EXHIBIT ARWA-600

PART 2 TESTIMONY OF JEFFREY WEAVER, P.E.

1. I am a registered civil engineer in the State of California and am employed by the firm HDR Engineering, Inc. I hold a Bachelor Science degree in Civil Engineering from the University of California, Davis.

2. My education and experience are set forth in more detail in paragraphs 2 and 3 of my testimony for Part 1 of this hearing, which is **Exhibit ARWA-100**, and my resume, which is Exhibit **ARWA-101**.

3. **Exhibit ARWA-501** is a joint PowerPoint presentation that summarizes key points of my testimony. That exhibit represents the "summary of testimony" requested by the SWRCB.

4. My testimony primarily concerns my analysis, using the CalSim II hydrologic model and the Sacramento River Water Temperature model, of the effects of implementing the Lower American River Modified Flow Management Standard (Modified FMS) being proposed in this hearing by the Sacramento Water Forum (Water Forum) and the American River Water Agencies (ARWA) group as terms and conditions on the Bureau of Reclamation's (Reclamation) water-right permits for Folsom Dam and Reservoir (Permits Nos. 11315 and 11316). Those terms and conditions are contained in **Exhibit ARWA-502**.

5. My work concerning the Modified FMS for this hearing is an extension of many years of work that I have done concerning water management related to the lower American River as a consultant to the Water Forum. The Water Forum's members comprise water suppliers, public agencies, environmental groups, business interests and civic organizations who seek to manage the lower American River to meet coequal objectives of providing reliable water supplies and supporting protecting the river's environmental resources.

Modeling of Modified FMS

6. Background regarding the CalSim II hydrologic model is available in paragraphs 6 to 11 of my testimony for Part 1 of this hearing (Exhibit ARWA-100), and in Technical Memorandum 2, *Lower American River Modified Flow Management Standard – CalSim II Assumptions* (TM 2), which is **Exhibit ARWA-603**.

7. I have reviewed the technical memorandum that is Technical Memorandum 1, *Project Description – Lower American River Modified Flow Management Standard* (TM 1), which is **Exhibit ARWA-602**. To the best of my knowledge, TM 1 accurately describes the Modified FMS. The description of the Modified FMS contained in TM 1 provided the basis for my modeling of the Modified FMS's effects using the CalSim II hydrologic model.

8. As described in TM 1, the Modified FMS is a refinement of the 2006 lower American River flow management standard (2006 FMS), which has been implemented by Reclamation since 2007 and was essentially incorporated by the National Marine Fisheries Service into its 2009 biological opinion for Central Valley Project (CVP) and State Water Project (SWP) operations.

9. I have reviewed the proposed water-right terms and conditions that would implement the Modified FMS that are contained in **Exhibit ARWA-502.** Those terms and conditions are consistent with the description of the Modified FMS in TM 1 and with the manner in which I analyzed the effects of the Modified FMS using the CalSim II model.

10. TM 2 accurately describes how I used CalSim II to model the effects of implementing the Modified FMS. Where TM 2 indicates that "the Water Forum" made a decision about how to model the Modified FMS, I participated in that decision and my work in modeling the effects of implementing the Modified FMS reflects that decision.

11. In addition to my modeling work, I also was the primary author of the *Rationale, Objectives, and Assessment Methodology for Water and Power Resources for the Modified Flow Management Standard*, which is **Exhibit ARWA-601**. The purpose of that document is to describe the hydrological objectives and the hydrological rationale for the Modified FMS's elements.

12. After modeling any given operation of CVP and SWP facilities, CalSim II generates an extensive collection of results reflecting various hydrologic conditions at different locations in the CVP and SWP systems. Those conditions include reservoir storage levels and streamflows, among other things.

13. The *Rationale, Objectives, and Assessment Methodology for Water and Power Resources for the Modified Flow Management Standard*, which is **Exhibit ARWA-601** contains selected results of my CalSim II modeling of the effects of the Modified FMS. These results include:

    - Folsom Reservoir storage and American River streamflows;
    - Shasta Reservoir storage;
    - Storage in the CVP's Trinity Reservoir and in the SWP's Oroville Reservoir; and,
    - North-of-Delta and South-of-Delta CVP and SWP deliveries, including deliveries to specified classes of settlement contractors and south-of-Delta CVP contractors.

14. Consistent with the Modified FMS's objective to maintain sufficient Folsom Reservoir carryover storage to keep reservoir levels above its municipal and industrial intake during droughts, the CalSim modeling results in **Exhibit ARWA-601** show that, under the assumed conditions, implementation of the Modified FMS would maintain at least 300,000 in Folsom Reservoir carryover storage at the end of December in all but seven years of CalSim II's 82-year period of record. The modeling results in **Exhibit ARWA-601** show that, in those remaining seven years, implementation of the Modified FMS would maintain end-of-December Folsom Reservoir storage above 230,000 acre-feet.

15. In order to identify any effects that implementing the Modified FMS might have on Sacramento River water temperatures, I imported the results of the CalSim II modeling that I conducted into the Sacramento River Water Temperature Model (SRWTM) developed by Reclamation. Kristin White at Reclamation provided the SRWTM to me in January 2016**.** Technical Memorandum 3, *Lower American River Flow Management Standard Technical Memorandum, Sacramento River Water Temperature Model Assumptions*, which is **Exhibit ARWA-604** (TM 3) accurately describes how I used the SRWTM to model the effects on Shasta Reservoir's cold-water pool and Sacramento River water temperatures, of implementing the Modified FMS. Where TM 3 indicates that "the Water Forum" made

a decision about how to model the Modified FMS, I participated in that decision and my work in modeling the effects of implementing the Modified FMS reflects that decision.

16. The results of my modeling of the Modified FMS using the SRWTM for Shasta Reservoir cold-water pool at 49 degrees Fahrenheit (depicted on the same figures as Shasta Reservoir storage) are contained in *Rationale, Objectives, and Assessment Methodology for Water and Power Resources for the Modified Flow Management Standard*, which is **Exhibit ARWA-601**.

17. The results of my modeling of the Modified FMS using the SRWTM for Sacramento River water temperatures below Keswick Dam, at Ball's Ferry, and at Red Bluff are contained primarily in Attachment F of the *Biological Rationale, Development and Performance of the Modified Flow Management Standard*, (**Exhibit ARWA-702**) as well as in the *Rationale, Objectives, and Assessment Methodology for Water and Power Resources for the Modified Flow Management Standard.* (Exhibit ARWA-601).

18. **Exhibits ARWA-504** and **ARWA-505** contain modeling results from the modeling that DWR and Reclamation conducted for the Cal WaterFix biological assessment (BA). In or about July 2017, I extracted these results from the CalSim II modeling that DWR made available for the BA. These exhibits contain modeling results for Folsom Reservoir storage in the Q0 (current) and Q5 (central tendency) climate change scenarios.