SOMACH SIMMONS & DUNN
A Professional Corporation
Andrew M. Hitchings (SBN 154554)
Aaron A. Ferguson (SBN 271427)
Kristian C. Corby (SBN 296146)
500 Capitol Mall, Suite 1000
Sacramento, California 95814-2403
Telephone: (916) 446-7979
Facsimile: (916) 446-8199
ahitchings@somachlaw.com
aferguson@somachlaw.com

Attorneys for Sacramento County Water Agency

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.	NOTICE OF ERRATA TO SCWA-4 RE TESTIMONY OF STEFFEN MEHL AND SUBMITTAL OF SCWA-50 AS A SUBSTITUTE FOR INCOMPLETE SCWA-4

On August 31, 2016, Sacramento County Water Agency submitted Exhibit SCWA-4. Inadvertently, pages 2, 4, 6, 8 and 10 were omitted when uploading Exhibit SCWA-4 into the SWRCB's FTP site.

Sacramento County Water Agency hereby corrects this omission and requests that the attached SCWA-50 be introduced into evidence as a substitute for Sacramento County Water Agency's incomplete Exhibit SCWA-4.

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

Executed on the 6th day of September 2016.

Aaron A. Ferguson

<u>NOTICE OF AVAILABILITY</u>
<u>and</u>
<u>STATEMENT OF SERVICE</u>

CALIFORNIA WATERFIX PETITION HEARING
Department of Water Resources and U.S. Bureau of Reclamation
(Petitioners)

I hereby certify that on September 6, 2016, I submitted to the State Water Resources Control Board and caused a true and correct copy of the following document(s):

> **Notice of Errata to SCWA-4 Re Testimony of Steffen Mehl and Submittal of SCWWA-50 as a Substitute for Incomplete SCWA-4**

to be uploaded to the Board's FTB site at https://ftp.waterboards.ca.gov/?u=water fix download&p=waterfix123. This Notice of Availability and Statement of Service was served **by Electronic Mail** (email) upon the parties listed in Table 1 of the Current Service List for the California WaterFix Petition hearing, dated September 2, 2016, posted by the State Water Resources Control Board at http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/service_list.shtml:

I certify that the foregoing is true and correct and that this document was executed on September 6, 2016

Signature: [signature]
Name: Yolanda De La Cruz
Title: Legal Secretary
Party/Affiliation: SACRAMENTO COUNTY WATER AGENCY
Address: 500 Capitol Mall, Suite 1000
Sacramento, CA 95814

SOMACH SIMMONS & DUNN
A Professional Corporation
Andrew M. Hitchings, Esq. (SBN 154554)
Aaron A Ferguson, Esq.. (SBN 271427)
Kristian C. Corby (SBN 296146)
500 Capitol Mall, Suite 1000
Sacramento, CA 95814
Telephone: (916) 446-7979
Facsimile: (916) 446-8199
ahitchings@somachlaw.com
aferguson@somachlaw.com
kcorby@somachlaw.com

Attorneys for Sacramento County Water Agency

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 STEFFEN MEHL**

I, Steffen Mehl, declare:

I. INTRODUCTION

I, Steffen Mehl, submit this testimony on behalf of Sacramento County Water Agency (SCWA) in the above-referenced matter. I am a professor of Civil Engineering at California State University Chico where I routinely teach courses in fluid mechanics, hydrology, and hydraulics. Previously, I worked as a hydrologist for the USGS National Research Program. I have a BS in Environmental Resources Engineering from Humboldt State, and a MS and a PhD in Civil Engineering from the University of Colorado, Boulder. I have 18 years of experience in groundwater flow and transport modeling in both government and academic sectors. I am part of the development team for MODFLOW-OWHM, an integrated groundwater/surface water modeling tool, and UCODE, a universal code for parameter estimation, sensitivity, and uncertainty analysis. I have applied these methods in situations ranging from regional systems to laboratory scale experiments. Exhibit SCWA-41 contains a true and correct copy of my CV.

The California WaterFix Project (CWF) proposes to add points of diversion and re-diversion along the Sacramento River between approximately Courtland and Clarksburg to the water right permits of the California Department of Water Resources (DWR), and United States Bureau of Reclamation (Reclamation). The proposed operation of the CWF would decrease freshwater instream flows downstream of these diversions. Reduction of instream freshwater flows could have impacts on interconnected groundwater supplies in the South American Subbasin by altering the hydraulic connection with the Sacramento River.

In this testimony, I assess potential impacts of the CWF on the groundwater basin that SCWA relies on to serve customers throughout its Zone 40 service area – i.e., DWR Bulletin 118-03 Groundwater Basin 5-21.65 Sacramento Valley South American Subbasin. The South American Subbasin lies within the broader Sacramento Valley Basin. (DWR Bulletin 118-03 Groundwater Basin 5-21.65 Sacramento Valley South American Subbasin.) These potential impacts include groundwater elevation decreases and changes in stream/aquifer interactions.

This testimony considers the potential impacts of the CWF on the groundwater system, in terms of possible changes in stream/aquifer fluxes and/or in groundwater levels. I expect the long-term decrease in surface-water flow could have an impact on the hydraulic connection between the Sacramento River and groundwater in the South American Subbasin. Based on existing conditions and current groundwater pumping rates, additional decreases in surface flows could reduce current levels of natural recharge resulting in groundwater elevation decreases, groundwater quality degradation, and adversely affect stream/aquifer interactions. A thorough analysis of surface water-groundwater interaction in the reach of the Sacramento River upstream and downstream of the proposed CWF intakes is not provided by Petitioners, and is necessary to fully evaluate the impacts.

II. PURPOSE AND SUMMARY OF TESTIMONY

In this testimony, I review the testimony submitted by the DWR and Reclamation (collectively, "Petitioners") to examine whether the information provided adequately and correctly evaluates the potential impact of the CWF on interconnected groundwater supplies in the South American Subbasin. I identify gaps in Petitioners' analyses that raise serious questions regarding the adequacy of their assessment of groundwater impacts associated with implementation of the CWF.

III. BACKGROUND

A. Interconnected Groundwater Supplies

SCWA is a water purveyor that currently serves approximately 149,000 people about 34,500 acre-feet per year throughout its Zone 40 service area. SCWA serves its customers a combination of groundwater and surface water as part of a conjunctive use plan, using surface water during wet years when it is available, and relying on groundwater during dry years. In addition to use of surface water, SCWA extracts groundwater from the South American Subbasin to serve municipal and industrial demands throughout Zone 40. (The location of SCWA's wells is shown in Exhibit SCWA-40.) SCWA has recently produced between 20,000 – 29,000 acre-feet per year (AF/YR) from the South American Subbasin. (See Exhibit SCWA-42.) At buildout, I understand that SCWA anticipates producing between about 25,000-63,000 AF/YR, depending on hydrologic year type. (See Exhibit SCWA-27.)

The "Central Basin" is located entirely within Sacramento County and partially within the South American Subbasin (DWR 118), and is bounded on the north by the American River, on the west by the Sacramento River and Interstate 5 and on the south roughly by the Cosumnes River. (See Exhibit SCWA-26.) According to the Central Basin Groundwater Management Plan (GMP), the majority of the Central Basin is collaboratively managed through the Sacramento Central Groundwater Authority in accordance with the GMP. According to the GMP, the Central Basin is interconnected with the Sacramento River. (See Exhibit SCWA-45, p. 2-26.)

IV. REVIEW OF PETITIONERS' TESTIMONY

This testimony addresses the potential impacts of long-term removal of water from the Sacramento River as proposed by the CWF, which could: 1) reduce the amount of fresh water moving downstream through the Delta, and 2) decrease the amount water available in the Sacramento River for leakage in and around the proposed new points of diversion. Over a single year, the leakage impacts could be small. However, over a period of 50 or 60 years (life of the CWF), the impacts may be considerable in terms of total volume of water not available for leakage through the riverbed and into underlying groundwater aquifers.

I reviewed the available documents and testimony to understand how both short and long term impacts to groundwater were evaluated by Petitioners. I focused on Petitioners' evaluation of the impacts related to the reduction in leakage from the Sacramento River to the South American Subbasin. Petitioner's documents and testimony did not adequately evaluate potential impacts of the CWF on groundwater supplies and quality or stream/aquifer interactions in the long term in and around the proposed points of diversion. The CWF documents and testimony omit key issues and do not provide sufficient documentation indicating adequate analyses were performed.

I reviewed the following testimony from Petitioners:

- Exh. DWR 66 and Exh. DWR 71: testimony describes the technical details of the CalSim II and DSM2 models used to simulate potential changes in water supply, water quality, and water levels in the Delta. Dr. Tehrani's testimony (Exhibit DWR-66) focuses on the potential impacts on water quality and uses the output provided by the CalSim II model as input for the DSM2 model to evaluate changes in water quality. Neither Exh. DWR-66 nor DWR-71 quantifies and explains the impact of stream/aquifer fluxes.
- Dr. Tehrani, in Exhibit DWR-66, explains the modeling approach used by Petitioners to compare water level and quality results for the operational scenarios to the No Action Alternative (NAA). Dr. Tehrani presents details

on "computer modeling performed to evaluate changes in the water quality and water levels associated with the CWF and any possible effects on legal users of water. This modeling provides information in support of how the CWF can be operated while continuing to meet DWR and Reclamation's responsibilities under the Water Rights Decision 1641 objectives (D-1641)" (DWR 66, p. 2, 18-22.) Based on modeling results from CalSim II and DSM2, Dr. Tehrani states that "[t]he highest changes to water levels correspond to locations close to the proposed North Delta Diversion (NDD) intakes and can be up to 1.2 ft (during high flows) to 0.5 ft (during low flows)." (Exh. DWR 513, pp. 11-15, Figures W1-W5)". "Petitioners expect that the highest impact to water levels happens just downstream of the diversion and not toward the Delta." (Exh. DWR-66, pp.9-10, and Exh. DWR-513, W1-W2-W3-W4-W5.) Dr. Tehrani states, at Exh. DWR-66, p. 9, that the frequency distribution of water levels is similar for the scenarios analyzed, except for the NAA. Regarding water levels, the testimony focuses on how the minimum stage is affected. The impact of these changes in water levels on stream/aquifer interactions, and in particular, effects on flows between the steam and the adjacent aquifer (stream leakage), was not included in Dr. Tehrani's testimony.

- Mr. Munevar's testimony (Exh. DWR-71), presented in conjunction with Dr. Tehrani's testimony (Exh. DWR-66), "provides an overview of the computer modeling performed to evaluate changes in the water supply, water quality, and water levels in the Delta associated with the CWF Alternative 4A, the preferred alternative from the Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS)." (Exh. DWR-71, pp. 2, 12-16.) My review of Exh. DWR-71 for potential impacts on interconnected groundwater supplies did not produce definitive results. Groundwater is mentioned as

SOMACH SIMMONS & DUNN
A Professional Corporation

an input feature of the CalSim II model to include stream accretions and depletions and groundwater operations (Exh. DWR-71, p. 4), but details of how stream/aquifer interactions are calculated are not provided. Based on my review of the CalSim II documentation, groundwater hydraulics are not directly simulated by CalSim II.

- Mr. Leahigh's testimony (Exh. DWR-61) was submitted to "explain current operations of SWP and CVP, the highly successful record of compliance with water quality standards in the Bay-Delta, and the anticipated manner of SWP/CVP operations following construction of the CWF to continue meeting current and any future standards applicable to the SWP/CVP." It is a qualitative description of the operation and there is no mention of the impact on groundwater or on surface water/groundwater interactions.
- Exh. DWR-4 (Petitioners' Operations Power Point) and Exh. DWR-5 errata (Petitioners' Modeling Power Point) provide information on operations and modeling, but in a very qualitative manner. More quantitative analyses appear in other documents, but as described later, are insufficient for addressing the CWF's impacts on interconnected groundwater supplies.
- Exh SWRCB-4 Draft Environmental Impact Report/Draft Environmental Impact Statement (DEIR/DEIS 2013) Appendix A, Ch. 7 – Groundwater – the overall focus is on the impacts on groundwater during construction dewatering and additional seepage from the operation of the forebays. The groundwater model developed by CH2M Hill and used for the analysis, namely, CVHM-D, is a refined version of the CVHM model focused on the delta. In the DEIR/DEIS 2013, p. 7-37, line 27-28, it states that this model can be used to "evaluate the effects of the Alternatives on streamflows and surface water/groundwater interactions". They provide detailed analysis of the effects of dewatering and seepage from forebays (for example, Figs. 7-7, 7-8, 7-9, and 7-27), however, no specific details, are provided for the

impacts to groundwater caused by the reductions in stream levels in the area directly downstream of the three proposed new points of diversion.

- Exh. DWR-218: Updated information for final EIR/EIS, CH2M Hill. The primary focus of this document is to explain how the use of specific construction techniques may alleviate localized groundwater impacts in and around the intake facilities during construction and operation of the CWF. Similar to the documents discussed above, analysis of short-term and long-term impacts to surface water/groundwater fluxes in the SCWA service area due to a reduction in stream flows is not provided. Only impact on groundwater levels in the proximity of the dewatering wells is analyzed.
- RDEIR/SDEIS chapter 14. The impacts on groundwater are focused on construction and operations of the forebays and there is no mention of impacts on stream/aquifer interactions or groundwater levels in the long term after the construction period.

V. AVAILABLE MODELS AND TOOLS

Based on our review of the above mentioned documents, the remainder of this testimony focuses on the missing information regarding the potential impact that the CWF may have on stream/aquifer fluxes and consequently on the groundwater system in the South American Subbasin.

Different approaches can be considered to evaluate the impact of the CWF on the groundwater basin including stream/aquifer interactions. These include simple analytical tools which can provide an initial qualitative understanding, and existing available numerical models that can help quantify the impact and develop future scenarios.

A. Basic Aquifer Response.

Simple analytical approaches help conceptualize the system physics and how the diversion may affect groundwater heads and stream leakage. However, the system is more complicated than the idealization of the analytic solution, so quantification should be based on a numerical model. Exhibit SCWA-44 is an illustration that depicts the basic aquifer response to a changing stream stage, but without firm numbers. This figure indicates that the hydraulic response propagates into the aquifer over time, which effects both the water levels in the aquifer, and the leakage between the stream and the aquifer over time.

B. Modeling Tools.

Complex modeling tools for the simulation of the system are available and they are the most appropriate means to demonstrate the potential impacts. Some of these tools have been used for other purposes within the CWF analyses, but they have not been used explicitly for evaluating the impact of the proposed diversions on the stream/aquifer interaction in the area in and around the proposed diversions. The numerical tools available are: C2VSIM (Brush, et al., 2013), CVHM (Faunt, et al., 2009), Sac-IGSM (RMC), and CVHM-D (CH2M Hill). Both CVHM and CVHM-D have been used in CWF analyses.

I present here a description of the characteristics of each tool that is most appropriate for this scope based on my knowledge and experience:

1. C2VSIM is a calibrated integrated surface water/groundwater finite element model developed by the Department of Water Resources for the entire Central Valley. Simulation time includes the period 1921 - 2009. Model discretization might be too coarse to accurately represent stream/aquifer interactions in the area directly downstream of the diversion.

2. CVHM is also a calibrated integrated surface water/groundwater model that spans a simulation period from 1961 – 2003 and is recognized and approved by the state. CVHM has a grid resolution of 1 sq. mile. I believe that the resolution is too coarse to simulate local details of production wells and surface water/groundwater interactions, but can still be used to get a general understanding of the impacts on groundwater next to the Sacramento River.

3. Sac-IGSM is a finite element model built on the Integrated Groundwater and Surface-Water Model (IGSM) platform. It is calibrated and the model domain includes the area directly downstream of the diversions. The element size varies from one quarter mile to a half mile, with an average of 0.18 sq.mi. per element over the model domain. Each layer of the model consists of an aquiclude and aquifer pair.

4. CVHM-D is a refined version of the CVHM in the delta area with a grid resolution of one quarter of a mile. Additional modifications include more detailed representation of the water balance regions, streams and sloughs, and was used to simulate various scenarios of the CWF. (Exhibit SWRCB-4, DEIR/DEIS, Ch. 7, p. 7-37, 2013.)

These tools, after proper modification considering the purpose of the modeling investigation, as discussed in the next section, could be used to characterize and quantify the impacts of the diversions on stream/aquifer interactions.

VI. ANALYSIS OF THE INFORMATION PRESENTED BY PETITIONERS AND GAPS IN THE INFORMATION REQUIRED

The potential impacts of the CWF on groundwater in the South American Subbasin that need to be analyzed and quantified to determine the long-term impact to ground water supplies are:

- changes in groundwater/surface water interactions
- potential decrease in available groundwater supplies

The testimony reviewed does not directly address the quantification of the impacts mentioned above. Exh. DWR 71 does not provide the required details on how CalSim II handles groundwater hydraulics and therefore impact on stream aquifer fluxes and/or on groundwater levels cannot be assessed. Furthermore, not only the effect on minimum stage should be considered (DWR-66 pp.3, 10-19), but also the changes in the average conditions. Groundwater flows move at much slower time-scales than surface water flows.. Therefore, the response of interconnected groundwater is often more representative of average conditions in the stream rather than the extremes.

There is substantial variability in surface water/groundwater interactions in water bodies throughout the Sacramento Valley (DEIR/DEIS, p.7-3, 29-30, 2013). Given this variability, these interactions could be altered by the North Delta Diversions in and around the proposed intakes.

The Petitioners modified the CVHM model to investigate the effects of the CWF on groundwater. However, the proposed North Delta Diversion intakes along the Sacramento River are not simulated in the Stream Flow Routing (SFR) Package. As a result, the stream, and interconnected groundwater in the South American Subbasin directly downstream of the actual diversion location, are subjected to higher stream flows than would actually occur.

The CVHM-D model was constructed to provide more refined representation of the delta region and used to assess impacts of the CWF construction and operation on groundwater. In this model, the SFR Package was modified to include a CWF diversion, but the North Delta Diversion Intakes were placed near the confluence of the Mokelumne and San Joaquin Rivers. (See Exhibit SWRCB-4, DEIR/DEIS Fig. 7A-3.). As with the Petitioners modified CVHM model, the CVHM-D model overestimates the stream flows directly downstream of the actual diversion location. The focus of the CVHM-D model appears to have been on intake and tunnel construction and operations effects on groundwater rather than addressing impacts of reduced stream flows directly downstream of the proposed diversions.

Furthermore, it is my opinion that a careful uncertainty assessment in the analyses is necessary to address potential impacts to stream/aquifer interactions. On a project of this magnitude that relies on different complex models, sensitivity and uncertainty analyses are needed to help quantify the likely impacts.

The tools that I have described can be used to quantify the above-mentioned potential impacts, but they all have shortcomings and they would all need some modification to properly account for the complexity of the system and to provide reliable results.

VII. CONCLUSIONS

In the Sacramento Valley there is substantial variability in surface water groundwater interaction and leakage rates both seasonally and yearly, which could be altered by the North Delta Diversions. There is no mention of the impact on stream/aquifer interactions in the area directly downstream of the diversions where the CWF will cause the greatest effect on water levels in the stream according to Exhibit DWR-66, p.2. In the long term, small changes in river stage can result in major effects on the general water balance for the area. The existing models available and used by the Petitioners, like CVHM and CVHM-D, are inadequate in their current form to assess the general water balance in the area around the proposed new points of diversion on the Sacramento River. These tools could be appropriately modified to evaluate and report the long-term impacts on stream/aquifer interactions due to the reduced stream flows and levels caused by the diversions.

I declare under penalty of perjury under the laws of the State of California that the facts recited above are true and correct. Executed on this 31st day of August, 2016 in Sacramento, California.

Steffen Mehl