Technical Memorandum: Update to the Redd Dewatering Analysis Conducted in the California WaterFix Biological Assessment for Fall-run Chinook Salmon and California Central Valley Steelhead in the American River

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During the State Water Resources Control Board Change in Point of Diversion hearings for California WaterFix (CWF), DWR was made aware of data previously thought unavailable and, therefore, not used in the Biological Assessment (BA) effects analysis of redd dewatering risk to fall-run Chinook salmon and California Central Valley steelhead in the American River. These data were collected by USFWS (as reported in USFWS 2011) and Cramer Fish Sciences (unpublished data) and were obtained by the Sacramento Water Forum (Water Forum) for use in their analysis of the Modified Flow Management Standard (Water Forum 2017). These data were graciously provided by the Water Forum to DWR to allow DWR to conduct a revised redd dewatering analysis for CWF, which is described in this technical memo.

The analysis for the American River conducted in the original BA[1] did not rely on actual field data of redd locations and river depths. Rather, the analysis was based solely on changes in modeled flow rates, which limited the certainty in conclusions drawn from the analysis. We have now completed a redd dewatering analysis using the American River redd location and river depth data to confirm the validity of our original conclusions. This technical memo describes the new analysis and compares its results to those of the original analysis in the BA.

The new analysis begins with our original analysis of monthly flow rates, but extends it by adding information on how flow changes can cause changes in stage of the American River and how the latter changes affect the percentage of redds dewatered. The flows used in the new analysis are identical to those used in the original analysis: CalSim II monthly flow estimates for the Nimbus location, which is the upper limit of the primary spawning reach of fall-run Chinook and steelhead in the American River. Using field data provided by ARWA on flow vs. river stage and river stage (depth) vs. proportion of redds found, the CalSim flow data were converted to stage data, and the maximum reduction in river stage relative to the assumed month of spawning was used to compute the percentage of redds dewatered. These analyses were conducted for the egg and alevin incubation periods of the two species for each year of the CalSim period of record. Note that ARWA used temperature modeling to calculate incubation duration. We assumed here a non-temperature dependent incubation period of 3 months. Note also that, although ARWA weighted their redd distribution through space (river mile) and time based on field data, we made no attempt to do so here. In addition, because we have both BA H3+ and CWF H3+ model outputs, we conducted the analysis on both. However, CWF H3+ is the current proposed project.

The results of the new analyses are generally similar to those of our original analyses, with slightly smaller differences among the scenarios. The results lead to the same conclusion as that of the original results, that effects of BA_H3+ or CWF H3+ relative to the NAA on fall-run and steelhead redd dewatering in the American River would be minor. The following summary tables provide the results obtained from the old analysis ("Mean Greatest Percent Flow Reduction") and the new analysis ("Mean Percent Redds Dewatered"):

[1] For a full description of the Methods used in the BA, please see BA Appendix 5.D, *Quantitative Methods and Detailed Results for Effects Analysis of Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale*, Section 5.D.2.2.5, *Redd Dewatering*.

FALL-RUN CHINOOK SALMON

		Mean Greatest Percent Flow Reduction, Difference (Percent Difference) - BA method		Mean Percent Redds Dewatered, Difference (Percent Difference) - ARWA (mod.) method	
Month	Water Year Type	BA_H3+ vs. NAA	CWF_H3+ vs. NAA	BA_H3+ vs. NAA	CWF_H3+ vs. NAA
September	Wet	-1 (-3%)	-1 (-1%)	-1 (-2%)	-2 (-6%)
	Above Normal	-7 (-23%)	-7 (-21%)	-4 (-57%)	-5 (-65%)
	Below Normal	-1 (-41%)	-1 (-41%)	0 (-100%)	0 (-100%)
	Dry	-1 (-26%)	1 (29%)	0 (0%)	0 (0%)
	Critical	-4 (-27%)	-6 (-42%)	-4 (-76%)	-4 (-76%)
	All	-2 (-11%)	-2 (-10%)	-1 (-12%)	-2 (-17%)
October	Wet	-5 (-45%)	-5 (-47%)	-4 (-65%)	-4 (-64%)
	Above Normal	-2 (-46%)	-2 (-41%)	0 (-100%)	0 (-100%)
	Below Normal	2 (44%)	-4 (-82%)	1 (412%)	0 (-100%)
	Dry	-1 (-17%)	-4 (-65%)	0 (-69%)	-1 (-100%)
	Critical	6 (39%)	3 (21%)	3 (83%)	1 (13%)
	All	-1 (-11%)	-3 (-36%)	-1 (-26%)	-1 (-49%)
November	Wet	-11 (-39%)	-11 (-41%)	-7 (-43%)	-8 (-51%)
	Above Normal	-7 (-35%)	-7 (-35%)	-3 (-85%)	-3 (-84%)
	Below Normal	0 (-3%)	-1 (-5%)	0 (-4%)	0 (-6%)
	Dry	0 (-3%)	-1 (-6%)	0 (-2%)	0 (-3%)
	Critical	-5 (-20%)	-4 (-19%)	-4 (-35%)	-4 (-35%)
	All	-5 (-26%)	-6 (-28%)	-3 (-34%)	-4 (-38%)

STEELHEAD

		Mean Greatest Percent Flow Reduction, Difference (Percent Difference) - BA method		Mean Percent Redds Dewatered, Difference (Percent Difference) - ARWA (mod.) method	
Month	Water Year Type	BA_H3+ vs. NAA	CWF_H3+ vs. NAA	BA_H3+ vs. NAA	CWF_H3+ vs. NAA
December	Wet	0 (1%)	0 (0%)	2 (8%)	1 (7%)
	Above Normal	0 (0%)	0 (-1%)	0 (-4%)	0 (-4%)
	Below Normal	0 (0%)	0 (-1%)	0 (1%)	0 (0%)
	Dry	-3 (-8%)	-3 (-9%)	-4 (-15%)	-4 (-15%)
	Critical	1 (8%)	6 (39%)	6 (152%)	6 (171%)
	All	0 (-2%)	0 (0%)	0 (2%)	0 (2%)
January	Wet	0 (0%)	0 (1%)	0 (1%)	1 (2%)
	Above Normal	0 (-1%)	0 (-1%)	0 (-2%)	0 (-2%)
	Below Normal	0 (0%)	0 (0%)	-2 (-6%)	-1 (-3%)
	Dry	0 (1%)	-1 (-2%)	0 (0%)	0 (-1%)
	Critical	5 (62%)	4 (55%)	4 (58%)	3 (34%)
	All	1 (2%)	1 (2%)	0 (2%)	0 (2%)
February	Wet	1 (1%)	1 (1%)	0 (-1%)	0 (-1%)
	Above Normal	4 (8%)	4 (7%)	-1 (-2%)	-1 (-2%)
	Below Normal	6 (12%)	6 (11%)	8 (22%)	5 (14%)
	Dry	0 (-1%)	0 (1%)	0 (2%)	0 (4%)
	Critical	7 (44%)	6 (36%)	3 (104%)	1 (42%)
	All	3 (6%)	2 (6%)	1 (3%)	1 (2%)

References

United States Fish and Wildlife Service (USWFS). 2011. Identification of the Instream Flow Requirements for Anadromous Fish in the Streams within the Central Valley of California and Fisheries Investigations. Annual Progress Report, Fiscal Year 2010. Available at: https://www.fws.gov/lodi/instream-flow/instream_flow_reports.htm

Water Forum. 2017. Lower American River Biological Rationale, Development and Performance of the Modified Flow Management Standard.