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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 ARMIN MUNEVAR (Exhibit DWR-86)

I, Armin Munevar, do hereby declare:

I. OVERVIEW

My name is Armin Munevar and I have previously testified in this matter. A summary of my expertise is included in [Exhibit DWR-71] and a true and correct copy of my statement of qualifications has previously been submitted as [Exhibit DWR-30].

This rebuttal testimony provides response to issues raised by Protestants relating to CalSim II modeling. The testimony is organized into four main sections and one technical memorandum identified as [Exhibit DWR-670.]

Specifically, I reviewed the written and oral testimonies of witnesses who focused on the modeling of the California WaterFix (CWF), with particular attention to the testimonies of Walter Bourez, Dr. Susan Paulsen, Dierdre Des Jardins, Eric Ringelberg and Chris Shutes.

A brief summary of my opinions is provided below:

- Even with MBK's more aggressive export of upstream storage using the new CWF facility, their modeling does not show any significant impact on legal water users because the water deliveries to Settlement Contractors, Exchange Contractors, Refuge Level 2 and Feather River Service Area Contractors are provided at a substantially similar level as the no action as shown in this rebuttal testimony.

- The MBK modeling modifications that result in the largest differences are all discretionary, which in my opinion are flawed, introduce an unreasonable amount of foresight into the modeling, and introduced bias in their comparative planning analysis for CWF.
- A sensitivity analysis was prepared to isolate the changes in MBK's modeling that were causing the largest differences compared to Petitioners modeling. The largest changes were a result of MBK's modification of the allocation logic, Joint Point of Diversion (JPOD) and the San Luis rule curve. All discretionary actions.
- MBK's two-year modeling example does not provide a sound basis for their claims that when going from a wet to critically dry year with California Water Fix, (1) RPA requirements would be difficult to meet and (2) inadequate water would be delivered to legal water users, because the results are highly sensitive to MBK's incorrect assumption regarding the use of JPOD.
- Sections V and VI address additional testimony provided by Sacramento Valley Water Users and other Protestants. The topics covered in these two sections include the boundary analysis, MBK's comments on draft BDCP and LTO DEIS, TUCPs in CalSim II, climate change analysis for CWF, North Delta Diversion Bypass Flow Criteria, and other baseline related testimony.

II. MBK'S MODELING SHOWS NO INJURY TO LEGAL WATER USERS

In SVWU-100 and 107, Mr. Bourez contends that the petitioners' CalSim modeling "unrealistically curtailed, modeled allocations are unreasonable suppressed, and modeled water storage remains in North of Delta CVP and SWP reservoirs, and Sn Luis Reservoir." [Exhibit SVWU-100 p. 2-3.] Mr. Bourez states "We have determined that the modeling submitted by CWF's proponents fails to demonstrate an absence of injury to legal users of water, due to inappropriate assumptions regarding the operation of the CVP and SWP with the addition of the CWF." [SVWU-100, §20.]

In my professional opinion based on my review of MBK's modeling, even with MBK's measures to more aggressively export upstream storage using the new CWF facility, their modeling does not show any significant impact on legal water users because the water deliveries to Settlement Contractors, Exchange Contractors, Refuge Level 2 and Feather River Service Area Contractors are provided at a substantially similar level as the no action and as shown in this rebuttal testimony. This is consistent with testimony and modeling provided by the Petitioners modeling. (Exhibit DWR-71 p. 20:9-19.)

Figures 1 through 5 (also, shown in DWR Exhibits 542, 543, 544, 545_errata, and 546) demonstrate that the modeling of Mr. Bourez and Mr. Easton does not show injury to legal users of water. At my direction, the following plots and tables were prepared from the MBK modeling results. These plots and tables show that for the various classes of legal users there is little to no change between the deliveries under the project compared to the no action alternative.

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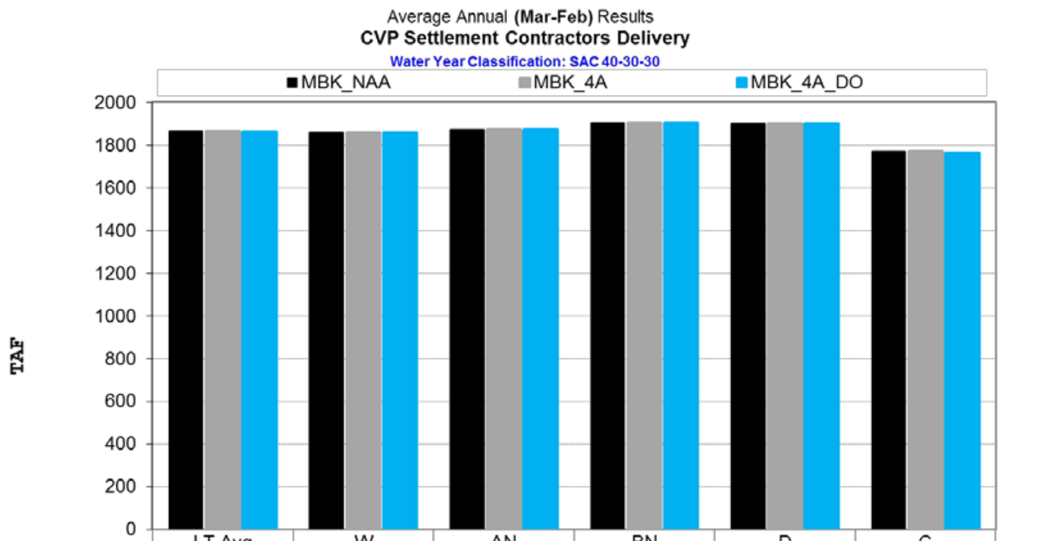
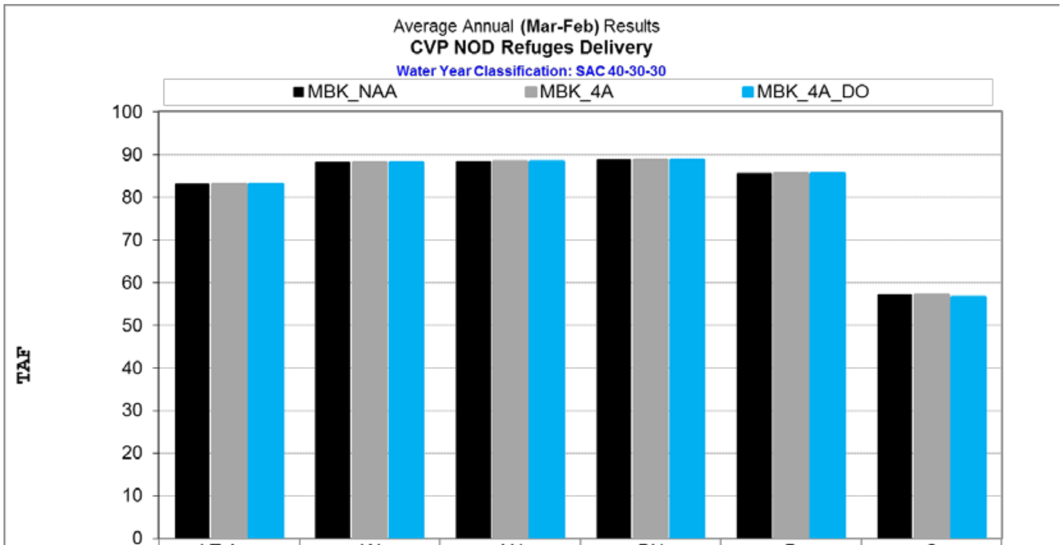
Figure 1: Annual CVP Sacramento River Settlement Contractors' Deliveries using MBK Modeling



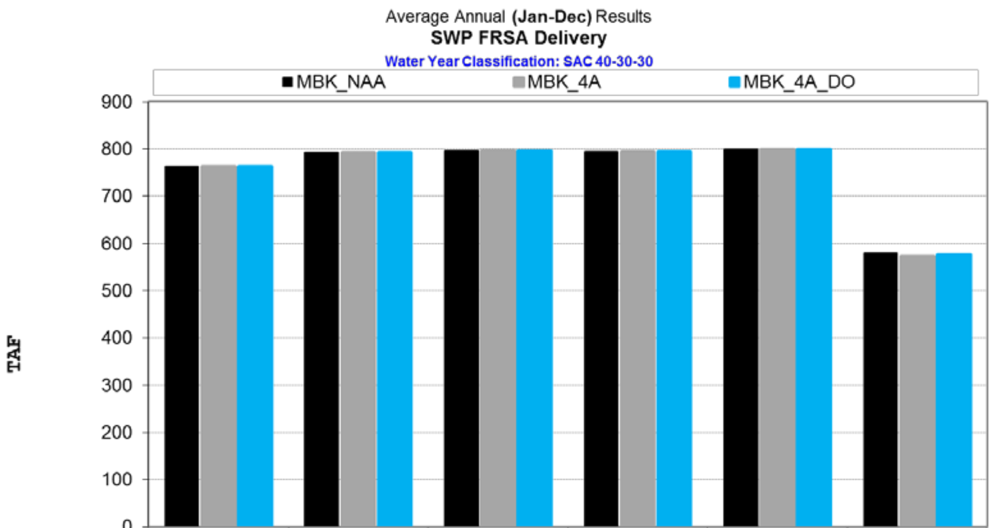
	LT Avg	W	AN	BN	D	C
MBK_NAA	1863	1858	1872	1901	1898	1769
MBK_4A	1863	1858	1871	1901	1898	1769
MBK_4A_DO	1862	1857	1871	1901	1898	1764

Figure 2: Annual CVP North-of-Delta Refuge Level 2 Deliveries using MBK Modeling



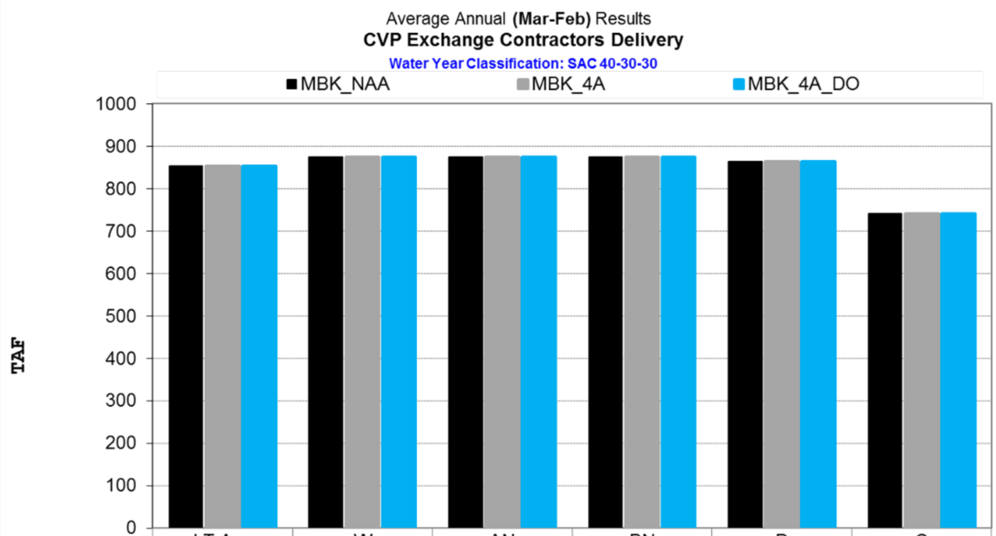
	LT Avg	W	AN	BN	D	C
MBK_NAA	83	88	88	89	85	57
MBK_4A	83	88	88	89	85	57
MBK_4A_DO	83	88	88	89	85	57

Figure 3: Annual SWP Feather River Service Area Contractors' Deliveries using MBK Modeling



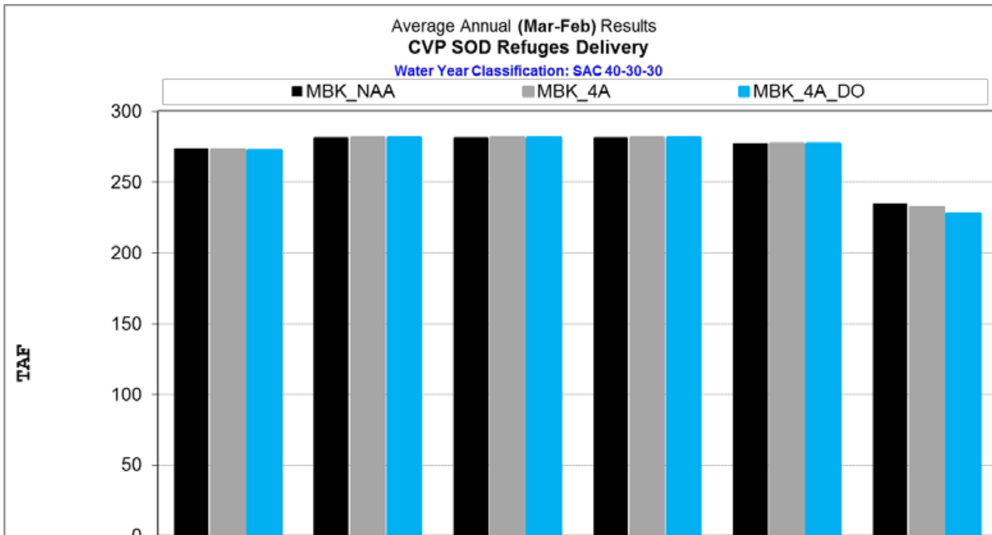
	LT Avg	W	AN	BN	D	C
MBK_NAA	764	793	796	795	799	580
MBK_4A	763	792	796	795	799	574
MBK_4A_DO	763	793	796	795	799	577

Figure 4: Annual CVP San Joaquin River Exchange Contractors' Deliveries using MBK Modeling



	LT Avg	W	AN	BN	D	C
MBK_NAA	852	875	875	875	864	741
MBK_4A	852	875	875	875	864	741
MBK_4A_DO	852	875	875	875	864	741

Figure 5: Annual CVP South-of-Delta Refuge Level 2 Deliveries using MBK Modeling



	LT Avg	W	AN	BN	D	C
MBK_NAA	273	281	281	281	277	234
MBK_4A	273	281	281	281	277	232
MBK_4A_DO	272	281	281	281	277	227

Mr. Bourez also argues that CalSim II does not address effects on many types of water users. He states that CalSim II "does not model any changes in water deliveries to

Sacramento River Settlement Contractors, Feather River Settlement Contractors, wildlife refuges, CVP Exchange Contractors or non-Project water right holders. Because all CVP and SWP Settlement Contractor deliveries and all non-Project water user deliveries are "Hard Coded", the model is forced to meet these deliveries unless it runs out of water." [Exhibit SVWU-107 p. 2, ¶ 4.]

Mr. Bourez's argument that water user deliveries are hard-coded in CalSim II is fundamentally wrong. Deliveries to water users are not hard-coded in CalSim II. Instead, CalSim II delivers water based on the available water supply and specified priority. For example, simulated delivery to Sacramento River Settlement Contractors, Feather River Settlement Contractors, wildlife refuges, and CVP Exchange Contractors are based on hydrologic conditions for the water year, tributary and delta minimum flow requirements, and availability of upstream storage. These deliveries are simulated at the highest priority as long as sufficient storage and regulatory flow conditions can be met. If simulated storage levels were insufficient to meet these deliveries, then reductions in deliveries could occur. If the model shows that water deliveries to these users, and the frequency of stressed water supply conditions for the project scenario matches the no action alternative, as is the case in this analysis, it indicates that the project scenario does not have any impact to the water users.

In short, even if we assume that MBK's more aggressive modeling is correct, which we do not, there is no evidence of injury to legal water users as detailed above.

III. SVWU MODELING OF DISCRETIONARY DECISIONS ARE FLAWED

I reviewed the MBK modeling. MBK modeling includes several changes as documented in [Exhibit SVWU-107, p.41] Of all the changes noted, MBK's changes to three inter-related inputs account for a majority of the differences between the petitioners' results and the MBK's results. All three MBK's changes were meant to prioritize higher south-of-Delta deliveries over protection of upstream carryover storage. These changes include:

1) use of unreasonable foresight in the allocation logic,

2) lack of changes to San Luis rule curve, and

3) use of Joint Point of Diversion (JPOD) in setting and meeting aggressive allocations.

The magnitude of these changes result in an approximately an average annual increase in Delta exports of 200,000 acre feet in MBK's modeling relative to the petitioners' modeling. Mr. Bourez testified that he changed these discretionary decisions[1] in the modeling because he thought they were more accurate: "*make the discretionary decision in the model more accurate and better balanced",* and that the work done *"is to get a better depiction of those balances and discretionary operations and have those become more realistic."* [October 20, 2016 Vol. 20, 125:2 – 7; See also Exhibit SVWU-100, ¶7(b), 21.]

In my opinion these changes are flawed for two reasons:

- These changes are not consistent with how the SWP/CVP operators would operate the Projects. This is described in detail in the rebuttal testimony of John Leahigh and Ron Milligan; (See Exhibits DWR-78 and DOI-32.)
- Discretionary decisions related to CWF are applied inconsistently between the proposed action and the no action alternative, thereby introducing bias into the comparative analysis and creating the appearance of a CWF project resulting in "increased risk" to legal users of water. [Exhibit SVWU-100, page 20.]

In addition to the above changes MBK's model did not consider climate change and sea level rise effects. Mr. Bourez also testified that:

> "*we're [MBK] carrying over far more water in both the no-action and the WaterFix alternative than the petitioners' model. They bring their storage down to dead pool, and they have much lower storages." (Vol 21, page 28: 20-24, pages 30: 21 to page 31: 2)*

[1] JPOD is not considered while setting allocations by the CVP operators. In their modeling of H3+, MBK assumed that JPOD would be used in determining the allocations, and therefore, considered as a discretionary decision in this discussion.

Mr. Bourez incorrectly assumes that this is due to the WaterFix, and fails to mention that the reservoir dead pool conditions under the petitioners' H3+ and No Action Alternative modeling are a result of the climate change and sea level rise effects. As shown in Ms. Parker's testimony (DOI-33), when the petitioners' models are run with the same hydrological inputs as the MBK's model, i.e. without climate change and sea level rise, the upstream storage results are similar to MBK's results, and more importantly H3+ results are similar or slightly better than the No Action Alternative.

I. III.1. Use of Unreasonable Foresight in the Allocation Logic

The MBK modelers modified certain aspects of the petitioner's model to develop their own model. These changes are summarized in [Exhibit SVWU-107, pg 41.] Many of the modifications included changes to discretionary decisions in the model. As described by MBK, "discretionary operational logic coded into CalSim II controls how DWR and Reclamation would operate the CVP/SWP system under circumstances for which there are no regulatory or otherwise definitive rules, e.g. when to move water from storage in CVP and SWP reservoirs upstream of the Delta to CVP and SWP reservoirs downstream of the Delta. … these discretionary operational criteria significantly influence model results." [SVWU-107 page 6: paragraph 6 to page 7: paragraph 1].

Mr. Bourez agreed in cross examination that their changes to discretionary operational logic including changes to the allocation logic, San Luis rule curve and use of JPOD, resulted in the biggest differences between the Petitioners modeling and his modeling. [October 20, 2016 Vol. 20, 204:19-205:9.]

Mr. Bourez testified regarding discretionary actions: "The ~~discretionary~~ project operators do have some flexibility in operations regarding the balance of stored water, whether they store more water in San Luis or keep that upstream, the balance between Shasta/Folsom, the balance between Trinity and Shasta, the balance between Oroville and State San Luis. All of these have regulatory constraints which are nondiscretionary, like RPA levels and so on. But there are the discretionary actions on how much water to allocate and what the allocations are discretionary by the project operators." [October 20, 2016 Vol. 20, 102:9-19]

CalSim II allocation logic generally includes two steps: (1) each year determine project allocations based on available water supply and storage conditions using generalized rules called Water Supply Index-Demand Index (WSI-DI) and Delivery-Carryover curves, and (2) reduce south-of-Delta delivery allocations, if needed, based on San Luis storage and estimates of export capacity, generalized for a broad range of hydrologic and operational conditions. Petitioners used this standard allocation logic for both the No Action Alternative and the CWF scenarios.

MBK modified this standard allocation logic in several ways: (1) determine allocations based on available water supply using WSI-DI and Delivery-Carryover curves[2], (2) determine export estimate values for each year and specify a time series of export estimates, (3) add manual adjustments to export estimate values in some years or bypass export estimate values entirely in some years, and (4) manually specify allocation values for some years[3]. Step 1 is the same as the standard approach except for manual adjustment of delivery target for CVP. Steps 2, 3 and 4 in MBK's approach involves running the model for the full simulation period and depending on the results, manually adjusting the inputs in 2, 3 and 4 until they obtained their desired result per their judgement. This MBK modeling approach is not reproducible by any other modeler, as admitted by Mr. Bourez on cross-examination [October 20, 2016 Transcript, Vol. 20, pp. 233-234], and does not allow for a systematic comparison of two scenarios to determine the potential project impacts. Transparency and reproducibility of results is a basic tenant in water resource modeling, and MBK's modeling does not meet these standards.

MBK claimed that their changes to discretionary decisions in the model were to produce a more realistic operation. However, with respect to the Export Estimate logic and the San Luis Rule Curve logic, their changes in assumptions made a less realistic model; operators

[2] MBK also manually adjusted delivery targets in setting the CVP allocations

[3] MBK manually specified CVP allocations in both versions of their Alternative 4A modeling. However, for SWP only in their Alt4A-DO modeling.

would have no ability to operate in a fashion similar to what they assumed in their model. [DWR-78 and DOI-32]

It is odd that MBK would again suggest that their model changes be used when DWR/USBR had previously expressed concerns because it included an unreasonable amount of foresight. For example, on July 15, 2015, Reclamation held a meeting to present some work that MBK had performed for Reclamation attempting to improve San Luis Reservoir operations and allocation logic. MBK presented their work and later distributed a draft memo titled "Tech Memo Draft 2015-07-16 rev1.docx". The Reclamation contract manager, Junaid As-Salek, asked DWR's Supervising Engineer for DWR's Modeling Support Branch, Erik Reyes, to review and comment on the work presented at the meeting and in the technical memorandum. The following excerpt is from an email sent from Erik Reyes to Junaid As-Salek.

> *"… their [MBK's] method for developing year by year export "forecasts" appears to go against the CalSim model convention of not giving the model an unreasonable amount of foresight. It seems that the export forecasts should be reviewed and studied to see if a more generalized rule could be derived from the forecasts. It does not seem reasonable to use these forecasts in production level studies …."* [DWR-671]

DWR modelers reviewed the algorithms developed by MBK and recommended that the agencies <u>not</u> adopt these algorithms. Importantly, the MBK method of developing export "forecasts" was rejected because it included an unreasonable amount of foresight that would not be available to an operator. Operators use independent variables (such as current reservoir storage, conservative forecasts of future runoff, and conservative assumptions on future regulatory requirements like Old and Middle River (OMR) flows) and relate them to dependent variables such as allocatable supply. Similar to operational decisions, the Petitioners' CalSim II model uses algorithms that relate these independent variables, of the kind that might be available in real time, to dependent variables in determining delivery allocations.

In contrast, MBK's method uses an input time series of export estimates in their model The MBK time series is shown in Figure 5 below. For example, if the model is simulating historical year 1984, the MBK method will utilize a specific, manually-derived export estimate for that year. Such use of pre-determination, or unreasonable foresight related to the outcome of the specific year, ignores the uncertainty that is used in actual operational decision-making and in the Petitioner's CalSim II model. The MBK model is inconsistent with standard modeling protocols. Unlike MBK's method, CVP and SWP operators, not knowing the future, use conservative estimates for future conditions, resulting in reasonable allocation that can be delivered.

Additionally, MBK disregarded its own export estimates for certain years to increase south of Delta allocations. In Figure 6 every entry that shows 9999 is an example of where MBK disregarded its own export estimate and manually bypassed the export estimate. Note that the 9999 (or manual bypass) does not show up in MBK' No Action alternative modeling, demonstrating an inconsistent implementation of discretionary decisions between alternatives. (For detailed technical information on this topic please see DWR-670)

Based on the July 15, 2015 joint review by DWR and Reclamation, the petitioners concluded that MBK's use of discretionary actions (pertaining to San Luis Reservoir operations and allocation logic) in their modeling is inappropriate for use in comparative planning modeling for the CWF; the results produced involve too much advanced knowledge of future conditions and cannot be justified in the context of real-time operations. Furthermore, it is my opinion that these changes are not justified because they induce bias between alternatives and it would be improper to incorporate them into this comparative analysis for CWF.

Figure 6. Timeseries of SWP Export Estimates (9999 value indicates that the export estimates are not used in determining the allocations)

Data:	/CALSIM/EXPESTSWP_TOAUG/EXPORT-ESTIMATE/01JAN1920/1MON/2020D09E/												
Units:	TAF												
YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**TOTAL**
1921	----	----	----	----	----	----	----	----	----	0	0	0	0
1922	2078	1949	1841	1615	1558	0	0	0	0	0	0	0	9040
1923	1594	1276	1100	948	897	0	0	0	0	0	0	0	5816
1924	288	152	59	41	23	0	0	0	0	0	0	0	564
1925	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1926	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1927	2348	1959	1685	1316	1277	0	0	0	0	0	0	0	8585
1928	2204	2178	1893	1482	1433	0	0	0	0	0	0	0	9191
1929	492	371	249	148	73	0	0	0	0	0	0	0	1333
1930	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1931	506	336	214	164	145	0	0	0	0	0	0	0	1365
1932	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1933	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1934	580	400	208	113	95	0	0	0	0	0	0	0	1395
1935	1955	1661	1535	1223	1182	0	0	0	0	0	0	0	7557
1936	2647	2338	1746	1242	1198	0	0	0	0	0	0	0	9171
1937	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1938	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1939	873	827	704	649	595	0	0	0	0	0	0	0	3648
1940	2437	2268	1720	1209	1147	0	0	0	0	0	0	0	8781
1941	2655	2098	1526	1198	1124	0	0	0	0	0	0	0	8601
1942	2355	1978	1626	1359	1295	0	0	0	0	0	0	0	8614
1943	2642	2031	1680	1067	1000	0	0	0	0	0	0	0	8420
1944	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1945	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1946	2374	1822	1624	1334	1298	0	0	0	0	0	0	0	8451
1947	677	537	412	298	251	0	0	0	0	0	0	0	2175
1948	1497	1400	1355	1235	1206	0	0	0	0	0	0	0	6693
1949	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1950	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1951	2323	1789	1440	1050	1011	0	0	0	0	0	0	0	7614
1952	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1953	2303	1813	1487	1239	1193	0	0	0	0	0	0	0	8033
1954	2248	2158	1844	1476	1424	0	0	0	0	0	0	0	9149
1955	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1956	2365	1956	1596	1206	1166	0	0	0	0	0	0	0	8289
1957	1104	1057	983	784	740	0	0	0	0	0	0	0	4668
1958	2670	2189	1858	1467	1326	0	0	0	0	0	0	0	9511
1959	1827	1773	1421	1214	1164	0	0	0	0	0	0	0	7398
1960	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1961	1152	963	571	321	275	0	0	0	0	0	0	0	3283
1962	1939	1775	1460	1175	1138	0	0	0	0	0	0	0	7487
1963	2282	2167	1813	1528	1493	0	0	0	0	0	0	0	9283
1964	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1965	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1966	1358	1310	1079	960	929	0	0	0	0	0	0	0	5637
1967	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1968	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1969	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1970	2694	2084	1732	1364	1331	0	0	0	0	0	0	0	9205
1971	2302	1952	1617	1325	1279	0	0	0	0	0	0	0	8475
1972	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1973	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1974	2436	1939	1608	1241	1188	0	0	0	0	0	0	0	8411
1975	2060	2014	1835	1468	1424	0	0	0	0	0	0	0	8801
1976	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1977	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1978	2423	1944	1465	1195	1101	0	0	0	0	0	0	0	8128
1979	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1980	2216	1608	1371	1131	1076	0	0	0	0	0	0	0	7402
1981	1423	1285	993	799	741	0	0	0	0	0	0	0	5241
1982	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1983	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1984	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1985	1260	1212	1087	964	901	0	0	0	0	0	0	0	5425
1986	2297	2195	1624	1150	1062	0	0	0	0	0	0	0	8327
1987	710	663	522	324	270	0	0	0	0	0	0	0	2490
1988	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1989	1546	1377	1300	1125	1054	0	0	0	0	0	0	0	6403
1990	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1991	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1992	429	350	271	164	102	0	0	0	0	0	0	0	1317
1993	2601	2087	1577	1254	1229	0	0	0	0	0	0	0	8749
1994	678	557	406	311	267	0	0	0	0	0	0	0	2220
1995	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1996	2552	2336	1764	1150	1099	0	0	0	0	0	0	0	8902
1997	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1998	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
1999	2240	1858	1513	1123	1081	0	0	0	0	0	0	0	7816
2000	2353	2298	1726	1342	1301	0	0	0	0	0	0	0	9020
2001	9999	9999	9999	9999	9999	0	0	0	0	0	0	0	49995
2002	1660	1186	969	758	723	0	0	0	0	0	0	0	5297
2003	9999	9999	9999	9999	9999	0	0	0	0	----	----	----	49995

III.2. San Luis Rule Curve

MBK formulated their rule curve for San Luis Reservoir to achieve their purported operational strategy "to divert as much surplus as possible and to operate upstream CVP and SWP reservoirs to convey surplus stored water when possible." [SVWU 107 p. 44.] As explained below it is my opinion that the MBK's San Luis rule curve formulation inadequately addresses differences in operational flexibility between the No Action and CWF scenarios.

The San Luis rule curve is an operational target in CalSim II which provides a target storage level for each month and is dependent on the South-of-Delta allocation and upstream reservoir storage. The San Luis rule curve is a model operational target that is used to represent operator decisions to move water from upstream reservoirs to South-of-Delta storage. The model simulated San Luis rule curve could differ depending on the available export capacity during winter and spring months, and the need to protect upstream carryover storage in the fall months. In the absence of any other operating criteria controlling the upstream reservoir releases or Delta exports, different San Luis rule curves can result in differences in upstream reservoir releases and storage, and Delta exports. A San Luis rule curve that is set relatively high will encourage release of water from upstream reservoir storage and export of these releases to San Luis Reservoir. Conversely, a lower San Luis rule curve would not drive an upstream storage release for San Luis Reservoir, and would thus maintain upstream storage. The San Luis rule curve could, and should change, when the ability to capture surplus water or export of stored water has changed due to regulatory or infrastructure modifications, and thus provide an opportunity to better maintain the balance between upstream storage flexibility and export capability.

The CWF is a prime example where changes in water delivery infrastructure and operations calls for a corresponding change in the San Luis rule curve. A rule curve that adequately utilized available export capacity and maintained an acceptable level of upstream carryover storage under the NAA is no longer appropriate under CWF. In the NAA, a higher level of exports in the fall is appropriate, given the export restrictions in the spring. However, under the CWF, the greater ability to capture excess flows in the winter and spring, requires less movement of stored water in the late summer and fall as compared to the NAA. Using this strategy, it is possible to use the north-Delta-Diversion to both develop increased water supply and maintain upstream storage flexibility. To implement this view in the modeling, the Petitioners set San Luis rule curve lower during the fall and higher in the spring in their Alternative 4a, compared to their NAA.

In contrast, MBK's approach ignores the increased flexibility in winter and spring associated with the north-Delta-Diversion in the CWF in setting San Luis rule curves. In doing so, MBK's Alternative 4a rule curve encourages release and export of stored water in the fall to the same degree as in their NAA. This, in conjunction with their other discretionary actions to increase south of delta allocation goals, serves to unreasonably draw down upstream storage. MBK essentially uses the same rule curve for CVP under Alternative 4a as was used in the NAA

Based on my review of MBK's modeling, it is my opinion that MBK's implementation and application of the San Luis reservoir rule curve inadequately acknowledges the changes in operational flexibility that is afforded by the CWF, and that their prioritization of conveying upstream stored water overshadows the additional goals of CWF to maintain upstream storage flexibility.

II. III. Use of Joint Point of Diversion in Setting Allocations

Mr. Bourez states that "DWR/USBR BA Model includes artificial limits on the use of Joint Point of Diversion." [SVWU-100 2: 7 b) 2)]. He also states that, "This assumption tends to artificially and incorrectly keep modeled storage in NOD CVP reservoirs higher under DWR/USBR BA Alternative 4A as compared to the No Action Alternative." [SVWU-107, p. 2.] MBK's statements are misleading. As noted in Ms. Parker's testimony [DOI-33], removing the permitted capacity constraint on the JPOD wheeling capacity alone does not change the petitioners modeling results presented in the Part 1A direct testimony.

In achieving their goals of lower upstream CVP storage under Alternative 4A compared to the No Action Alternative, in addition to removing the permitted capacity constraint from JPOD wheeling under Alternative 4A [SVWU-107 42: para 4], MBK changed the priority of the CVC wheeling and JPOD wheeling as stated here: “MBK Alternative 4A CVC wheeling logic alters the CalSim II logic to spread deliveries over the summer months, as opposed to concentrating deliveries in July, and to give priority to JPOD wheeling from July to September when it is needed to maintain CVP San Luis Rule Curve.” [SVWU-107, pp. 41-42]. Further, MBK assumed that available JPOD wheeling capacity will be known during Mar-May when the allocations are set, and used this additional capacity to manually boost CVP SOD service contractor supply. [SVWU-100, p. 52.]

In justifying their changes related to JPOD, MBK speculates that JPOD wheeling capacity could be included in the CVP allocation process as a reliable means to convey CVP stored water, it could be used to boost CVP SOD allocations that SOD allocations are export capacity constrained. [SVWU100, pp. 41-42.]

However, as noted in Ms. Parker’s testimony [DOI-33], it is not possible for Reclamation to include JPOD export wheeling capacity as part of the allocation setting process in Mar-May, given the uncertainty and unpredictability of the available Banks pumping plant capacity in the summer months.

III. III.4. The Sensitivity Analysis Isolates the Major Changes Between MBK and Petitioners’ Modeling and Shows These Changes Were Discretionary

Exhibit SVWU-107, page 41 contains a bullet list for changes that MBK made to the petitioner’s CalSim models to create their own CalSim model versions. The lists consists of 9 change categories for the No Action Alternative and an additional 8 change categories for Alternative 4A. MBK claims that their models with these changes show significantly different impacts than the petitioner’s models. Through sensitivity studies it is shown that only three changes, two of which are heavily based on modeler discretion and were not accepted by the agencies, are responsible for most the differences.

Changes to discretionary decisions in CalSim II model are the cause for the majority of the differences between petitioners' and SVWU results. Exhibit DWR-549 shows the effect of the factors causing the majority of this difference between the MBK models and the petitioner's models. These results are also shown in Figures 8, 9 and 10 below.

DWR modelers took the MBK No Action Alternatives (NAA) and MBK Alternative 4A models, and reverted three changes made by MBK to the original implementation. The three changes are 1) incorporate climate change effects, 2) rollback San Luis rule curve logic, and 3) rollback allocation logic changes including boosting of allocations recognizing JPOD. *It is important to note that the rule curve logic change and allocation logic change are assumptions that were previously reviewed and rejected by DWR and Reclamation.* These three assumptions were reverted back in both MBK NAA and MBK Alternative 4A models to produce modified MBK models. At my direction, DWR modelers then compared the various NAA versions to their respective Alt 4A versions. The original MBK studies showed that Alt 4A exported 491 TAF more annually than the NAA. This was significantly more than what the petitioner's models showed (an increase of about 226 TAF, annually). The modified MBK models show that Alt 4A increases exports by 280 TAF annually over the NAA. It is therefore my opinion that the bulk of the difference between the petitioner's model and the MBK models is attributable to assumptions differences with climate change, rule curve logic, and allocation logic. The other 17 changes in MBK's assumptions bullet lists have a relatively small combined impact. The three main changes applied to the MBK model are fundamental differences of assumptions.

Figure 7: Change in Delta Exports (Jones plus Banks) – DWR/USBR BA Alternative 4A (H3+) minus DWR/USBR BA NAA. (This figure matches Figure 6 in Exhibit SVWU 107)

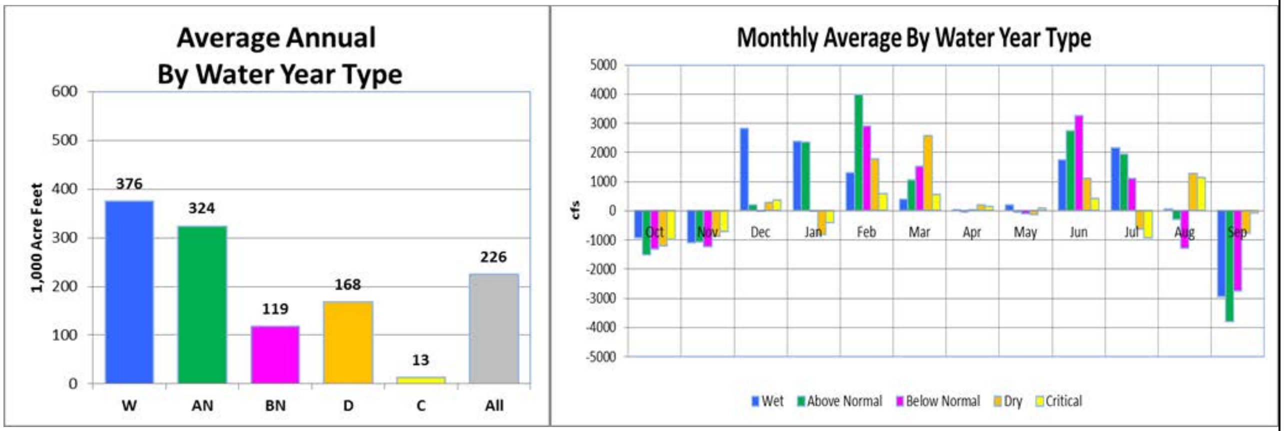


Figure 8: Change in Delta Exports (Jones plus Banks) – MBK Alternative 4A minus MBK NA (This figure is a Graphical Representation of Data Contained within CalSim_MBK_NAA.zip and CalSim_MBK_Alternative_4A.zip, and matches Figure 41 in Exhibit SVWU 107.)

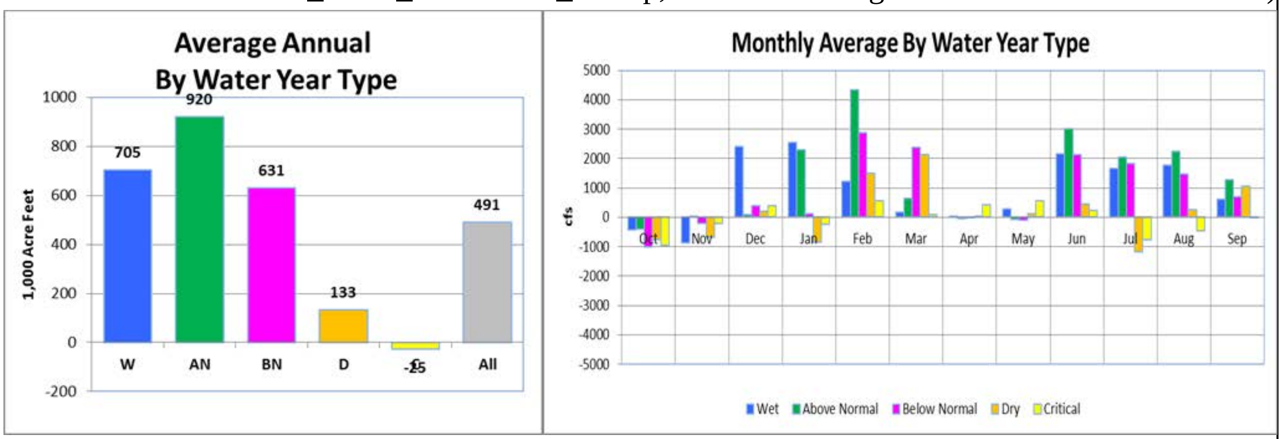
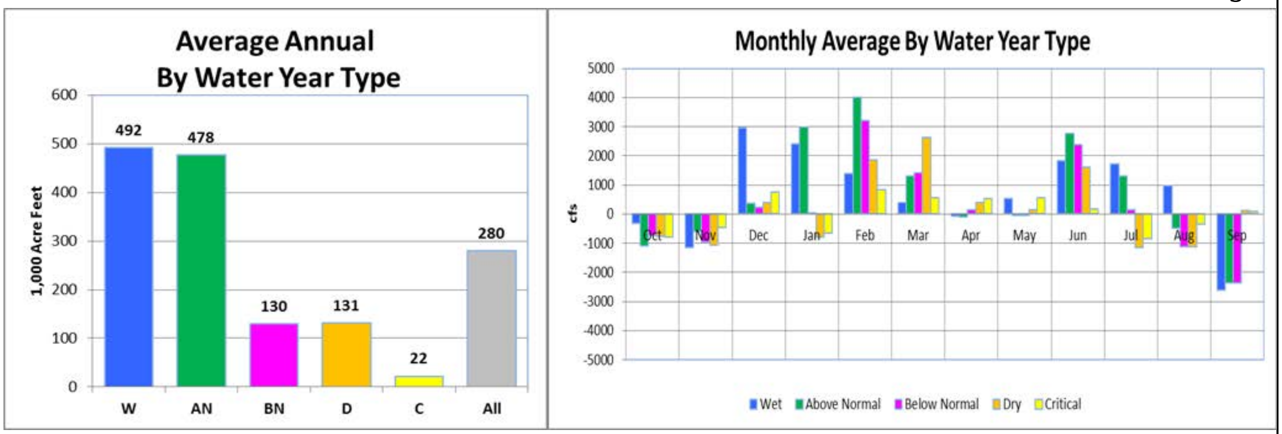


Figure 9: Change in Delta Exports (Jones plus Banks) – Modified MBK Alternative 4A minus Modified MBK NAA. *The data represented in these figures was from sensitivity studies developed by DWR. These studies start from MBK NAA and MBK Alt 4A and modify the climate to reflect ELT conditions. They also revert the rule curve logic and allocation logic (including "boost" from JPOD) back to DWR/USBR BA logic.*



The difference in impacts between MBK modeling and the Petitioner's modeling are a result of implementing a set of discretionary assumptions that were reviewed and rejected by DWR and Reclamation. The petitioners therefore contend that it is unreasonable to make conclusions regarding the impacts of the California Water Fix based on rejected assumptions, which include unreasonable foresight.

IV. MBK 2-year Example is Based on Same Flawed Discretionary Decisions

MBK states that their "basic operational strategy would be, given regulatory constraints, to divert as much surplus as possible and to operate upstream CVP and SWP reservoirs to convey surplus stored water when possible." [SVWU 107, p. 44.] With this premise, Mr. Bourez testified that "If you draw down storage more because of the California WaterFix in a wetter year and you go into a drier year with less water, it would be more difficult to meet the RFA [sic] requirements." [October 20, 2016 Vol. 20, 59:21-24.] In SVWU-108, pg. 9, MBK also goes on to conclude that with the lower carryover storage going into a dry year, it would be difficult to deliver adequate water to the Sacramento River Settlement Contractors.

To support MBK's statements that the CWF operations would negatively impact carryover storage in a wet-dry sequence of years, MBK modeled a two-year example showing a wet year (1993) followed by a critical year (1994) and compared the results between their NAA and Alternative 4a scenarios. MBK's modeling results show that the export of stored water in the summer of 1993 increased under the proposed project [SVWU 110, pg. 21], causing storage to be lower going into 1994, a critical year. MBK claims that the lower storage going into a critical year makes it difficult to meet RPA requirements and can adversely affect deliveries to Sacramento River Settlement Contractors (which they say is exemplified by decreased exports in 1994 under their Alternative 4a).It is my professional opinion that MBK's two-year modeling example does not provide a sound basis for their narrative because the results are highly sensitive to an incorrect assumption regarding the use of the Joint Point of Diversion (JPOD) to unreasonably export stored water.

IV. <u>MBK's ability to Model Increased Exports is Tied to JPOD Assumptions</u>

MBK's argument relies heavily on the assumption that additional capacity from JPOD would be available to achieve the delivery of artificially increased south-of-Delta CVP allocations. In their written testimony, MBK has acknowledged the use of JPOD capacity to "boost CVP SOD allocations in years that SOD allocations are export capacity constrained." [SVWU-107, pg. 41-42] To reflect this in their modeling, MBK has altered the logic for the timing and magnitude of CVP's ability to move water in a way that is inconsistent with how operators would make decisions; CVP operators have indicated that they do not make assumptions about presumed JPOD capacity when making allocation decisions in the spring. [See DOI-32 and DOI-33.] MBK's incorrect JPOD assumption allows their modeling to export more water and drive NOD storage lower as shown in their results. It is important to note that MBK's manual manipulation of SOD delivery goals are also a sensitive factor, since these inputs work in tandem with the JPOD assumptions.

However, this argument focuses only on identifying the effect of MBK's JPOD assumptions on export and storage.

In order to demonstrate that MBK's JPOD assumptions are critical to delivering water in 1993, MBK results were recreated and compared to a newly created sensitivity study, referred to as *MBK Alternative 4a JPOD revert* in the figures below. *MBK Alternative 4a JPOD revert* is based on MBK's Alternative 4a, but with their JPOD assumptions reverted back to be consistent with the Petitioners' modeling. This sensitivity study shows that the additional export of stored water in the summer of 1993, and subsequent storage decrease in 1994, is highly dependent on MBK's incorrect JPOD assumptions.

The results of this work can be summarized as follows:

- After reverting MBK's JPOD assumption, total exports in the summer of 1993 decreased, as a direct result of reduced use of JPOD capacity. (Figure 10)
- Total exports in summer of 1994 are increased back up to NAA levels, refuting the claim that it would be more difficult to deliver adequate water to legal water users. (Figure 10)
- NOD storage conditions improve as a result of not moving the stored water through JPOD. (Figure 11,12)
- Without additional JPOD capacity to deliver artificially high south-of-Delta allocations, CVP San Luis storage is drawn down to dead-pool in 1993 and shortage conditions occur. (Figure 14)

Figure 10: Comparison of total exports for the 1993-1994 example operation. MBK's NAA and Alternative 4a are plotted along with a sensitivity study (green), where MBK's JPOD assumptions are reverted (MBK Alternative 4a JPOD Revert). The results show that JPOD assumptions are a primary driver of increased exports in MBK's Alternative 4a.

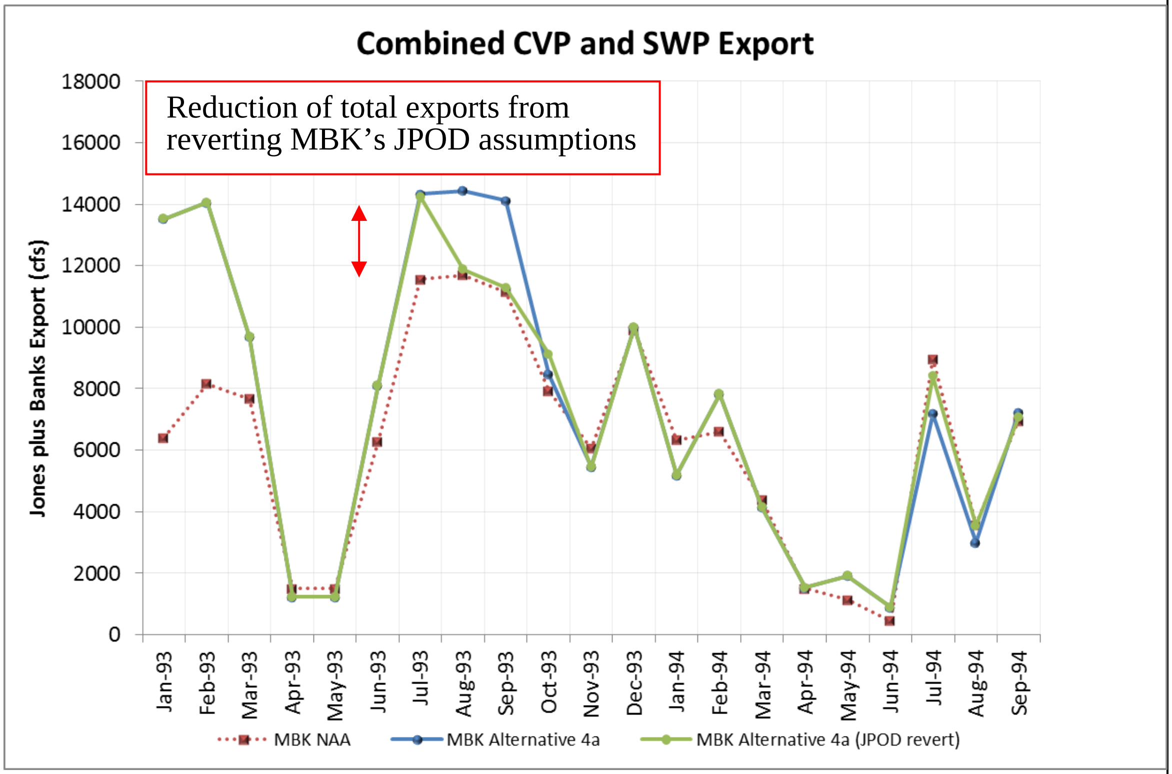


Figure 11: Shasta storage between Total CVP wheeling between MBK NAA, MBK Alternative 4a and MBK Alternative 4a (JPOD revert). MBK Alternative 4a JPOD revert shows improvement of storage conditions going into 1994, as a direct result of lower– and more realistic– pumping levels in 1993.

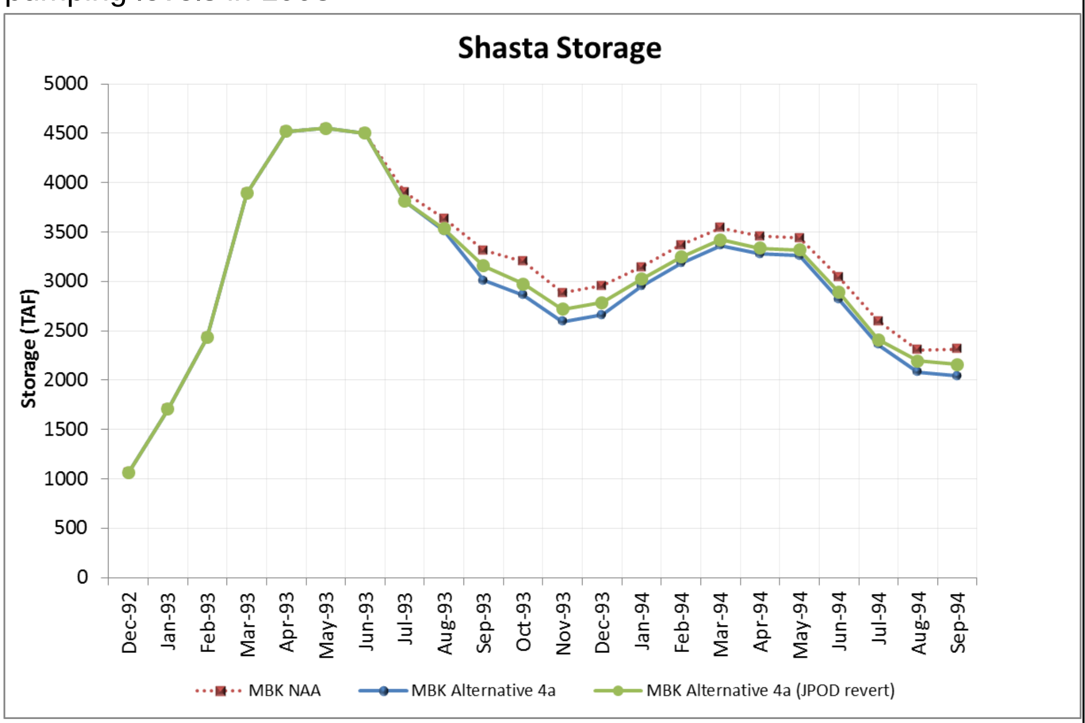
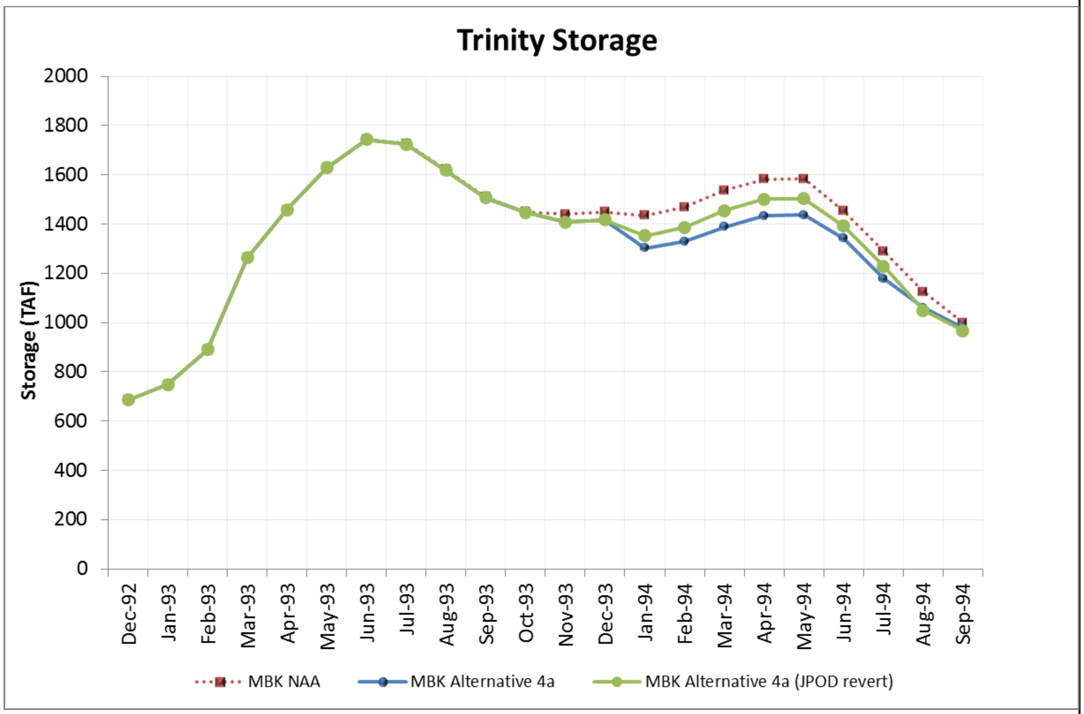


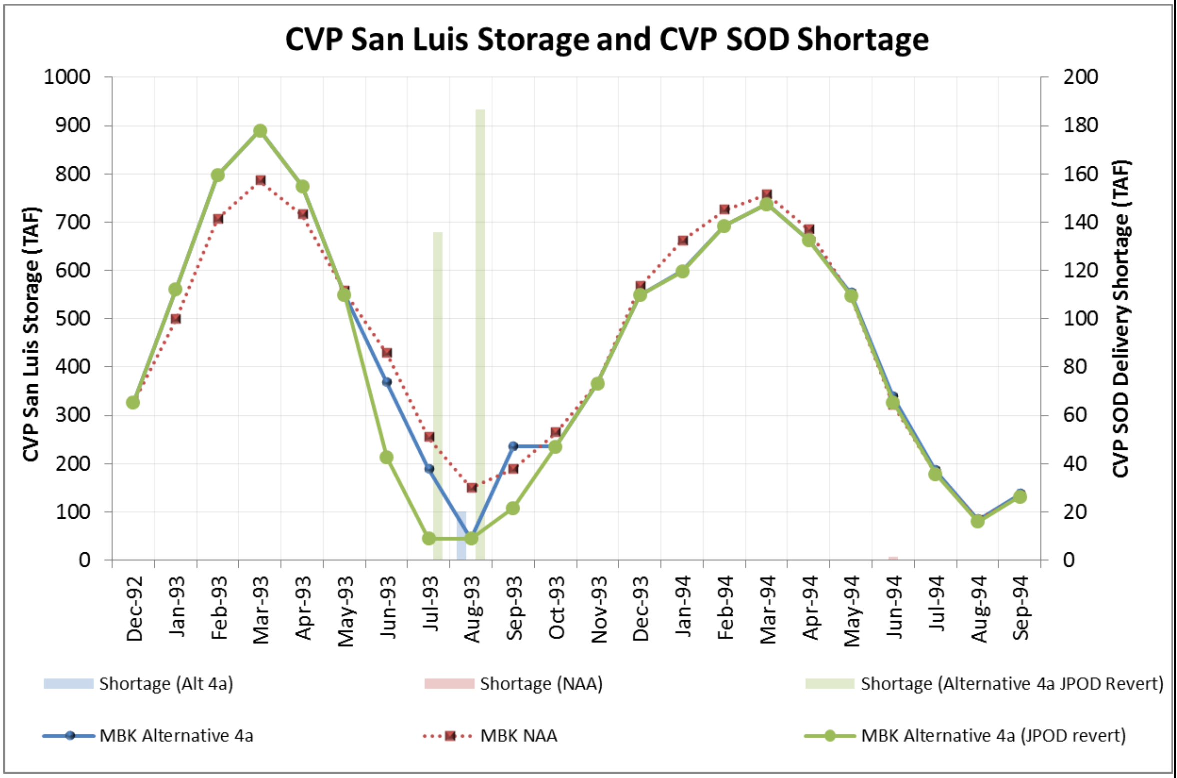
Figure 12: Trinity storage between Total CVP wheeling between MBK NAA, MBK PA and

MBK Alternative 4a (JPOD revert). Like in Shasta, storage conditions improve, as a direct result of reverting MBK's JPOD assumptions.



As shown in Figure 13, most of MBK's JPOD use in July and August is directly delivered, while most of their September JPOD use is stored. Without the higher level of assumed JPOD capacity, San Luis would need to be drawn down further, resulting in CVP SOD delivery shortage. Note: Truly re-running an acceptable model without JPOD assumptions to MBK's specifications would require retuning their user-defined SOD allocations; if MBK observed shortage conditions as shown below, it could be presumed that they would adjust the SOD delivery goals and re-run the model to obtain a more reasonable result. The purpose of this sensitivity analysis is not to produce a production-level CalSim II study. Rather, it is to demonstrate the high sensitivity of the JPOD component and the high-risk nature of allocating based on anticipated JPOD capacity. This is important because the narrative derived from MBK's two year example hinges heavily on their JPOD assumption.

Figure 13: CVP San Luis Storage between MBK NAA, MBK *Alternative 4a* and MBK *Alternative 4a* (JPOD revert).



MBK's two-year modeling example does not provide a sound basis for their claims that when going from a wet to critically dry year with California Water Fix, (1) RPA requirements would be difficult to meet and (2) inadequate water would be delivered to legal water users, because the results from their two year example are highly sensitive to an incorrect assumption regarding the use of JPOD.

V. Other SVWU Arguments

This section addresses several other topics raised in the SVWU testimony.

V.1. Boundary Analysis Purpose

Mr. Bourez stated that "The Boundary Analysis fails to meet its purported purpose because it does not consider this additional capacity or the flexibility it would provide to the operations of the CVP and SWP." [SVWU 100, ¶7(a).] As explained below, it appears Mr. Bourez misunderstood the purpose of the petitioners' boundary analysis.

As explained in Ms. Pierre's testimony [DWR-51, p. 10: 3-16], the purpose of the boundary analysis is to demonstrate to the State Water Board that the CWF offers enough flexibility to operate CVP-SWP without impacting other legal water users under a broad range of operations criteria that may occur through adaptive management. The boundary analysis included operational scenarios with varying level of Delta export restrictions and/or Delta outflow requirements[4] in addition to the proposed North Delta Diversion. The variations covered the initial operational range represented by H3 and H4 scenarios, and two additional scenarios Boundary 1 and Boundary 2, which are representative of potential future changes resulting from the adaptive management.

The initial operational criteria for CWF will include existing regulatory requirements and new criteria associated with new and existing SWP/CVP facilities and the new permitting requirements specified by the biological opinions and the 2081(b) permit. Therefore, the petitioners selected H3 and H4 to represent range of operations within which the initial operational criteria would fall.

Similarly, the operational criteria included in the two boundaries provide a representation of the possible adjustments that may be made to initial CWF operational criteria through the adaptive management framework. [DWR-51.12: 12-16]. The adaptive management framework would allow for review of the monitoring data over time and consideration of the latest science, and if needed alter the initial operational criteria. The operations criteria assumed for the Boundary 1 and Boundary 2 were such that the selected criteria would provide broad enough range to provide flexibility for the Water Board

[4] Contrary to the unsubstantiated assertions of Mr. Tom Canon [CSPA-8, p.6] the CWF continues to implement the E/I ratio, as testified to by DWR witnesses under cross examination. The E/I Ratio was implemented for a similar purpose to the OMR restrictions and other fish specific protections. The E/I Ratio will continue to constrain south Delta exports while a more restrictive set of requirements are included in the north Delta diversion proposal. Because the E/I Ratio is a criteria for the protection of fish, DWR will address this further in its Part 2 testimony.

to allow for implementation of the adaptive management program and any future modifications based on monitoring and science.

The purpose of the boundary analysis modeling was to provide results that represent the CVP-SWP operations under NAA and each of the four CWF scenarios. The boundary analysis modeling assumed consistent discretionary decisions in the model to depict same level of flexibility for the upstream carryover storage conditions across the scenarios. The purpose of the boundary analysis was not to perform a tradeoff analysis or to present hypothetical extreme possibilities of CVP-SWP operations with the CWF.

V.2. MBK's Comments on Draft BDCP, BDCP DEIRS and BDCP/CWF RDEIR/SDEIS

In his testimony, Mr. Bourez refers to MBK's 2014 review of the petitioner's CalSim II modeling for the BDCP DEIRS. Mr. Bourez also references MBK's 2015 technical comments on the BDCP/CWF RDEIR/SDEIS [SVWU-100 p. 3 paragraphs 9 – 15].

DWR and USBR addressed MBK's 2014 and 2015 review in (1) a Master Response 30 included in the BDCP/CWF Final EIR/EIS, and through response to comments on the DEIRS and RDEIR/SDEIS. A majority of the MBK's comments were related to the underlying CalSim II model, which forms the basis for the No Action Alternative and the BDCP/CWF alternatives' CalSim II modeling included in the Draft EIR/EIS. The BDCP and the Draft EIR/EIS CalSim II modeling has been based on the Existing Conditions, No Action Alternative, and Alternative 1 models developed in April – May of 2010 (2010 models). In 2010, CalSim II Existing Conditions and No Action Alternative models were updated in coordination with the fishery agencies to include the 2008 USFWS and 2009 NMFS biological opinions. This model formed the basis for Alternative 1 in the DEIR/DEIS model development in 2010. All the action alternatives modeled since then continued to be based on the 2010 models to allow comparability with the baselines.

Models always evolve and are refined as operational understanding improves and the assumptions are better defined. In August 2011, several model improvements were identified by the DWR and Reclamation modelers, fishery agencies, and the modeling community. The identified improvements were compiled, and the Existing Conditions, No Action Alternative, and Alternative 1 models were updated in coordination with DWR, Reclamation and USFWS modelers. This update was performed to verify if the compiled model improvements have altered the incremental changes between Alternative 1 and the Existing Conditions and No Action Alternative, relative to the 2010 modeling. The findings from the 2011 update showed that the results remained consistent with the 2010 modeling. Therefore, the action alternatives modeled since 2011 continued to rely on the 2010 modeling, allowing consistency and comparability (see BDCP/CWF FEIRS Appendix 5A Section D.10.5).

Since 2011, DWR, USBR and others have continued to improve the 2011 Existing Conditions and No Action Alternative CalSim II models for other studies. A majority of the changes included in the MBK's 2014 baseline model, were already part of the 2011 review mentioned above. At the beginning of the 2015, USBR and DWR used the latest CalSim II version to evaluate CWF for the Biological Assessment. This same CalSim II version was also used for the boundary analysis presented for this process. The FEIRS Appendix 5G compares the incremental changes resulting under H3+ versus NAA using the 2010 CalSim II model, and the 2015 CalSim II model. This sensitivity analysis concluded that results using the 2010 CalSim II model and the 2015 CalSim II model remained similar.

In his opinion 13 [SVWU-100, 3: paragraph 6], Mr. Bourez lists specific findings. The first two findings were related to climate change assumptions and applicability to all the BDCP/CWF alternatives including the No Action Alternative in the Draft EIR/EIS [SWRCB-4]. It is not necessary to discuss the merit of Mr. Bourez's comments, which were addressed in detail in the response to comments (and Master response No. 30) in the EIR/EIS. Because the climate change assumptions were the same across all the Alternatives and the No Action Alternative, therefore, climate change is not a variable that will be expected to affect the comparability of the results. Mr. Bourez's remaining five findings listed under opinion 13 [SVWU-100, 4: paragraph 1] were specific to how the BDCP Alternative 4 was modeled by the petitioners in the Draft EIR/EIS. The majority of these comments are related to the discretionary decisions in the model under the circumstances for which there are no definitive rules (e.g. exporting from north Delta intakes vs south Delta intakes, moving upstream storage to south of Delta storage etc.). These discretionary decisions within the model rely on the modeler's professional judgement. Petitioners' assumptions were based on their best professional judgement and are consistent with the CVP-SWP operator's operational priorities. BDCP modeling provided a reasonable representation of the proposed operations criteria under the alternatives, and is consistent across all the alternatives, allowing for a fair comparison. The findings Mr. Bourez included in his opinion 15 were similar to those expressed in opinion 13 and the same arguments apply.

V.3. MBK's Comments on Reclamation's LTO DEIS

In his testimony, Mr. Bourez refers to MBK's 2015 Technical Comments on Coordinated Long-Term Operation of the Central Valley Project and State Water Project Draft Environmental Impact Statement [SVWU-100 p. 4 ¶¶ 16–18]. Given that CWF modeling and the LTO DEIS modeling share the same climate change approach, Mr. Bourez states that their comments of LTO DEIS are relevant in this proceeding.

All of the CalSim II model runs in this proceeding as well as in the BDCP/CWF draft and final EIR/EIS alternatives included consistent climate change assumptions without consideration of potential regulatory or operational changes due to climate conditions in the future. Potential climate-related operational changes are currently unknown and it would be speculative to develop such assumptions for CEQA and NEPA analyses. The climate change approach bias-corrected the rim reservoir inflows for the projected climate change scenarios before using in CalSim II. This correction was partially to address the potential operational effects of the reservoirs located upstream of the rim reservoirs.

The impact analysis typically compares conditions under the action alternatives to the No Action Alternative. This comparative approach eliminates effects of future uncertainty that cannot be modeled (such as changes in operations of large reservoirs upstream of the rim reservoirs in CalSim II) because the uncertainty would occur under all compared alternatives. This comparative approach reduces the uncertainty from future incremental changes because these changes would occur under both the action alternatives and the No Action Alternative

V.4. Delta Cross Channel Operations

The DWR/USBR BA Alternative 4A results in significantly more October surplus Delta outflow as compared to the DWR/USBR BA NAA. The cause of this Delta surplus at a time when the Delta is frequently in balance is primarily due to the proposed south Delta export constraints (OMR flow criteria and no through-Delta exports during the San Joaquin River October pulse period). MBK incorrectly contends that in DWR/USBR BA NAA and DWR/USBR BA Alternative 4A, it was assumed that the Delta Cross Channel (DCC) gates would be open for the entire month of October, which influences the Delta outflow.

October DCC operations can vary significantly in real-time in response to the 2009 NMFS BiOp Action IV.1.2. The model representation of this real-time operation is very simplified. However, the DCC assumptions in the CALSIM II model are consistent between the No Action Alternative and action alternatives. Even though the model shows differences in October DCC operations between Alternative 4A and NAA, in reality the operations would remain consistent with the NAA, given that the same real-time operations criteria would govern the DCC gate operations in October. Under the future operations, there would be a continued balance between operations of DCC closure to minimize effects on fisheries, upstream reservoir storage and water quality criteria in addition to Rio Vista and other Delta flow requirements.

VI. Other Protestants' Arguments Related to CalSim II

This section addresses CalSim II related arguments by other protestants.

VI.1. TUCPs in CalSim II

Mr. Bourez contends that "Foreseeable adaptations that the CVP and SWP could make in response to climate change include: (1) updating operational rules regarding water releases from reservoirs for flood protection; (2) during severe droughts, emergency drought declarations could call for mandatory conservation and changes in some regulatory criteria similar to what has been experienced in the current and previous droughts;" (SVWU-103, p7)

Similarly, Dr. Paulsen, in a response to a question from Mr. Herrick regarding whether or not TUCPs can be modeled contended that one could perform such modeling. Further, Dr. Paulsen goes on to say that the 16-year DSM2 simulation period does not include hydrologic conditions similar to what we experienced in the recent years [December 14, 2016 Transcripts Vol 35, p206-208], when in fact the 16-year period included two historical drought periods (1976-77 and 1986-91).

As to Mr. Bourez's point (2) and Dr. Paulsen's contention, it is not possible to represent measures that may be in response to a specific drought in a long-term planning model, as it would dependent on the circumstances specific to that event and it would be speculative to assume any such measures.

CalSim II is a monthly model developed for a long-term planning level analyses over an 82-year simulation period (water year 1922 – 2003). This simulation period reflects historical hydrologic sequence and includes three major drought periods (1928-1934, 1976-1977 and 1986-1991). As noted in the direct testimony [DWR-71 10: 25-28], CalSim II relies on generalized rules to provide a coarse representation of the project operations under adjusted hydrologic conditions to reflect future demands and land use, and it does not include specific operations in response to extreme events.

CalSim II model uses a set of pre-defined generalized balances/targets, collectively referred to as rules, which reflect the assumed regulations and are used to specify the operations of the CVP/SWP systems. These generalized rules have been developed based on historical operational trends and on limited CVP/SWP operator input and only provide a coarse representation of the project operations over the hydrologic conditions considered. These rules are often specified as a function of year type or a prior month's simulated storage or flow condition. The model has no capability of adjusting these rules to respond to specific events that may have occurred historically, e.g., extreme droughts, levee failures, fluctuations in barometric pressure that may have affected delta tides and salinities, facility outages, etc. Thus, results should not be expected to exactly match what operators might do in a specific month or year within the simulation period since the latter would be informed by numerous real-time considerations. Rather, results are intended to be a reasonable representation of long-term operational tendencies or trends. Under stressed water supply conditions, given the generalized nature of specified operations rules, CalSim II model results should only be considered as an indicator of stressed water supply conditions, and should not necessarily be understood to reflect literally what would occur in the future under a given scenario. For example, CalSim II model can result in instances where the required minimum instream flows, or regulatory flow/salinity requirements cannot be achieved, or deliveries to senior water rights holders could be shorted due to extreme water supply conditions in the reservoirs.

CalSim II includes the State Water Resources Control Board regulatory requirements for CVP-SWP as specified for each water year type. However, CalSim II does not currently reflect any potential temporary relaxations of standards that the State Water Resources Control Board in coordination with other regulatory agencies might invoke under extreme circumstances. As a result, CalSim II may tend to underestimate reservoir storages and overestimate flows during the most severe droughts. CalSim II also does not account for the compromises and temporary arrangements that are made among stakeholders during such dry circumstances. In reality the operations are managed in close coordination with various regulatory agencies and stakeholders under such extreme circumstances. In actual future operations, the project operators would continue to work in real time to satisfy legal and contractual obligations based on the water supply conditions and other information available at the time. None of these can be included in the CalSim II model as the portfolio of actions that may be considered under each occurrence of drought would vary depending on the circumstances specific to that event, to assume otherwise would be speculative.

VI.2. Climate Change Assumptions

Need modeling for drier projections

Dierdre Des Jardins in her testimony claims that the climate change analysis conducted for BDCP/CWF has major flaws [PCFFA 81 errata, p. 3:9-10]. She asserts without a citation that "recent observations and research point towards a much hotter and potentially drier future" [PCFFA 81 errata, p. 4:10-11] and recommends that the Board require DWR and Reclamation to submit operations modeling results using the Q2 drier/warmer scenario. [PCFFA 81 errata, p. 4:16-17]. As acknowledged by Ms. Des Jardins [PCFFA 81 errata, p. 4:18-19] DWR and Reclamation have included such modeling in the CWF Biological Assessment [SWRCB-104], as well as in the DEIR/EIS (SWRCB-4), both of which were included as exhibits for the current hearings. Based on the extensive climate change analyses conducted for BDCP/CWF, including the recent Q2 climate change analysis in the BA, the findings were consistent across the multiple climate change projections considered. Overall the incremental changes due to the CWF operations as compared to the NAA evaluated under a variety of future climate change scenarios considered, were similar to that described under the Q5 climate change projection included in the DWR and USBR's Part 1A direct testimony. Consistently, CWF scenarios found to result in flexible operations allowing the projects to export more winter excess runoff. Further, CWF operations generally result in similar or slightly higher upstream storage conditions compared to the corresponding NAA scenarios under same climate projection.

Sea Level Rise Projections

Ms. Des Jardins states that DWR should not use the assumption that there will be six inches of sea level rise by 2025-2030 since, in her opinion, the latest science shows that such an assumption would be "50% exceedance estimate at best" and that these assumptions are “unrealistic” [PCFFA 81 errata – p5: 13-16]. However, the sea level rise assumptions for the CVP-SWP operations modeling for CWF are within the range of projections and appropriate values selected based on the best available science.

As noted in Section A.7.6 of BDCP DEIRS [SWRCB-4] Appendix 5A, given considerable uncertainty in the sea level rise projections and the state of sea level rise science, BDCP used the mid-range estimates. For BDCP/CWF a 15 cm sea level rise was assumed by 2025-2030, and a 45 cm sea level rise was assumed by 2060 based on the Rahmstorf (2007[5]), in considering the effects of sea level rise on the CVP-SWP operations with and without CWF. These assumptions were also consistent with Vermeer and Rahmstorf (2009[6]), the USACE 2011 guidance for incorporating sea level change in civil works programs, and the National Research Council sea level rise projections from 2012 [SWRCB-4, Table 29-2].

In addition to considering the 15 cm and 45 cm sea level rise projections, several other sea level rise values were simulated using UnTRIM, a three-dimensional Bay-Delta hydrodynamics and salinity model to capture the uncertainty in the sea level rise projections and to understand the potential impact on the Delta hydrodynamics and salinity intrusion. UnTRIM was simulated for sea level rise values including 15 cm, 30 cm, 45 cm, 60 cm, 140 cm and 140 cm with 5% tidal range amplification. UnTRIM results for the simulated sea level rise scenarios were included in the SWRCB-4, Appendix 5A Section D Attachment 3.

<u>Range of Climate Scenarios Considered for CWF analyses</u>

Extensive analyses were performed for BDCP/CWF recognizing the uncertainties associated with climate change and sea level rise. As noted in SWRCB-4, Appendix 5A, DWR and Reclamation in coordination with federal and state resource agencies developed

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[5] Rahmstorf, S. (2007). A semi-empirical approach to projecting future sea level. Science, vol 315. 18 January.

[6] Vermeer and Rahmstorf(2009): Global sea level linked to global temperature, Proceedings Nat. Acad. Sci. 2009 vol 106 no. 51 pp. 21527-21532, DOI: 10.1073

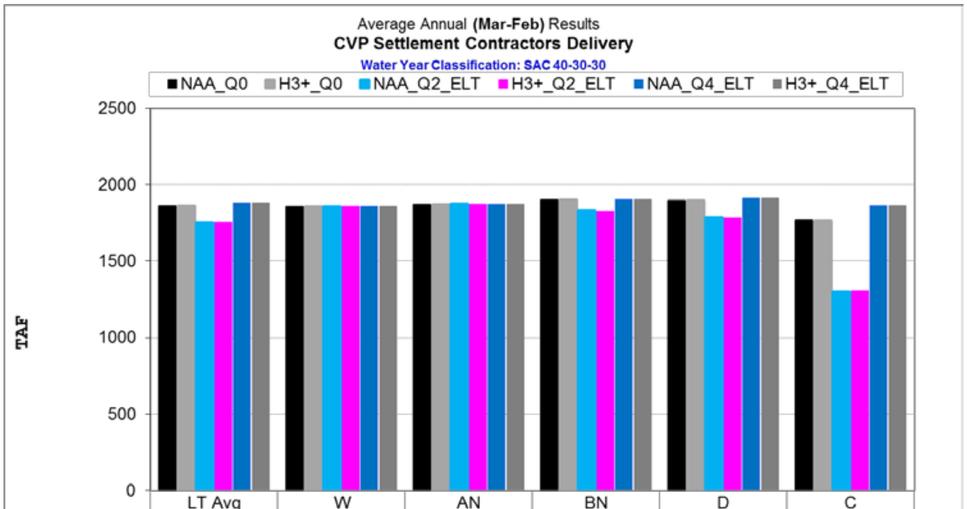
climate change and sea level rise projections at 2025-2030 and 2060 for use in the BDCP/CWF. 112 climate projections from the CMIP3 database formed the basis for the five BDCP/CWF projections. The 112 projections were bias corrected and statistically downscaled to better reflect the local conditions. The five (Q1-Q5) climate projections were developed using ensembles of the 112 projections. The five ensemble informed projections captured the range (Q1-Q4) and the central tendency (Q5) of the 112 projections. Ms. Des Jardins agrees that this was a "reasonable approach to [capture] the uncertainty about regional climate change scenarios if it was carried through to the final WaterFix modeling." [PCFFA 81 errata, p. 13:17-19.] Obviously, the five climate projections were developed DWR and Reclamation to study the sensitivity of the CWF under a wide range of climate change conditions.

Over the years, several analyses were performed using the Q1-Q5 climate projections at 2025 and 2060 for several variations of BDCP/CWF preferred alternative. In 2010, all five Q1 – Q5 projections were used to analyze changes expected under BDCP DEIRS Alternative 1 at 2025 and 2060 compared to the No Action Alternative. This analysis showed that incremental changes in the CVP-SWP system response due to CWF under all five climate projections was consistent. This analysis was documented in the SWRCB-4, Appendix 5A Section D.3.3. Given the consistency in findings across all the climate projections most of the subsequent CWF analyses used the Q5 projection.

More recently, in 2015, Q0 (current climate), Q2 (drier-warmer), Q4 (wetter-warmer) and Q5 (central tendency) projections were used to study the sensitivity of the incremental changes in the CVP-SWP system response due to CWF H3+ compared to No Action Alternative under the CWF BA. This analysis also provided the same conclusions as the 2010 analysis for Alternative 1. Key outputs resulting system response were included in the CWF BA Section 5A.A.3 [SWRCB-104].

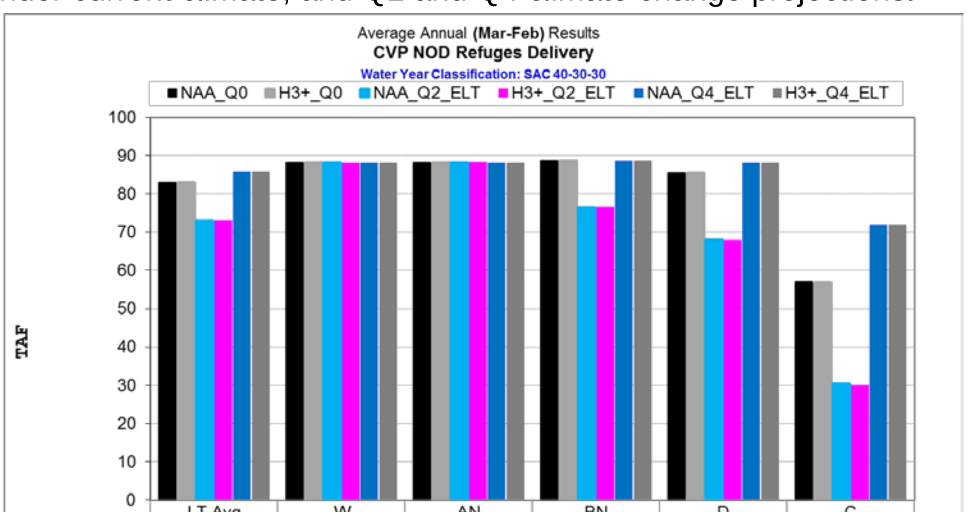
To further demonstrate that CWF does not cause any effects beyond NAA, results for key deliveries for Q0, Q2 and Q4 climate projections under the NAA and CWF H3+ are shown below in Figures 14-18.Detailed modeling results were made available to public for all the modeling conducted for the BDCP/CWF DEIRS, RDEIR/SDEIS, FEIRS and the BA.

Figure 14. Simulated CVP Deliveries to Sacramento River Settlement Contractors for NAA and CWF H3+ scenarios under current climate, and Q2 and Q4 climate change projections.



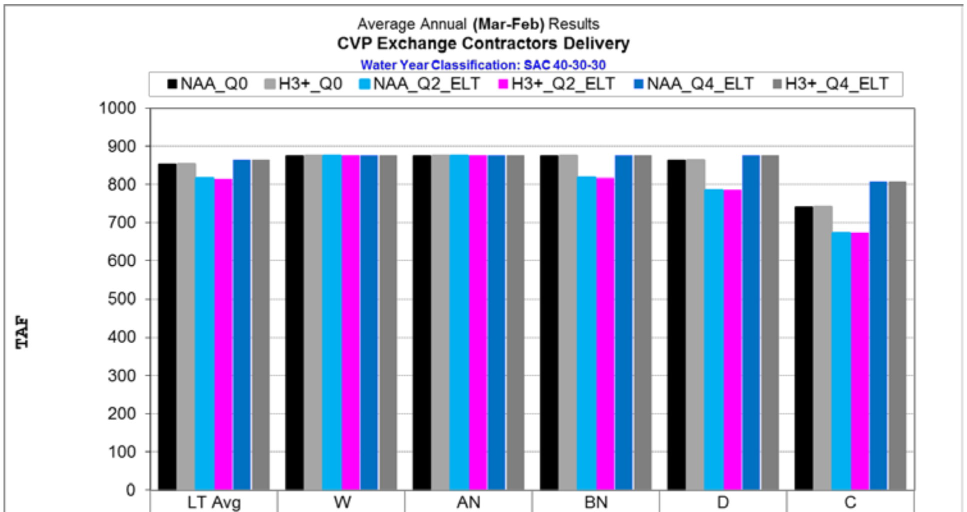
	LT Avg	W	AN	BN	D	C
NAA_Q0	1863	1857	1871	1902	1898	1769
H3+_Q0	1862	1857	1871	1902	1898	1764
NAA_Q2_ELT	1756	1858	1874	1828	1785	1298
H3+_Q2_ELT	1756	1858	1874	1828	1784	1304
NAA_Q4_ELT	1880	1857	1871	1901	1914	1862
H3+_Q4_ELT	1880	1858	1871	1901	1914	1862

Figure 15. Simulated CVP Deliveries to North-of-Delta Refuges for NAA and CWF H3+ scenarios under current climate, and Q2 and Q4 climate change projections.



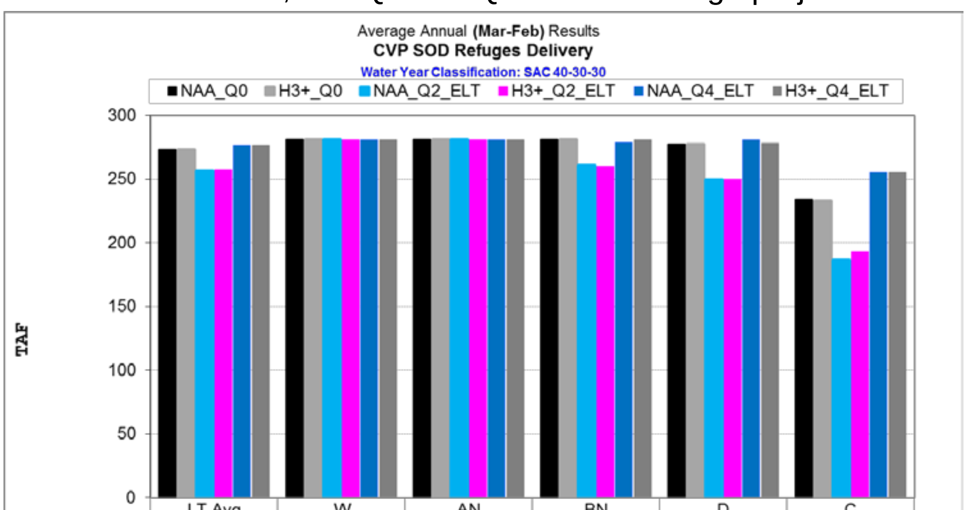
	LT Avg	W	AN	BN	D	C
NAA_Q0	83	88	88	89	85	57
H3+_Q0	83	88	88	89	85	57
NAA_Q2_ELT	73	88	88	76	68	30
H3+_Q2_ELT	73	88	88	76	68	30
NAA_Q4_ELT	86	88	88	89	88	72
H3+_Q4_ELT	86	88	88	89	88	72

Figure 16. Simulated CVP Deliveries to San Joaquin River Exchange Contractors for NAA and CWF H3+ scenarios under current climate, and Q2 and Q4 climate change projections.



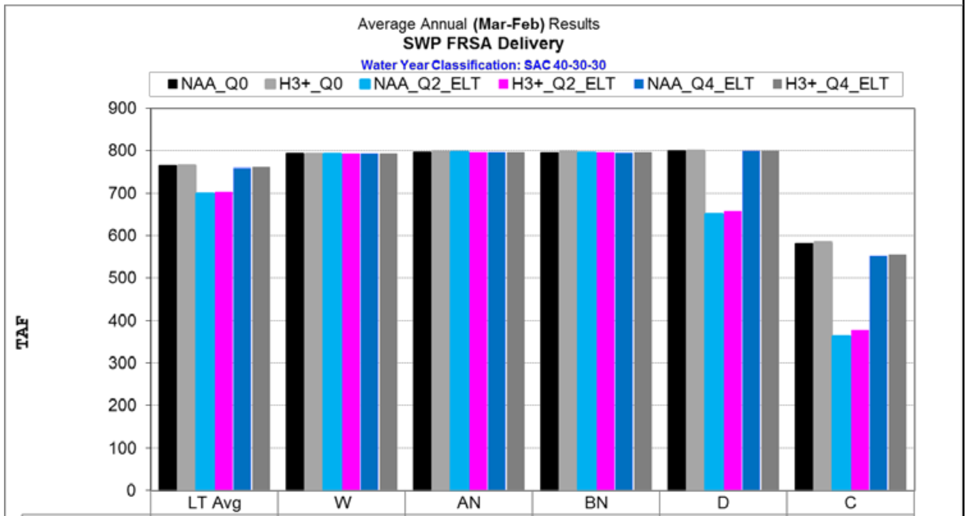
	LT Avg	W	AN	BN	D	C
NAA_Q0	852	875	875	875	864	741
H3+_Q0	852	875	875	875	864	741
NAA_Q2_ELT	815	875	875	817	785	674
H3+_Q2_ELT	815	875	875	817	785	674
NAA_Q4_ELT	865	875	875	875	875	808
H3+_Q4_ELT	865	875	875	875	875	808

Figure 17. Simulated CVP Deliveries to South-of-Delta Refuges for NAA and CWF H3+ scenarios under current climate, and Q2 and Q4 climate change projections.



	LT Avg	W	AN	BN	D	C
NAA_Q0	273	281	281	281	277	234
H3+_Q0	273	281	281	281	277	233
NAA_Q2_ELT	257	281	281	261	250	187
H3+_Q2_ELT	257	281	281	260	250	193
NAA_Q4_ELT	277	281	281	279	281	255
H3+_Q4_ELT	277	281	281	281	278	255

Figure 18. Simulated SWP Deliveries to Feather River Service Area Contractors for NAA and CWF H3+ scenarios under current climate, and Q2 and Q4 climate change projections.



	LT Avg	W	AN	BN	D	C
NAA_Q0	764	793	796	795	799	582
H3+_Q0	764	793	796	796	799	583
NAA_Q2_ELT	698	793	796	796	651	362
H3+_Q2_ELT	702	793	796	796	657	377
NAA_Q4_ELT	759	793	796	795	799	551
H3+_Q4_ELT	760	793	796	796	799	556

<u>Conclusion</u>

There is a significant uncertainty associated with climate change and sea level rise effects on California water resources. After considering a broad range of future climate change and sea level rise projections, CWF does not appear to cause any new effects compared to the no action alternative.

VI.3. North Delta Diversion Bypass Flow Criteria

The foundation of entire Mr. Ringelberg's argument in II_24 is based on his contention on page 4: 21-26 and page 5: 1-5, that CWF creates drought-equivalent conditions on the Sacramento River.

As explained in greater detail below, I have concluded that the proposed project diversion in the North Delta under certain project scenarios will establish essentially the equivalent of drought conditions, and their associated lower flows, in the Delta by removing significant flow of the Sacramento River during critical agricultural water use periods (for planting and maintenance during late spring and summer, and for salinity control and wetland management, fall) for salinity control.

From the limited summary flow data provided in the application, it appears that the flows immediately downstream of the intakes would be altered in the following manner (DWR-515 and DWR 5 errata, Pg 25-6):

- 6,000 cfs, 300 cfs would be diverted, leaving 5,700 cfs in the river.
- 15,000 cfs, 3,000 cfs would be diverted, leaving 12,000 cfs in the river.
- 22,000 cfs, 9,000 cfs would be diverted, leaving 13,000 cfs in the river.

4

II_24_Revised

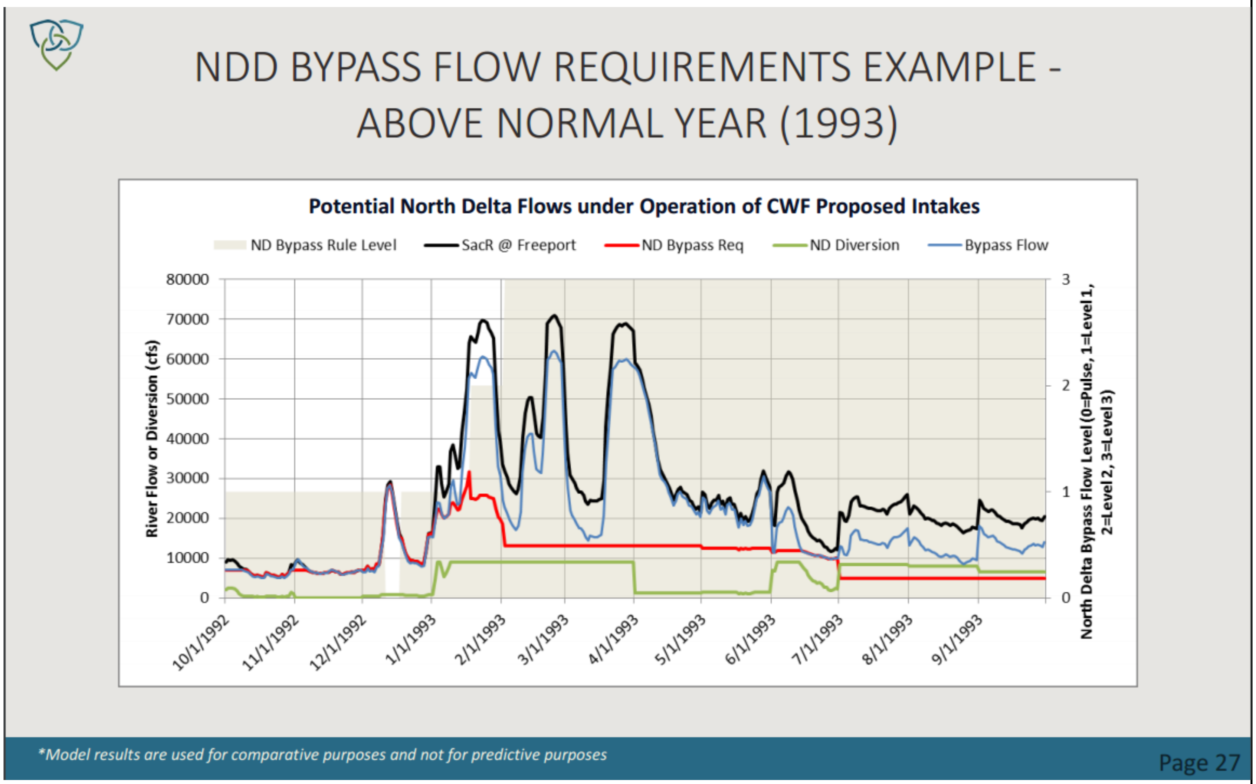
These flow rules represent a flow reduction up to to 41%. Under these rules, the flow, for the vast majority of the time, would be constrained from 5,700 cfs to 13,000 cfs. These flows are directly equivalent to the range of flows at Freeport during critically dry year (mean 9,345 cfs 1922) to a dry year (mean 16,003 cfs 1989). (II-29, ICF 2016, Pg. 2-3). In plain language, the project rules create a drought-equivalent conditions on the Sacramento River. The project

The testimony of Erik Ringelberg, excerpts from IL24 provided above, argues that WaterFix would cause Sacramento River flow to be equivalent to drought conditions. The testimony cites specific operating rules, Dec-Apr Level 3 Post Pulse Operations criteria, but fails to name such rules, nor considers the conditions in which those rules would be implemented, or how those rules apply to the historical range of flows on the Sacramento River. Furthermore, the testimony does not account for temporal variation in its argument. It compares minimum possible daily averaged bypass flows, as a result of Level 3 Post Pulse Operations criteria, to an annual average flow of two specific dry and critical years.

For these reasons, the conclusion argued by the protestant fails to represent the actual effect of the project on the Sacramento River.

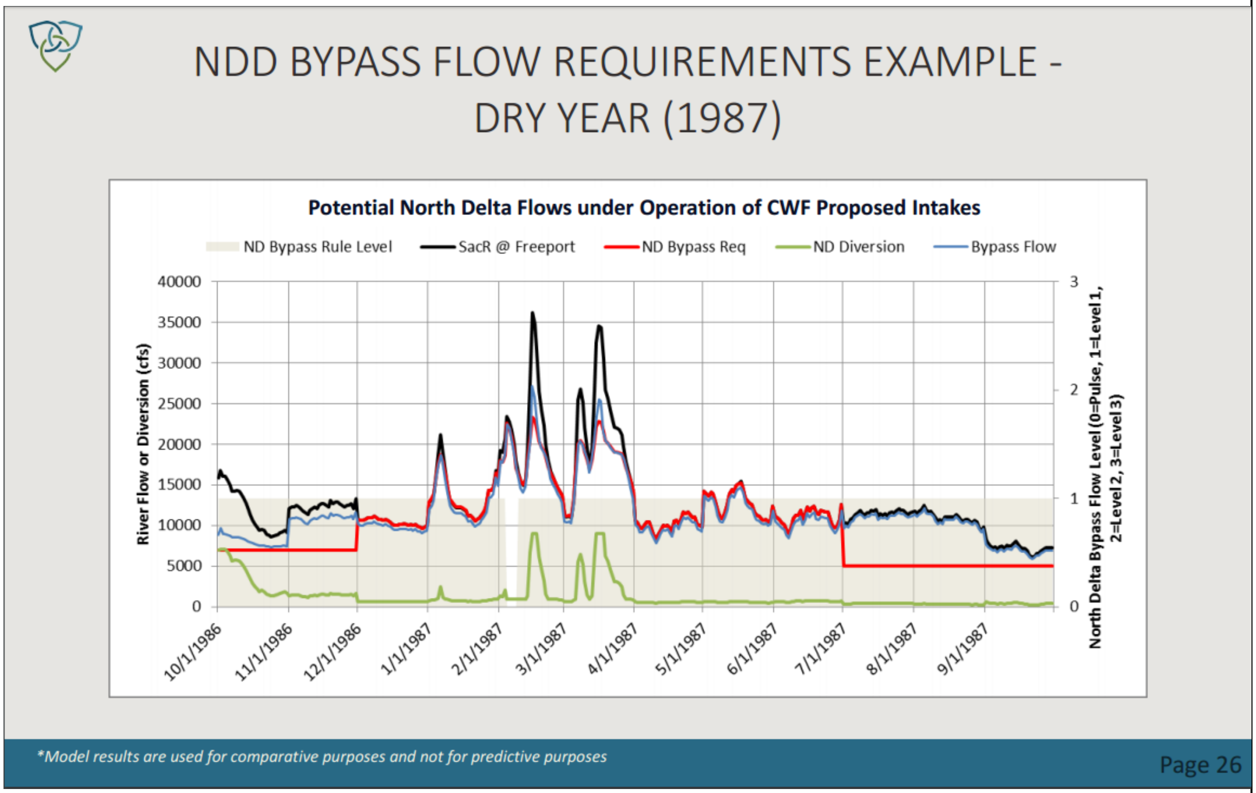
The testimony states, “Under these rules [Level 3 Post Pulse Operations Criteria], the [Bypass] flow, for the vast majority of time, would be constrained from 5,700 cfs to 13,000 cfs.” [IL-24, p5: 1-2] Before applying Level 3 Post Pulse Operations criteria, the following criteria need to be met: the date must be within December through April, there must be at least one pulse flow event that should have occurred (described in Chapter 3 of the Biological Assessment), and 30 days of bypass flow greater than 20,000 cfs. These criteria ensure that Level 3 Post Pulse Operations criteria only occur in conditions that are wetter than droughts. Also, the assumption that bypass flows would be constrained from 5,700 cfs to 13,000 cfs is incorrect. The slide on Page 27 (Figure 20) illustrates conditions in 1993 as an example of a typical above normal year. Level 3 Post Pulse Operations Criteria starts in February 1993. Under these rules, the bypass flows range from 8,400 cfs to 62,000 cfs, and 87% of the days have flows greater than 13,000 cfs. Therefore, the Level 3 Post Pulse Operations Criteria allow for flows above 13,000 cfs for the vast majority of time.

Figure 19. Page 27 of DWR-5 Errata



Then, the testimony [IL-24 p5: 2-4] uses the following annual average flows to represent "drought conditions": 9,345 cfs in 1922 and 16,003 cfs in 1989.[Exhibit II-29, , pg. 2-3.] In fact, the reference cites 1924, not 1922, as Mr. Ringelberg reported. Aside from that, the argument's logic is lacking. Stating that a daily average flow should be compared against an annual average flow assumes that Sacramento River flow is constant across all days in any given water year. The range of flows in Figure 19 shows that daily averaged flow rate in an above normal year varying from 5,200 cfs to 71,000 cfs. Furthermore, flows in water year 1987 range from 6,000 cfs to 36,000 cfs (Figure 20). Thus, the implicit assumption in the testimony's argument is invalid.

Figure 10. Page 26 of DWR 5-Errata



> As validation of my conclusions regarding diversion flow rules, the scenarios that were provided as illustration of the project modeling analysis ~~archive to~~ achieve the same diversion rates as the maximum diversion rules: 1978, which was also classified as a dry year is modeled with a flow in the river of 14,000 cfs, and a 6,000 cfs diversion, leaving 8,000 cfs in the river with a 43% flow reduction. The same modeling shows that even in an above normal year (1993), at a flow of 21,000 cfs, 9,000 cfs is diverted, leaving 12,000 cfs in the river, (DWR-5 errata, Pg 25-6).

The excerpt from IL24 page 5: 15-21 above describes evidence provided by Mr. Ringelberg to validate his testimony. Again, the testimony used the wrong year as argument. DWR-5 errata pg 25 provides a time series plot of 1987, not 1978. Further, the flow levels reported by Mr. Ringelberg only occurs in October for a few days, which is outside of the Dec-Apr period when the Level 3 post pulse bypass flow criteria is applicable. Mr. Ringelberg's 1993 example also once again points to a few days in October. Therefore, this does not equal drought conditions, as described in the paragraph above.

The excerpts presented above from IL-24 represent the foundational argument of Mr. Ringelberg's testimony in IL-24. The modeling results indicate that the bypass flows would not be constrained to the range provided by the protestant, as diversions are limited by pulse flow protection, level 1, level 2 and level 3 bypass flow criteria, real-time monitoring (which is not modeled) and several other Delta regulations. The logic used for the term "drought conditions" does not account for variation in flow along the Sacramento River during the course of a typical year. For the reasons described, it is invalid to assume that there would drought-like conditions in the Sacramento River with WaterFix.

VI.4. CalSim II Calibration/Validation

It is important to distinguish between general criticism of the CalSim engine and specific complaints about Petitioner's application of CalSim to the CWF. Both criticisms have been levied during protestant testimony.

Multiple protestants have cast doubt on the viability of CalSim, deeming it uncalibrated and insufficiently peer reviewed. Since its 2003 official peer review, many issues raised in that process have been and are being addressed through ongoing development. CalSim has also continued to be the subject of constant "real peer review" through assessments of model applications to specific studies and projects. Fifteen years of use by an ever-growing field of engineering and modeling professionals who represent a wide range of interests in CVP/SWP operations has steadily yielded improvements and corrections. The CVP/SWP system is large, operations are complex, and modeling analysis of it in any environment is a challenge to master. This does not mean that CalSim is not appropriate to the task.

The experienced CalSim modelers who have either provided review of petitioner modeling or prepared alternative modeling do not imply that the CalSim engine itself is flawed, that the solution algorithm is not sufficient, or that any modeling fails the basic threshold of mass balance (Vol 21, p76-78). Their protests focus instead on the results of the model scenarios. This rebuttal addresses the specific complaints by protestants examining model logic and results.

Ms. Des Jardins repeatedly cites the recommendations from the 2012 Scientific Panel on Analytical Tools for Evaluating Water Supply, Hydrodynamic and Hydropower Effects in the Bay Delta Plan for best calibration aspects for a Delta hydrodynamics model. Ms. Des Jardins also incorrectly states that the panel considered CalSim II as a Delta hydrodynamics model (Vol 34, P150, L21), and thereby infers that CalSim II should be calibrated and validated in similar fashion as DSM2. However, the panel rightly does not include CalSim II as part of the Delta hydrodynamics models (DDJ104 P10 - P11), and only include it as a model for evaluating Operations Planning. As such the panel's recommendations for calibration of hydrodynamics and water quality models cited by Ms. Des Jardins [DDJ-108-errata2, p17: 8-19] do not apply to CalSim II. Even so, some of the regression equations used in CalSim II such as the flow split at Delta Cross Channel and Georgiana Slough, and Old and Middle River flows, have been developed based on calibrated DSM2 model results. CalSim II relies on an Artificial Neural Network (ANN) to estimate flow-salinity relationship in the Delta. The ANN used in the CalSim II is trained based upon the results from a calibrated DSM2 model. A full circle analysis is performed wherein the ANN results are compared back to DSM2 results to assess the performance of the ANN following the completion of the training process. This process ensures that the ANN emulates the DSM2 results reasonably well.

Ms. Des Jardins also infers that CalSim II results are inaccurate because it (1) has not been subject to calibration and validation and therefore is not "demonstrably using standard engineering development practices" (20161213, P136, L25 – P137, L22) and (2) does not adhere to development standards used in SacWAM, which is having a "full peer review" and is "doing everything right" [December 13, 2016 Transcripts Vol 34, p.153:12-21]. She defends SacWAM development as a foundational benchmark and infers that CalSim II development and review should adhere to the same standards in order to be deemed satisfactory. It is a double standard to denounce CalSim and commend SacWAM development at the same time, since SacWAM uses CalSim results to validate operations and the calibration of physically-based parameters adheres to the same principles in both models. The petitioners therefore contend that Ms. Des Jardins' inconsistent remarks are grounds to challenge the credibility of her critiques.

Like SacWAM, CalSim has some routines that are physically based and can be calibrated such as Crop Evapotranspiration used in the hydrology input development methodology. Another example is the rainfall runoff process which is calibrated against historical rim inflow, historical outflow, historical import, and historical export of each Depletion Study Area (DSA). I pointed this out in my cross exam testimony when referring to the input hydrology of CalSim:

> *"The statement on the hydrology component being able to be calibrated is that the hydrology is developed with gauged flow, measured gauge flows as its starting point, and then adjustments are made as we move upstream in order to account for the next upstream gauge and the accretions or the flows or losses that occur between those gauges. And then in a typical projected hydrology, we then adjust that historic hydrology to represent a future condition. So the statement on the calibration is that we start with measured gauge flows as the basis for the hydrology development." (*August 26, 2016, Vol. 16, Page 15, Line 22 to Page 16, Line 9.)

Regarding the validation of operations, the SacWAM documentation states that "*many aspects of SacWAM are not physically based, being simplifications of complex operating criteria and regulations. These management aspects of the model cannot be calibrated. Instead SacWAM simulation has been validated through comparison with CalSim II, a management or planning model for the SWP and CVP."* (Sacramento Valley Water Allocation Model, Model Documentation, Draft Version 001, September 2016, Section 11.5 Model Validation and Calibration)

Like SacWAM, CalSim has operating criteria and regulations that it simulates but cannot be calibrated because these management aspects of the model, such as operator decisions, cannot be calibrated. In fact, the outputs of CalSim are used to validate

SacWAM operations, a critical part of the overall modeling. Therefore it is not reasonable to use the merits of SacWAM to invalidate CalSim; the models are not mutually exclusive.

VI.5. Baseline Related

CSPA 4 revised p.2: *The testimony of DWR and the Bureau in this proceeding, and the NEPA and CEQA review that they have offered in support of CWF, have not defined or quantified either current operation of the SWP and CVP reservoirs or planned future operation of these reservoirs if the proposed CWF North Delta Diversions (NDD) are constructed and operated.*

CSPA 4 revised p.3: *CalSim II modeling in support of the proposed CWF does not clarify baseline reservoir operations, No Action Alternative reservoir operations, or planned reservoir operations under CWF.*

The intent of using the CalSim II modeling is to quantify the potential changes in the CVP-SWP operations including the operation of the CVP-SWP reservoirs across a range of hydrologic conditions under the No Action Alternative and the CWF scenarios.

Appendix 5A of the BDCP DEIRS [SWRCB-4] specifies the CalSim II modeling assumptions used for Existing Conditions, No Action Alternative and the BDCP Alternatives considered as part of the DEIRS. Appendix 5A of the CWF BA [SWRCB-104] specifies the CalSim II modeling assumptions used for the No Action Alternative presented by the petitioners as part of the current hearing, as well as the modeling assumptions for the CWF H3+ scenario, which is the basis for majority of the CWF assumptions in the scenarios presented in support of the boundary analysis, except for the differences outlined in DWR-515.

The modeling assumptions outline major regulatory and operations criteria based on which the key CVP-SWP facilities are operated. For example, Section 5.A.5 of SWRCB-104 notes that the NAA assumptions represent the operations criteria outlined in the 2009 NMFS Biological Opinion. Section 5.A.A.7 of SWRCB-104 outlines the individual criteria outlined in the 2009 NMFS Biological Opinion, and the modeling assumptions related to those criteria.

CSPA 4 revised p11: *Mr. Munévar admitted that for all alternatives presented in this proceeding, the rules employed in the model are to maintain storage or improve upstream storage in modeled scenarios.*

As noted in SWRCB-104 Section 5.A.A.7, the performance measures specified in Action Suite 1.2 under the NMFS BiOp were not explicitly modeled in CalSim II under the No Action Alternative and the CWF scenarios. Therefore, to achieve the storage performance measures outlined under Action Suite 1.2, the modeling philosophy employed for the CWF scenarios is to maintain or improve upstream storage conditions as compared to the No Action Alternative.

CSPA 4 revised p12: *The CalSim II modeling for WaterFix should have treated reservoir storage as a variable, not a constant.*

CalSim II modeling for WaterFix was performed to demonstrate the potential effects on the CVP-SWP operations including reservoir storage conditions, river flows, and deliveries under various WaterFix scenarios in comparison to the No Action Alternative. The intent of the modeling performed for this hearing was not to analyze the tradeoffs between reservoir storage, instream flow and water deliveries for No Action Alternative or WaterFix scenarios. Instead, it is to estimate potential changes in the storage, flows and diversions under the WaterFix scenarios compared to the No Action Alternative within the same risk tolerance depicted under the No Action Alternative CalSim II model, which represents the existing regulatory requirements that would continue even under the WaterFix.

CSPA 4 revised p14: *It is unknown how the causes of these anticipated end-of-September storage decreases between 2009 and 2025 break down among climate change, sea level rise, additional north-of-Delta deliveries, additional SWP south-of-Delta demands, and other factors described in the RDEIR/SDEIS.*

Appendix 5A section D.10.2 of the BDCP DEIRS [SWRCB-4] describes the findings based on several sensitivity runs to demonstrate the effects of climate change and sea level rise on the CVP-SWP operations under the No Action Alternative. The results from this sensitivity analysis show that the effects on the upstream operations are primarily due to the climate change effect on the reservoir inflows, river temperatures, and the increased salinity intrusion in the Delta due to the projected sea level rise. The proposed BDCP operations did not impact the upstream reservoir conditions, both at end-of-May and end-of-September, because of the increased flexibility in the system.

In a response to Mr. Herrick's question as documented in the transcript Vol 35 : p194-195:

> *MR. HERRICK: And it was your testimony that you were actually able to tease out the difference between the effects of a climate-change-included scenario with just the project; is that correct?*
>
> *WITNESS PAULSEN: Well, that was the purpose of comparing the existing condition to the no action and then, again, those two scenarios to the Boundary scenario. It was try to figure out, based on DWR's model run, what the impact of sea level rise primarily would be, climate change and sea level rise, and then to look at the difference between the no action alternative and the Boundary 1 scenario to try to figure out on top of that what the impact to the project would be.*
>
> *MR. HERRICK: And you did that because, if we don't separate out the difference in impacts from climate change and just the project, then we don't really know what the impacts attributed to the project alone are, correct?*
>
> *WITNESS PAULSEN: That's exactly correct, yeah.*

In in response to Mr. Herrick's question excerpted above Dr. Paulsen incorrectly stated that comparing the No Action Alternative, which includes climate change and sea level rise, to an Existing Conditions scenario (without climate change and sea level rise) is a required comparison to discern the effect of the project alternative. Given the purpose of the modeling analysis is to determine the effects of the CWF under likely circumstances at the time the project would be operational (around 2030), the petitioners' comparison of project scenario to No Action Alternative, both of which include the same expected circumstances, is exactly what is needed.

Dr. Paulsen also contends that, "The appropriate baseline condition for evaluating the impacts of the proposed WaterFix Project is the existing condition." (Brentwood-102 p19) The comparison suggested by Dr. Paulsen, which is to compare CWF scenarios with climate change and sea level rise effects to an existing condition without climate change and sea level rise. This comparison will not distinguish any project effects from the effects resulting from climate change and sea level rise.

Models should only be compared with the same climate change assumptions whether they assume zero climate change or some projected change, the models being compared should have the same climate basis (the exception is the analysis of climate change impacts). The intent of petitioner's analysis is not to determine the effects of the climate change and sea level rise on the CVP-SWP operations. Therefore, there is no need for a comparison with the Existing Conditions. The changes in the modeling results from the CWF scenarios when compared to the No Action Alternative, would provide the expected effects of the operations with CWF, given both the CWF scenarios and the No Action Alternative included same hydrology and sea level rise assumptions, and the only differences were specific to the changes proposed under CWF. If the planning model run was being used to identify the effects related to the climate change then Dr. Paulsen's analysis might have been appropriate but that was not the intent of the planning model run.

Similarly, Dr. Paulsen, in determining her opinion 4 of Antioch's testimony [Antioch 202, pg 37], CWF Boundary 1 scenario results to Existing Conditions scenario. By doing this Dr. Paulsen is incorrectly attributing the effects of climate change and sea level rise to the Boundary 1 scenario.

Lastly, for the Existing Conditions scenario modeling results Dr. Paulsen relied on an 2010 version of the CalSim II model. By comparing Boundary 1 scenario, which was based on 2015 version of CalSim II, to Existing Conditions, any effects due to changes in CalSim II model versions are being attributed to the Boundary 1 scenario, as well.

Executed on this 23 day of March, 2017 in Sacramento, California.

(Armin Munevar)