring flows show that excellent and good Chinook fry rearing conditions can be found in the Klamath River near Iron Gate Dam under KBRA management in 22 of the 40 years of the WRIMS analysis.

[9] This is not offered as a complete flow analysis, but 2500 cfs (or more) is identified as a flow which provides substantial habitat for Chinook fry during certain times of year.

Table 2: Spring flow analysis. Numbers shown are relative to a flow of 2500 (i.e. if the value shown is 600, the flow is 2500+600=3100. Thus any positive number represents a flow over 2500 cfs. Flows of over 2500 cfs (provision of 90% plus of available habitat are shaded green. Flows that miss by less than 10% of that flow (i.e. 2250 cfs) are colored light green. Years in which this condition is reached throughout the entire spring are designated as "excellent". Years that come within 10% in no more than two timesteps, but otherwise reach 90% habitat are marked as "good".

	Mar 1-15	Mar 16-31	Apr 1-15	Apr 16-30	May 1-15	May 16-31	
1961	137	489	-126	-380	-742	-607	
1962	-18	0	-297	597	-278	-128	
1963	-218	135	1670	1292	140	193	Good
1964	-97	-113	-684	515	-286	-407	
1965	1639	1986	937	739	142	118	excellent
1966	135	187	-226	218	-258	-395	
1967	454	926	1069	740	1292	1594	excellent
1968	193	566	-358	-802	-1251	-1123	
1969	667	991	3614	3285	493	523	excellent
1970	1326	1600	-112	-737	-426	-357	
1971	2849	3210	4275	3940	2369	2780	excellent
1972	7883	8136	1805	1458	278	295	excellent
1973	62	116	-252	-274	-784	-744	
1974	2999	3360	4562	4202	560	697	excellent
1975	2507	2905	2277	1954	1136	1505	excellent
1976	523	558	363	-246	-366	-368	
1977	-1183	-1185	-1168	-1250	-1456	-1274	
1978	1278	1574	1485	1151	209	159	excellent
1979	-244	-373	-501	-504	-748	-622	
1980	320	620	-149	-313	-488	-386	
1981	-851	-851	-787	-807	-1196	-1060	
1982	3039	3394	3686	3327	380	414	excellent
1983	4680	5000	3394	3139	1474	1828	excellent
1984	3537	3912	3086	2720	943	1292	excellent
1985	374	394	1608	2024	96	-117	good
1986	4095	4366	753	475	88	-96	good
1987	284	582	-389	-460	-713	-777	
1988	-474	-150	-868	-868	-1061	-951	
1989	1976	4151	2693	2407	307	294	excellent
1990	-958	311	-693	-948	-827	-745	
1991	-1260	-1225	-1107	-1067	-1322	-1185	
1992	-1488	-1497	-1455	-1494	-1707	-1681	
1993	-68	3258	3004	2688	420	512	good
1994	-1272	-1367	-1335	-1393	-1592	-1460	
1995	581	2242	1267	944	292	368	excellent
1996	2007	2346	1346	1066	509	723	excellent
1997	871	842	195	273	-66	-137	good
1998	2252	2648	2321	1974	2958	3235	excellent
1999	3639	3949	3642	3258	684	1045	excellent
2000	748	1035	1079	818	75	60	excellent

HVT Raises Concern About August Flows: Based upon unadjusted raw WRIMS output, HVT claims to be concerned about August flows. However, as with the rest of their analysis, HVT fails to account for 1) a drought plan that will prevent the lowest flows evident in current model output, and 2) ESA minimum flow protections, and 3) the conservative nature of current model output.

Furthermore, in 12 of the 20 August flows flagged as "violations" by HVT, it appears that the situation can be remedied by holding excess July flows back, and releasing them in August, something that the WRIMS model was not directed to do, but which flow managers during real-time conditions are perfectly capable of doing. It is clear, however, that August flows will command the attention of the Technical Team charged with managing flows and lake levels.

Dam Removal will unleash a killing plume of anoxic (oxygen-free) water: This assertion is made without any reference or source, and thus is difficult to take seriously. Although the reservoirs do contain anoxic water at certain times of year (summer and fall months), the current plan is to begin reservoir drawdown after the lower layers of the reservoirs become replenished with oxygen. A preliminary search of the scientific literature failed to turn up any relevant examples of this "anoxic" plume despite numerous dam removals regionally (Marmot, Chiloquin, Savage Rapids). The recent Stillwater Sciences report "Effects of sediment release following dam removal on the aquatic biota of the Klamath River" did not even mention this as a possible concern.

Conclusion

HVT's analysis is flawed in fundamental respects. It fails to disclose facts and assumptions made during the WRIMS modeling that HVT has been aware of for some time now. The net effect of these errors is to present an unrealistically gloomy picture of the effects of KBRA flows. Our own analysis shows that the Klamath River will enjoy dramatically increased flows with associated increases in habitat, particularly during the critical spring months. HVT's assertion that this flow regime would, or could, threaten the survival of the Klamath River salmon is without merit, and lacks the support of the currently available scientific evidence.