CITY OF STOCKTON
Office of the City Attorney
JOHN M. LUEBBERKE, ESQ (SBN 164893)
TARA MAZZANTI, ESQ, (SBN 186690)
City Attorney
425 N. El Dorado Street, 2nd Floor
Stockton, CA 95202-1997
Telephone: (209) 937-8333
Facsimile: (209) 937-8898
john.luebberke@stocktonca.gov
tara.mazzanti@stocktonca.gov

SOMACH SIMMONS & DUNN
A Professional Corporation
PAUL S. SIMMONS, ESQ. (SBN 127920)
KELLEY M. TABER, ESQ. (SBN 184348)
KRISTIAN C. CORBY, ESQ. (SBN 296146)
500 Capitol Mall, Suite 1000
Sacramento, CA 95814
Telephone: (916) 446-7979
Facsimile: (916) 446-8199
psimmons@somachlaw.com
ktaber@somachlaw.com
kcorby@somachlaw.com

Attorneys for CITY OF STOCKTON

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.	**PART 2 REBUTTAL TESTIMONY OF SUSAN PAULSEN, Ph.D., P.E.**

QUALIFICATIONS

My name is Susan Paulsen. I am a Registered Professional Civil Engineer in the State of California and expert in the areas of hydrology, hydrogeology, hydrodynamics, aquatic chemistry, and the environmental fate of a range of constituents. My educational and professional qualifications and experience are described in detail in Exhibits STKN-25 and STKN-26, previously submitted in this proceeding.

TESTIMONY

Previously in this proceeding, in oral and written testimony (Exhibit STKN-25) and supporting expert report (Exhibit STKN-26), I described how the California WaterFix (CWF) will impact the City of Stockton's ("Stockton" or "City") municipal water supply derived from its intake on the San Joaquin River. My testimony and exhibits (STKN-25 and STKN-26) were based on the California WaterFix operating scenarios identified by the Department of Water Resources ("Petitioners" or "DWR") in their Part 1 Case in Chief testimony. (See, e.g., DWR-71, pp. 2:12-24, 14:7-13 [identifying operating scenarios Alternative 4A, H3 and H4 as well as Boundaries 1 and 2]); see also DWR-1010, p. 3:2-5.) On November 30, 2017, DWR submitted various exhibits identifying a new "approved" operating scenario for the California WaterFix, identified as CWF H3+. (See, e.g., DWR-1010 at pp. 2:15-16, 3:12-13, 7:12-8:10; DWR-1011, DWR-1015, DWR-1016, DWR-1077, DWR-1078.) Stockton retained Exponent to evaluate whether WaterFix operations under scenario CWF H3+ will have an impact on San Joaquin River water quality and in particular at the location of Stockton's intake. The results of Exponent's work are the basis for the following opinions:

1. WaterFix Operating Scenario CWF H3+ will have greater water quality impacts at Stockton's intake than the impacts described in Exhibits STKN-25 and STKN-26 for existing conditions, the NAA, and all other WaterFix Scenarios.

I have evaluated the extent to which WaterFix operations under scenario CWF H3+ would affect San Joaquin River water quality at the location of Stockton's intake. Scenario CWF H3+ was modeled using DSM2 with similar operations as those described for H3 and H4 (DWR-1069). However, there are some differences in operations that have water quality implications. Most applicable to Stockton, CWF H3+ includes higher spring outflow requirements which are met by reducing south Delta exports, and therefore less Sacramento River water is moved through the Delta. As a result, DSM2 results show higher salinity in the interior Delta (DWR-1015, p.4:4-7). In addition, the fall Delta export restrictions are removed from Scenario CWF H3+ during November and December, which results in a "lower net Delta outflow and higher salinity in the fall and winter months" (DWR-1015, p.4:10-13).

Consistent with the salinity impacts described by DWR, my analysis of salinity impacts from Scenario CWF H3+ operations shows that Scenario CWF H3+ would result in the fewest days of useable water for Stockton of all WaterFix scenarios, including Boundary 2 (discussed previously in STKN-26 as the Part 1 WaterFix scenario resulting in the fewest number of usable water days for Stockton). CWF H3+ will adversely affect the quality of water diverted by Stockton for municipal and industrial beneficial uses by increasing the levels of chloride relative to baseline conditions (i.e., EBC2 and No Action Alternative scenarios). DSM2 results at node 33 (the approximate location of Stockton's intake) show that over the 16-year model simulation period, CWF H3+ operations result in 848 days with chloride concentrations greater than 110 mg/L (Table 1). The existing conditions (EBC2) and NAA scenarios resulted in 454 and 572 days of chloride concentrations greater than 110 mg/L, respectively (Table 1); thus, relative to existing conditions (EBC2) and NAA, CWF H3+ increases the time during which Stockton cannot use their drinking water intake in the Delta by 87 percent and 48 percent, respectively. The Boundary 1 and Boundary 2 scenarios result in 629 and 759 days of chloride concentrations greater than 110 mg/L, such that the CWF H3+ scenario increases the time during which Stockton cannot use its drinking water intake by 35 and 12 percent, respectively, relative to these scenarios.

Table 1. Number of equivalent days per year that water at Stockton's intake *exceeds* 110 mg/L chloride for WaterFix model scenarios for each water year between 1976 and 1991 (update to STKN-26 Table 4).

Water year	Water Year Type	Total Days	Number of equivalent days per year water at Stockton's intake exceeds chloride threshold of 110 mg/L[1]						
			EBC2	NAA	H4	B1	H3	B2	CWF H3+
1976	Critical	366	25	0	29	11	30	87	30
1977	Critical	365	9	76	70	56	73	71	88
1978	Normal	365	45	82	74	105	78	24	110
1979	Normal	365	12	29	19	33	18	31	18
1980	Normal	366	50	23	4	34	12	1	12
1981	Dry	365	12	14	47	5	46	82	58
1982	Wet	365	20	23	2	30	2	4	30
1983	Wet	365	0	0	0	0	0	0	0
1984	Wet	366	0	0	0	0	0	0	0
1985	Dry	365	7	1	42	7	42	76	42
1986	Wet	365	26	20	7	4	7	15	7
1987	Dry	365	11	6	47	63	47	81	63
1988	Critical	366	15	10	33	18	29	88	49
1989	Dry	365	93	125	107	109	105	71	145
1990	Critical	365	54	24	12	11	10	57	22
1991	Critical	365	75	139	126	143	135	72	175
Summary	(all)		454	572	619	629	634	759	848

Note: Because the City can turn its intake on and off over relatively short timescales, "equivalent" days are presented here, which are calculated from the number of one-hour intervals during which chloride exceeded 110 mg/L.

2. Based on the similarity of CWF H3+ to Scenarios H3 and H4, I expect that operation of California WaterFix under CWF H3+ will increase the likelihood of *Microcystis* blooms in the Delta, as these scenarios have similar impacts to those described in Exhibits STKN-25 and STKN-26 with respect to residence time in the Delta and *Microcystis* growth.

The analysis of channel velocities presented in DWR-1035 shows the probability of exceedance for 15-minute absolute velocities, and maximum daily velocities for CWF H3+, in addition to NAA, H3, H4, and BA H3+. As I have testified in the past, presenting velocity data in this format is not useful for determining the residence time of water in the Delta, because maximum velocities and absolute values of velocity are largely unrelated

[1] Guivetchi 1986 calculated two electrical conductivity (EC) to chloride conversion equations for various locations in the Delta. For RSAN035, the location nearest to Stockton's intake, the two conversion equations are: 1) Cl [mg/L] = -28.9 + (0.23647 * EC [umhos/cm]) and 2) EC [umhos/cm] = 127.69 + (4.05649 * Cl [mg/L]). Equation 2 was used to generate this table from DSM2 output files.

to residence time in a “sloshing” tidal system. For DWR to reach the conclusion that “all technical assessment findings and conclusions reached in Exhibit DWR-653 with regards to how in-channel velocities in the Delta for the CWF (Alternative 4A, operational scenarios H3 and H4) would affect cyanobacteria blooms, and particularly *Microcystis* blooms, relative to that which would occur for the NAA, also apply to CWF H3+” (DWR-1035, p.11), DWR should have used the tidally- or daily-averaged velocity, which is much lower than the maximum channel velocity throughout most of the Delta and is more appropriate when considering velocity as a surrogate for residence time (STKN-48, p.31). Tidally- or daily-averaged velocities are a better surrogate for residence time because they account for the “sloshing” nature of flows within the Delta; longer residence times mean less flushing from the Delta, thereby increasing the likelihood of *Microcystis* blooms.

I calculated monthly residence times for CWF H3+ by year and by water year type following the methods described in STKN-26 Section 4.5. My analysis of CWF H3+ indicates that residence times are generally expected to be higher than residence times under existing conditions (EBC2) and NAA, especially in the months of July through October (see STKN-62), when water temperatures are expected to be warmest and the likelihood of *Microcystis* blooms is greatest. From this analysis, I conclude that CWF H3+ will have impacts with regards to residence time and *Microcystis* growth similar to those described in STKN-26 and STKN-48.

3. DWR’s analysis of temperature is insufficient to support DWR’s conclusions regarding *Microcystis*, and DWR has not presented additional information on the temperature of waters in the Delta for Scenario CWF H3+.

As discussed in STKN-048, longer residence times increase the likelihood of Microcystis blooms by decreasing flushing from the Delta. Longer residence times are also likely to lead to higher water temperatures in the Delta, which in turn also increase the likelihood of *Microcystis* blooms. DWR has not modeled the temperature of Delta waters for Scenario CWF H3+, and instead has relied on temperature modeling for NAA and Scenario BA H3+. Further, DWR has presented temperature information in the form of long-term monthly averages (i.e., the average of the monthly temperatures for each month in the 82-year simulation period), which is insufficient to evaluate the impacts of changes in temperature on *Microcystis* blooms. Water temperature is a function of many factors, including meteorological parameters such as solar radiation, air temperature, humidity, and wind speed (see, e.g., STKN-63; STKN-64, STKN-65[2]), such that daily, weekly, or even monthly average (single month) temperatures will fluctuate significantly relative to the 82-year monthly average temperatures presented by DWR.

Because DWR presents temperature modeling results only for two future scenarios (i.e., NAA and BA H3+) and not for an existing conditions (EBC2) scenario, it is unclear which modifications have been made to change the meteorological input data from current observations to future conditions. Because DWR compares two future conditions to each other, it does not appear to be possible to determine how or if DWR has adjusted air temperatures and other meteorological parameters for future scenarios relative to current conditions. Water temperatures in the Delta are expected to be warmer in the future as a function of both warming air temperatures caused by climate change (FEIR/FEIS p. 8-262) and increased residence times.

Microcystis blooms in the Delta now occur relatively frequently. For example, there have been multiple blooms reported recently in the Delta (e.g., Big Break, and Old and Middle Rivers; see https://mywaterquality.ca.gov/habs/where/freshwater_events.html). Increases in water

---

[2] Exhibit STKN-63 is a true and correct copy of Vroom, J., van der Wegen, M., Martyr-Koller, R. C., & Lucas, L. V. (2017). What determines water temperature dynamics in the San Francisco Bay-Delta system? Water Resources Research, 53, 9901–9921. https://doi.org/10.1002/2016WR020062.

Exhibit STKN-64 is a true and correct copy of Caissie, D. (2006), The thermal regime of rivers: a review. Freshwater Biology, 51: 1389-1406. doi:10.1111/j.1365-2427.2006.01597.x.

Exhibit STKN-65 is a true and correct copy of van Vliet, M.T.H., Yearsley, J.R., Franssen, W.H.P, Ludwig, F., Haddeland, I., Lettenmaier, D.P., and Kabat, P. (2012). Coupled daily streamflow and water temperature modeling in large river basins. Hydrology and Earth System Sciences. 16. 4303-4321.10.5194/hess-16-4303-2012.

temperature and residence times are expected to increase the likelihood of *Microcystis* blooms in the future, including for Scenario CWF H3+. Warmer future background conditions will magnify the effect of incremental temperature increases due to CWF H3+ operations, increasing the significance of the project's cumulative impact to *Microcystis* formation.

For these reasons, DWR has not presented sufficient information to support its conclusion "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." (DWR-1017, pp.6:28 – 7:1-2). The opinion I presented in Exhibit STKN-26, p. 40 – that my "analysis of residence times indicates that the proposed WaterFix project will result in longer Delta residence times in all water year types. Longer residence times in the Delta can lead to increased water temperatures that are conducive to growth of *Microcystis* and other harmful microorganisms." – remains applicable to the WaterFix under all operating scenarios presented in this Hearing, including CWF H3+.

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

Executed this 12th day of July 2018 in Pasadena, California.

EXPONENT, INC.

DATED: July 12, 2018 By Susan C. Paulsen

Susan C. Paulsen, Ph.D., P.E.