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BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

HEARING IN 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 MICHAEL BRYAN (EXHIBIT DWR-1017)

I, Michael Bryan, do hereby declare:

INTRODUCTION

I am a Principal Scientist and Managing Partner at Robertson-Bryan, Inc. (RBI). I received a Bachelor of Science degree in Fisheries Biology from the University of Wisconsin-Stevens Point in 1986, a Master of Science degree in Fisheries Biology from Iowa State University in 1989, and a Doctor of Philosophy degree in Toxicology and Fisheries Biology from Iowa State University in 1993. I have 23 years of experience assessing impacts of water resource projects on water quality and aquatic biological resources in California. My expertise includes assessing measured and modeled data developed to characterize the environmental effects of projects in order to determine impacts to beneficial uses of waters throughout northern California, with a focus on Central Valley water bodies from Shasta Reservoir to the Sacramento-San Joaquin River Delta (Delta).

For the California WaterFix (CWF), I led a team of scientists and engineers at RBI in the preparation of the Water Quality Chapter of the Bay Delta Conservation Plan (BDCP) Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS), BDCP/CWF Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS), and Final Environmental Impact Report/Environmental Impact Statement (FEIR/FEIS). A true and correct copy of my statement of qualification is submitted as Exhibit DWR-33.

SUMMARY OF TESTIMONY

In October 2015 DWR and Reclamation petitioned the State Water Resources Control Board (State Water Board) for the addition of three new points of diversion on Petitioners' water rights permits. In testimony submitted in Part 1 of this hearing, the project was described as Alternative 4A with initial operational criteria that would fall within a range of operations described as H3 to H4. These operational criteria were described in the Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS). For purposes of Part 2 of the hearing, including this testimony, the California WaterFix project is described by Alternative 4A under an operational scenario described as H3+ that is set forth in the FEIR/FEIS and supplemental information adopted by DWR through the issuance of a Notice of Determination in July 2017. The adopted project is thus referred to as CWF H3+. Additional information is also referenced in this testimony from documents released prior to July 2017, including the Alternative 4A described in the FEIR/FEIS and Biological Assessment (BA).
The interrelationship and use of these terms is further described in the testimony of Ms. Buchholz, Exhibit DWR-1010.

My previous testimony (Exhibit DWR-81) for Part 1 of this hearing addressed the effects of implementing the CWF on cyanobacteria blooms, with an emphasis on *Microcystis* blooms, in the lower Sacramento River, the lower American River, and the Delta, based on the CWF operations being within the range defined by Alternative 4A, operational scenarios H3, H4, Boundary 1 and Boundary 2. Based on my assessments summarized in this testimony, the opinions I reached in my prior testimony (Exhibit DWR-

81) regarding the effects of the CWF on cyanobacteria blooms in the lower Sacramento River, lower American River, and Delta also pertain to CWF H3+. I prepared a technical report to support my opinions set forth in this testimony (Exhibit DWR-1035). This report (Exhibit DWR-1035) is incorporated into this testimony.

Opinion #1:

My opinions pertaining to the hydrologic, hydrodynamic, and temperature effects of the CWF on cyanobacteria blooms, with an emphasis on Microcystis blooms, in the lower Sacramento River, lower American River, and Delta for CWF H3+ are unchanged from those presented in DWR-81.

LOWER SACRAMENTO RIVER

River Velocities and Water Temperatures

My testimony in Exhibit DWR-81, as supported by DWR-651, described how a range of operational scenarios of the CWF would affect cyanobacteria blooms in the lower Sacramento River, with an emphasis on *Microcystis* blooms. A component of my testimony related to how the CWF would affect river velocities and how, in turn, CWF-driven changes to river velocities, relative to velocities that would occur for the No Action Alternative (NAA), would affect *Microcystis* blooms in the lower Sacramento River, near river mile (RM) 58. CWF H3+ would result in probability distributions of river channel velocities at the location assessed (RM 58) that are similar to those that I assessed previously for Alternative 4A, operational scenarios H3 and H4 (Exhibit DWR-1035).

In addition to previously assessing the effects of river channel velocities resulting from the CWF on cyanobacteria blooms in the lower Sacramento River, I also assessed the effects of altered water temperatures due to the CWF on the potential for blooms to occur in the river. The modeled temperature data I relied upon in my prior analysis of temperature effects of the CWF on *Microcystis* blooms in the lower Sacramento River (Exhibit DWR-651) utilized temperature modeling data for Alternative 4A, operational scenario H3+ that was originally presented in the CWF BA (BA H3+). For BA H3+ and CWF H3+, very similar incremental changes were modeled, relative to the NAA, for upstream Shasta, Oroville, and Folsom reservoir storage and monthly average lower Sacramento, Feather, and lower American river flows. (Exhibit SWRCB-108, Section 5.1, Figures 3–8, pp. 135–138 and Figures 18–22, pp. 144–148.) The minor changes in upstream reservoir storage and river flows for CWF H3+ compared to BA H3+ would be expected to have negligible effects on lower Sacramento River water temperatures in the stretch of the lower Sacramento River in close proximity to the legal Delta (e.g., City of Sacramento Water Treatment Plant at RM 60). As stated in Exhibit DWR-81 (p. 18:4-8), by the time water released from upstream reservoirs reaches the Delta, it is typically at or close to equilibrium with ambient air temperatures. Based on these findings, I would expect that lower Sacramento River temperatures in the vicinity of the City of Sacramento Water Treatment Plant for the CWF H3+ would differ little, if at all, from that modeled for BA H3+, which I assessed previously (Exhibit DWR-651; Exhibit DWR-81). As such, my prior evaluation and conclusions regarding temperature effects of BA H3+ on *Microcystis* blooms in the lower Sacramento River similarly apply to CWF H3+.

Because CWF H3+ would result in probability distributions of river channel velocities at the location assessed (RM 58) that are similar to those I assessed previously (DWR-1035), and because my previous assessment of BA H3+ temperature can be applied to CWF H3+, my prior testimony presented in Part 1 of this hearing pertaining to lower Sacrament River channel velocity and temperature effects of the CWF on cyanobacteria blooms also applies to CWF H3+. It remains my opinion (Exhibit DWR-81, p. 4:19–22, Opinion #1) that the effects of the CWF, including under CWF H3+, on lower Sacramento River flow velocity and water temperatures would not be sufficient to change the frequency or magnitude of cyanobacteria blooms that could potentially occur in the river upstream of the Sacramento Water Treatment Plant intake, relative to the NAA.

LOWER AMERICAN RIVER

River Flows and Water Temperatures

The modeled lower American River flow and temperature data I relied upon in my prior analysis of temperature effects of the CWF on cyanobacteria blooms in the lower

American River (Exhibit DWR-651) utilized lower American River flow and temperature data output from modeling performed for BA H3+. Under both BA H3+ and CWF H3+, very similar incremental changes were modeled, relative to the NAA, for Folsom Reservoir storage and monthly average river flows at Nimbus Dam (Exhibit SWRCB-108, Section 5.1, Figures 7–8, pp. 137–138 and Figure 21, p. 147). Based on these findings, I would expect that lower American River flows and temperatures for the CWF H3+ would differ little, if at all, from that for BA H3+, which I assessed previously (Exhibit DWR-651; Exhibit DWR-81). As such, my prior evaluation and conclusions regarding flow and temperature effects of BA H3+ on *Microcystis* blooms in the lower American River similarly apply to CWF H3+.

It remains my opinion (Exhibit DWR-81, p. 8:22–26, Opinion 2) that the effects of the CWF, including under CWF H3+, on lower American River flows and water temperatures would not be sufficient to substantially change the frequency or magnitude of cyanobacteria blooms that could potentially occur in the river, relative to the NAA.

DELTA

Channel Velocities

My testimony in Exhibit DWR-81, as supported by Exhibit DWR-653, described how a range of operational scenarios of the CWF would affect cyanobacteria blooms in the Delta, with an emphasis on *Microcystis* blooms. A component of my testimony related to how the CWF would affect Delta in-channel velocities and how, in turn, CWF-driven changes to in-channel velocity, relative to velocities that would occur for the NAA, would affect *Microcystis* blooms in the Delta. CWF H3+ would result in probability distributions of river channel velocities at the nine Delta locations that are similar to those I assessed previously for Alternative 4A, operational scenarios H3 and H4 (Exhibit DWR-1035). Consequently, my prior testimony (Exhibit DWR-81, Opinion #5) presented in Part 1 of this hearing, pertaining to the hydrodynamic effects of the CWF on *Microcystis* blooms in the Delta, also applies to the CWF as defined by CWF H3+.

It remains my opinion (Exhibit DWR-81, p. 15:17–21, Opinion #5) that although *Microcystis* blooms are expected to occur at certain Delta locations in the future, as they have historically, channel velocities at various Delta locations would not be altered to a degree that would make hydrodynamic conditions substantially more conducive to *Microcystis* blooms for the CWF, including under CWF H3+, relative to that which would occur for the NAA.

Temperature

The modeled temperature data that I used for my prior assessment of how the CWF would affect Delta water temperatures and how such effects on temperature would, in turn, affect cyanobacteria blooms in the Delta (Exhibit DWR-653) were obtained from the CWF BA, which modeled operational scenario H3+ (BA H3+). As noted above, under both BA H3+ and CWF H3+, very similar incremental changes were modeled, relative to the NAA, for upstream reservoir storage and monthly average river flows. (Exhibit SWRCB-108, Section 5.1, Figures 3–8, pp. 135–138 and Figures 18–24, pp. 144–150.)

As stated in Exhibit DWR-81 (p. 18:4-8), by the time water released from upstream reservoirs reaches the Delta, it is typically at or close to equilibrium with ambient air temperatures. As such, and as stated in the FEIR/FEIS, page 8-262, ambient meteorological conditions are the primary driver of Delta water temperatures, and thus climate warming and not water operations will determine future water temperatures in the Delta. Consequently, minor changes in upstream reservoir storage and river flows for CWF H3+ compared to BA H3+ would be expected to have negligible effects on Delta water temperatures.

Based on similar modeled incremental changes in upstream reservoir storage and river flow, coupled with the fact that Delta water temperatures are typically at or near equilibrium with ambient air temperatures, I would expect that Delta water temperatures for the CWF H3+ would differ little, if at all, from that modeled for BA H3+, which I assessed previously (Exhibit DWR-653; Exhibit DWR-81). As such, my prior evaluation and conclusions regarding temperature effects of BA H3+ on *Microcystis* blooms in the Delta similarly apply to CWF H3+. Consequently, it remains my opinion (Exhibit DWR-81, p. 17:26–28, Opinion #7) that the small differences in water temperature between the CWF and NAA scenarios modeled for various locations across the Delta would not substantially increase the frequency or magnitude of cyanobacteria blooms within the Delta.

Opinion #2:

My opinion pertaining to the turbidity effects of CWF H3+ on cyanobacteria blooms in the Delta, relative to that which would occur for the NAA, are unchanged from those presented in Exhibit DWR-81.

Turbidity

As stated in the FEIR/FEIS, the CWF, operational scenario H3+, is expected to have a minimal effect on total suspended solids (TSS) and turbidity levels in the Delta, relative to the NAA. (Exhibit SWRCB-102, Section 8.3.4.2, pp. 8-971 – 8-972.) This is also the case for the CWF, as defined by CWF H3+. This is because the factors that would affect TSS and turbidity within the Delta would remain the same under both operationally defined scenarios. Turbidity and TSS levels in Delta waters are affected by TSS concentrations and turbidity levels of inflows (and associated sediment load), as well as fluctuation in flows within the Delta channels due to the tides, with sediments depositing as flow velocities and turbulence are low at periods of slack tide, and sediments becoming suspended when flow velocities and turbulence increase when tides are near the maximum. Turbidity and TSS variations can also be attributed to phytoplankton, zooplankton and other biological material in the water. These factors would be similar under the various CWF operational scenarios, including CWF H3+, and would differ minimally from that which would occur for the NAA.

In addition, it is the absolute daily velocities in Delta channels, regardless of direction of flow, that generate much of the turbidity at any given site. Because CWF H3+ would result in probability distributions for in-channel flow velocities that are similar to those I assessed previously for the CWF operational scenarios H3 and H4, and would differ little from that for the NAA for the nine Delta locations assessed (Exhibit DWR-1035), in-channel, velocity driven turbidity also would be expected to differ little among these scenarios. Also, as I testified to previously, cyanobacteria are not light limited in the Delta from June through November when other conditions are suitable for blooms (Exhibit DWR-

653). Because Delta turbidity for CWF H3+ would not differ substantially, if at all, from turbidity levels that would occur for operational scenarios assessed previously, my prior testimony (Exhibit DWR-81, p. 18:18-19, Opinion #8) presented in Part 1 of this hearing, pertaining to the turbidity effects of the CWF on cyanobacteria blooms in the Delta, also applies to the CWF as defined by CWF H3+.

Consequently, it remains my opinion (Exhibit DWR-81, p. 18:18–19, Opinion #8) that any minor change in turbidity that may occur from the CWF, including under CWF H3+, would not have a substantial effect on the frequency or magnitude of cyanobacteria blooms in the Delta.

Executed on this 28th day of November, 2017 in Sacramento, California.

Michael D. Bryan

Michael Bryan