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COUNTY SANITATION DISTRICT

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 TESTIMONY OF SUSAN PAULSEN, Ph.D., P.E. ON BEHALF OF SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT

SRCSD-29

QUALIFICATIONS

My name is Susan Paulsen, and I am a Registered Professional Civil Engineer in the State of California (License # 66554). My educational background includes a Bachelor of Science in Civil Engineering with Honors from Stanford University (1991), a Master of Science in Civil Engineering from the California Institute of Technology ("Caltech") (1993), and a Doctor of Philosophy (Ph.D.) in Environmental Engineering Science, also from Caltech (1997). My education included coursework at both undergraduate and graduate levels on fluid mechanics, aquatic chemistry, surface and groundwater flows, and hydrology, and I served as a teaching assistant for courses in fluid mechanics and hydrologic transport processes.

My Ph.D. thesis was titled, “A Study of the Mixing of Natural Flows Using ICP-MS and the Elemental Composition of Waters,” and the major part of my Ph.D. research involved a study of the mixing of waters in the Sacramento-San Joaquin River Delta (the Delta). I collected composite water samples at multiple locations within the Delta, and used the elemental “fingerprints” of the three primary inflow sources (the Sacramento River, the San Joaquin River, and the Bay at Martinez), together with the elemental “fingerprints” of water collected at two interior Delta locations (Clifton Court Forebay and Franks Tract) and a simple mathematical model, to establish the patterns of mixing and distribution of source flows within the Delta during the 1996–1997 time period. I also directed model studies to use the chemical source fingerprinting to validate the volumetric fingerprinting simulations using Delta models (including the Fischer Delta Model [FDM] and the Delta Simulation Model [DSM]).

I am currently a Principal and Director of the Environmental and Earth Sciences practice at Exponent, Inc. (“Exponent”). Prior to that, I was the President of Flow Science Incorporated, in Pasadena, California, where I worked for 20 years, first as a consultant (1994-1997), and then as an employee in various positions, including President (1997-2014). I have 25 years of experience with projects involving hydrology, hydrogeology, hydrodynamics, aquatic chemistry, and the environmental fate of a range of constituents. I have knowledge of California water supply issues, including expertise in California’s Bay-Delta estuary. My expertise includes designing and implementing field and modeling studies to evaluate groundwater and surface water flows, and contaminant fate and transport. I have designed studies using one-dimensional hydrodynamic models, three-dimensional computational fluid dynamics models, longitudinal dispersion models, and Monte Carlo stochastic models, and I have directed modeling studies and utilized the results of numerical modeling to evaluate surface and groundwater flows.

I have designed and implemented field studies in reservoir, river, estuarine, and ocean environments using dye and elemental tracers to evaluate the impact of pollutant releases and treated wastewater, thermal, and agricultural discharges on receiving waters and drinking-water intakes. I have also designed and managed modeling studies to evaluate transport and mixing, including the siting and design of diffusers, the water quality impacts of storm water runoff, irrigation, wastewater and industrial process water treatment facilities, desalination brines and cooling water discharges, and groundwater flows. I have designed and directed numerous field studies within the Delta using both elemental and dye tracers, and I have designed and directed numerous surface water modeling studies within the Delta. A copy of my *curriculum vitae* is included as SRCSD-30.

BACKGROUND

Sacramento Regional County Sanitation District (Regional San) is the primary wastewater treatment agency in the Sacramento area. Regional San operates the Sacramento Regional Wastewater Treatment Plant (SRWTP) near Elk Grove, California. SRWTP is one of the largest publicly-owned treatment works (POTWs) in California. SRWTP discharges treated effluent to the Sacramento River near Freeport through a 300-foot long, 74-port diffuser situated on the river bottom.[1] The diffuser is located in the northern end of the Sacramento-San Joaquin River Delta (Delta), and thus it is subject to tidal influence. High tides reduce river flows past the diffuser under all but very high flow conditions, and tidal forcing sometimes causes the river to flow in an upstream direction ("reverse flow" events).

Regional San is allowed to discharge treated effluent only when the ratio of river flow to effluent flow is 14:1 or greater. When river flow rates fall in response to the tides such that a ratio of 14:1 or greater cannot be maintained, Regional San temporarily ceases discharging treated effluent to the river and diverts the treated effluent to

[1] The diffuser was constructed with 99 ports. However, in 2005 it was discovered that effluent mixing near the eastern bank of the river was not occurring according to diffuser design criteria during low river flows. Therefore, 25 ports were blocked in order to restore intended mixing conditions under low flow conditions. As a result, only 74 ports have been active on the diffuser since 2007.

emergency storage basins (ESBs) located adjacent to the treatment plant. Once the river flow returns above the 14:1 ratio, treated effluent discharges to the river resume, augmented by additional flows from the ESBs until the ESBs are empty again. In addition to the 14:1 flow discharge requirement, Regional San must meet several thermal discharge and receiving water requirements that sometimes necessitate diversion of treated effluent to ESBs.

TESTIMONY

Regional San retained Exponent to evaluate and prepare technical comments on the California WaterFix project (WaterFix), including the WaterFix Part 2 proceedings. Specifically, Regional San asked Exponent to evaluate whether the proposed WaterFix operations will have an impact on SRWTP operations and permitting conditions. Exponent completed the report "Impacts of the California WaterFix Project Affecting Sacramento Regional County Sanitation District," which is identified as Exhibit SRCSD-31. This report was prepared by me and persons working under my direction who are also experts in its subject matter.

The results of Exponent's work are the basis for the following four opinions:

1. WaterFix will increase the residence time of water in the Delta.

Exponent used DSM2 model input files obtained from the California Department of Water Resources (DWR) to evaluate residence time in the Delta. Results show that, in general, residence times are expected to increase markedly as a result of WaterFix in all water year (WY) types (i.e., critical, dry, below normal, above normal, and wet). The greatest increase in residence times relative to existing (EBC2) and no action alternative (NAA) scenarios is simulated to occur from July to December—a period that includes the summer months when water temperatures are highest. Increased residence times in the Delta are expected to result in the degradation of water quality in the Delta.

2. Increased *Microcystis* growth may result from WaterFix. *Microcystis* is a genus of cyanobacteria containing species known to produce toxic chemicals called microcystins, which are a risk to humans, livestock, and wildlife. Increased residence time in the Delta is expected to increase the likelihood of *Microcystis* blooms by decreasing the loss rate of *Microcystis* from the area by flushing, which in turn will lead to more opportunity for *Microcystis* growth and toxin production. Additionally, water temperatures within the Delta are expected to increase as a result of WaterFix (partly due to increased residence times), particularly during the already-warm summer months, likely leading to higher growth rates of *Microcystis* and longer periods of time when water temperatures exceed the threshold for *Microcystis* bloom formation.

3. WaterFix will cause an increase in salinity in the Delta. The WaterFix operations scenarios involve the export of water from new diversion structures on the Sacramento River, and some operational scenarios will lead to an increase in the total amount of water exported from the Delta. WaterFix will lead to the export of more Sacramento River water than under existing conditions (i.e., the EBC2 scenario). Thus, WaterFix diversions from the north Delta will change the composition and quality of water within the Delta. The interior Delta will generally contain less high-quality Sacramento River water and more water from other, lower-quality sources, including San Joaquin River water, agricultural return flows, and saline inflow from Martinez. DSM2 modeling results for the Boundary 1 (B1) scenario show that chloride concentrations at Antioch and Brentwood are expected to increase markedly relative to both the no action alternative (NAA) and existing condition (EBC2) scenarios. The increased salinity in the western Delta under Boundary 1 operations is expected to result in more frequent exceedances of the D-1641 chloride objectives for municipal and industrial (M&I) beneficial uses and lead to higher salinity in the western Delta even when D-1641 objectives are satisfied. Impacts to water quality, including increased salinity, are expected to occur in the interior Delta as well. Declining water quality in the Delta—

including increased temperatures, increased *Microcystis* growth, and increased salinity—has the potential to result in more stringent future permit conditions on existing discharges to the Delta, including discharges from the SRWTP.

4. WaterFix will affect SRWTP operations by increasing the frequency and duration of diversion events relative to baseline conditions (i.e., EBC2 and NAA scenarios). To evaluate the extent to which WaterFix operations would change flow rates in the Sacramento River at Freeport and thereby affect SRWTP operations, Flow Science, working based on instructions from Exponent, used output from DWR's DSM2 model to simulate Regional San's discharge and diversion operations. Flow Science's analysis shows that increases relative to baseline conditions (i.e., EBC2 and NAA scenarios) are expected in a number of relevant parameters, including (1) the number of diversion events, (2) the percentage of time that diversion would be required, (3) the percentage of time that effluent would be stored in ESBs, and (4) the cumulative volume of water that would be pumped from ESBs over the 16-year modeling period (1976–1991). A summary of model results demonstrating these increases is presented in Table 6 of Exhibit SRCSD-31. Increasing the frequency and magnitude of diversion events will result in higher operation and maintenance costs and the potential for additional odor impacts. Additionally, the expected increase in the number of diversion events effectively amounts to an encroachment on Regional San's available ESB capacity.

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

Executed on this 29th day of November 2017 in Pasadena, California.

EXPONENT, INC.

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

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