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BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

HEARING ON THE MATTER OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UNITED STATES BUREAU OF RECLAMATION REQUEST FOR A CHANGE IN POINT OF DIVERSION FOR CALIFORNIA WATER FIX.	**TESTIMONY OF R. CRAIG ADDLEY, Ph.D**

This testimony is offered on behalf of the American River Water Agencies (ARWA).

I. INTRODUCTION

I have a Bachelor of Science degree in Fisheries and Wildlife, a Master of Science degree in Civil and Environmental Engineering, and a Doctor of Philosophy degree in Civil and Environmental Engineering from Utah State University, Logan, Utah. I have 30 years (1987-Present) experience working on water supply and hydropower projects in the Western United States (California, Oregon, Washington, Alaska, Montana, Nevada, Arizona, and Utah). My expertise includes hydrology, hydrodynamics, instream flow, and water temperature modeling and aquatic ecology, including temperature ecology and bioenergetics of fish (particularly endangered fish species). I have many years of experience designing, modeling, and analyzing water resource project operations that provide resource benefits to people (hydropower, agriculture, municipal and industrial water supply) and natural ecosystems. In California

I have worked on numerous projects in different river systems (such as the American, Klamath, Pit, Stanislaus, Yuba, Santa Ynez, Kaweah, and Rush Creek Rivers). For the past 10 years I have worked extensively in the American and Yuba River basins related to water supply, hydropower, and water rights. I have assisted Placer County Water Agency (PCWA) and the Sacramento Area Water Forum analyze the hydrology and environmental effects of American River water resource operations on the Central Valley Project (CVP) and State Water Project (SWP) and vice versa. I work as a senior consultant at Cardno, Inc., Sacramento. A true and correct copy of my qualifications is provided in Exhibit ARWA-200.

For this hearing, I was asked to analyze the effects of the California WaterFix Project on American River water users related to their water supply from Folsom Reservoir. Along with my colleagues at Cardno, Inc., I prepared a technical memorandum addressing this issue. Exhibit ARWA-202 is a true and correct copy of that memorandum. A PowerPoint presentation that contains a summary of my testimony and the technical memorandum (Exhibit ARWA-202) is provided in Exhibit ARWA-203.

I reviewed the California WaterFix operations as presented in the Bay Delta Conservation Plan/California WaterFix Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS) and the Petitioners' exhibits filed in support of the California WaterFix water right change petition. In particular, I reviewed:

- The WaterFix Folsom Reservoir operations and the effects of those operations on the ability of American River water users to obtain their water supplies from Folsom Reservoir;
- The WaterFix Shasta Reservoir operations in relation to the National Marine Fisheries Service (NMFS) 2009 Biological Opinion and Conference Opinion for the Long-term Operations of the Central Valley Project and the State Water Project (2009 BO) Reasonable and Prudent Alternative (RPA) measures related to Shasta Reservoir storage; and

- How reoperation of Shasta Reservoir to comply with the 2009 BO RPA criteria could affect Folsom Reservoir storage and American River water users.

II. WATERFIX EFFECTS ON FOLSOM RESERVOIR OPERATIONS

Folsom Reservoir modeled operations under California WaterFix Alternative 4A H3 (or other scenarios within Boundary 1 and Boundary 2) and the No Action Alternative (NAA) show that such operations will impact the ability of American River water users to meet water demands in drier years. Figure 1 in Exhibit ARWA-202 shows the Folsom Reservoir operations from California WaterFix Testimony presented in Exhibit DWR-515, Figure 14. In approximately ten percent (10%) of the years, end of September (EOS) storage is below a safe level required for diversion by Folsom Reservoir water purveyors. Folsom Reservoir provides water to multiple municipalities and water users through a single outlet (84-inch diameter) at an elevation of 317 feet National Geodetic Vertical Datum 1929 (NGVD 29) (centerline), which feeds a pumping station. The pumping station head (storage) versus pumping capacity curve is provided in Exhibit ARWA-202, Appendix A – Figure 1, and the monthly deliveries through that outlet for Alternative 4A H3 are shown in Exhibit ARWA-202, Appendix A – Figure 2. Delivery shortages greater than 50 cubic feet per second (cfs) (average for a month) would occur in nine of 82 years (Exhibit ARWA-202, Appendix A – Figure 2), and reservoir levels would be dangerously close to causing delivery restrictions in several other years (Exhibit ARWA-202, Figure 1).

Extremely low EOS storage (carryover storage for the subsequent year) in approximately 10% of the years increases the likelihood that a subsequent severe drought year with very low inflow such as 1977 or 2015 could result in disastrous water supply consequences. The California WaterFix operations would provide inadequate carryover storage in those years when EOS storage is extremely low. (Exhibit ARWA-202, Figure 1). It should be noted that average storage typically decreases after September.

The WaterFix modeling of Alternative 4A H3 (or other scenarios within Boundary 1 and Boundary 2) and NAA represent modeling/operation decisions to maintain south of Delta exports and Delta water quality in the face of estimated future climate change to the determent of upstream local municipal and industrial (M&I) water supply deliveries at Folsom Reservoir. For example, as shown in Exhibit ARWA-202, Figure 1, the EOS storage draw-down on Folsom Reservoir presented in the WaterFix modeling is substantially greater in comparison to EOS storage draw-down in the Existing Conditions modeled in the 2008 Operational Criteria and Plan (OCAP) Biological Assessment study (OCAP BA) without climate change assumptions. Exhibit ARWA-205 is a true and correct copy of the 2008 OCAP BA. The differences in the modeling/operations assumptions have large relative impacts on the water supply security of American River water users. (Exhibit ARWA-205, Ch. 10, p. 10-63, Figure 10-92.)

In my opinion, using the WaterFix NAA as a baseline by which to measure impacts related to WaterFix alternatives is not appropriate. The NAA simulates operations of Folsom Reservoir storage in 5-10% of the driest years in a manner that would result in EOS storage that is far below levels maintained according to current management practices or any future management that would reasonably safeguard water supplies. In September 2015, one of the driest periods on record, Folsom Reservoir storage was at 170 thousand acre feet (TAF) at the end of September. By contrast, the NAA model shows Folsom Reservoir at dead pool (90 TAF) at the EOS for the driest 5% of years. In my opinion, operating Folsom Reservoir to dead pool is not a realistic representation of existing or future operating conditions; when used as a baseline by which to measure WaterFix project changes in storage, it has the effect of significantly understating potential impacts to water users that obtain water from Folsom Reservoir. This, along with concerns identified below related to the NAA operations at Shasta Reservoir, suggests that the NAA as modeled in WaterFix, is not a technically appropriate baseline for absolute or comparative purposes.

III. WATERFIX SHASTA RESERVOIR OPERATIONS

As demonstrated in Exhibit ARWA-202, Figure 3 and Appendix B – Table 1, Shasta Reservoir operations in Alternative 4A H3 (or other scenarios within Boundary 1 and Boundary 2) and NAA do not meet the RPA criteria in either the 2009 BO or Amended 2011 BO that were designed to protect winter-run salmon in the Sacramento River downstream of Shasta Reservoir. The California WaterFix Shasta Reservoir EOS storage is on average 442 TAF below what is required by the 2009 BO RPA performance criteria. (See Exhibit ARWA-202, Figure 3 and Appendix B – Table 1.)

Exhibit ARWA-202, Figure 3 shows Shasta Reservoir EOS storage as presented in the California WaterFix Testimony (Exhibit DWR-515, Figure 12) compared to the 2009 BO RPA requirements and the 2008 OCAP BA modeling (Exhibit ARWA-205, Ch. 10, p. 10-32, Figure 10-46). Exhibit ARWA-202, Appendix B – Figure 1 shows that the 10-year running average of Shasta Reservoir EOS storage as specified in the 2009 BO RPA (Exhibit ARWA-202, Appendix B – Tables 1 and 2) does not meet the 2009 BO RPA requirements.

Supplemental information provided in Exhibit ARWA-202, Appendix C illustrates that Shasta Reservoir EOS operations under Alternative 4A H3 (or other WaterFix Alternatives or the NAA) are not viable operations in relation to winter-run Chinook salmon temperature protection criteria and would have to be modified. For example, Exhibit ARWA-202 Appendix C demonstrates that, as specified in the 2009 BO RPA, (1) spring Shasta Reservoir storage (e.g., April/May) directly affects water temperature downstream of Keswick Reservoir (Exhibit ARWA-202, Appendix C – Figure 1); (2) Shasta Reservoir EOS storage has a direct effect on water temperature downstream of Keswick Reservoir the following year (lower storage equates to higher water temperature) (Exhibit ARWA-202, Appendix C – Figure 2); and (3) modeled Alternative 4A H3 (or other WaterFix Alternatives or NAA) water temperatures result in a large increase in water temperature compared to the WaterFix RDEIR/SDEIS Existing Conditions scenario (Exhibit ARWA-202, Appendix C – Figure 3). In addition, the

modeled Alternative 4A H3 (or other WaterFix Alternatives or NAA) water temperatures exceed the 2009 BO criteria, State Water Resources Control Board (SWRCB) Orders WR 90-5 and WR 91-1 criteria, Basin Plan Criteria for the Central Valley Region (Basin Plan), and the thermal tolerance of winter-run Chinook salmon egg incubation. (Exhibit ARWA-202, Appendix C.) Also, increasing the water temperature downstream of Shasta Reservoir under Alternative 4A H3 compared to Existing Conditions is contrary to how the reservoir is currently being managed to reduce water temperatures in the Sacramento River downstream of Keswick Dam below 56 degrees Fahrenheit (e.g., Exhibits ARWA-207, ARWA-208, and ARWA-209). Exhibit ARWA-207 is a true and correct copy of a March 31, 2016 NMFS letter regarding temperature management below Keswick Dam; Exhibit ARWA 208 is a true and correct copy of a June 27, 2016 Bureau of Reclamation (Reclamation) letter regarding temperature management below Keswick Dam; Exhibit ARWA-309 is a true and correct copy of a June 28, 2016 NMFS letter regarding temperature management below Keswick Dam.

Because the WaterFix NAA scenario does not represent a viable operation that meets the existing Shasta Reservoir storage or water temperature requirements downstream of Shasta Reservoir (e.g., those mandated by the 2009 BO RPA, SWRCB Orders WR 90-5 and WR 91-1 criteria or Basin Plan criteria), the NAA as modeled in WaterFix is not a technically appropriate baseline for absolute or comparative purposes.

IV. COMPLIANCE WITH SHASTA RESERVOIR 2009 BO RPA EFFECTS ON FOLSOM RESERVOIR

Compliance with the 2009 BO RPA Shasta Reservoir EOS storage criteria, designed to protect winter-run Chinook salmon, requires much higher Shasta Reservoir EOS storages than modeled in the California WaterFix operations. Specifically, in order to comply with the 2009 BO RPA, Shasta Reservoir EOS storage would need to be, on average, 442 TAF higher (Exhibit ARWA-202, Figure 3). If other California WaterFix deliveries were held static (e.g., Delta water quality and Delta exports) as depicted in the

Petitioners' evidence and testimony, the primary potential operational solution to comply with 2009 BO RPA would be to greatly increase draw-down of Folsom Reservoir storage compared to modeled storage. Conservatively, assuming only 50% of the approximately 422 TAF of the water came from Folsom Reservoir, the results would still have a very large impact on Folsom Reservoir storage. This adverse effect on Folsom storage is illustrated in Figure 4 of Exhibit ARWA-202. Such operations would result in injury to American River water users in many years. Additionally, another 200 TAF or more of water would have to come from some other part of the CVP/SWP system.

V. CONCLUSION

Future operation of Folsom Reservoir as disclosed in the California WaterFix RDEIR/SDEIS and California WaterFix water right change petition exhibits represents, to the best of MY knowledge, how the WaterFix would affect operations of the CVP/SWP. As demonstrated in my technical memorandum (Exhibit ARWA-202), those operations result in extremely low EOS Folsom Reservoir storage that would cause injury to American River water user diversions in dry years and would not include adequate carryover storage to protect against the second year of a drought sequence. The injury could be greatly exacerbated given that the California WaterFix operations disclosed at Shasta Reservoir would need to be modified (e.g., storage increased to comply with the 2009 BO RPA) and would require additional water releases from Folsom Reservoir; these WaterFix-related operational changes would result in further injury to American River water users in many years.

To summarize, the key findings of my analysis are that:

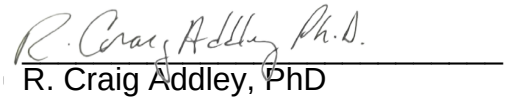
- Modeled California WaterFix storage operations at Folsom Reservoir limit American River water users' access to water from Folsom Reservoir in dry years, resulting in injury.
- Modeled California WaterFix operations do not comply with the EOS storage criteria in Shasta Reservoir as specified in the 2009 BO RPAs - modeled storage is much lower than the storage specified in the 2009 BO to protect

water temperature in winter-run salmon spawning/incubation habitat.

- Compliance with the 2009 BO RPA (also various water temperature criteria) would require increased storage in Shasta Reservoir, which would cause larger draw-downs of Folsom Reservoir than disclosed in the modeling (if other portions of the system remain as modeled) and the result would be further injury to American River water users in many years.
- The WaterFix NAA is not a technically appropriate baseline (for absolute or comparative purposes) because it does not adequately depict Folsom Reservoir storage in the driest years and does not meet Shasta Reservoir storage requirements in the 2009 BO, nor does it comply with various applicable water temperature criteria.
- It is my opinion that operations criteria for Folsom Reservoir that provide storage protection (with a safety factor) for both individual years and carryover storage for multiple year drought sequences are necessary to prevent injury to the American River water users and should be included in DWR's/Reclamation's water rights permit terms related to the California WaterFix Project.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Executed on this 31st day of August 2016 in Auburn, California.



R. Craig Addley, PhD