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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	REBUTTAL TESTIMONY OF JOHN LEAHIGH (EXHIBIT DWR-78)

I, John Leahigh, do hereby declare:

I. INTRODUCTION

A. Organization of Testimony

In my rebuttal testimony, I provide a statement of my qualifications, a discussion of how conservative assumptions are used for allocations, a description of the sources of water available for export, the primary reasons for releases made from Lake Oroville, the use of existing pumping capacity, increased opportunities to capture excess flows as a substitute for stored water, difficulties in meeting water quality standards in some years, an increased efficiency of Delta flow regime with the California WaterFix (CWF), and finally an explanation as to why application of Term 91 would not be expected to change with the CWF operation.

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B. Qualifications.

I have provided my qualifications in my opening testimony [Exhibit DWR-61] and Statement of Qualifications [Exhibit DWR 21]. There are no material changes.

II. ALLOCATION

Mr. Bourez contends that his modeling is a more realistic representation of what actual operations would be under the CWF by claiming that "operators have a lot more information at their disposal to make these decisions." [October 20, 2016 Transcript, Vol 20, p. 211:11-19.] He further implies that available water supply and export capability is pretty well known and makes adjustments to the model allocations in response to that assumption. However, the MBK modeling presented in the Sacramento Valley Water Users (SVWU) case-in-chief incorporates more foresight than the operators truly possess and results in a more risky operation of the SWP than is consistent with the SWP's practice of prudently conservative operations.

The SWP allocation incorporates a broad range of variables including but not limited to: 1) volume of water stored in Lake Oroville and San Luis Reservoir; 2) end of year storage targets for Lake Oroville and San Luis Reservoir; 3) forecasted runoff based on snow survey measurements; 4) required Feather River flows for fish habitat, senior water right holders, and terms of the Federal Regulatory Energy Commission license; 5) Feather River service area delivery obligations from Thermalito Afterbay; 6) anticipated depletions in the Sacramento River basin; 7) estimated Delta consumptive use; 8) anticipated State Water Board Delta outflow and salinity requirements; 9) anticipated export restrictions for the protection of listed fish species under the National Marine Fishery Service and United States Fish and Wildlife Service biological opinions; and 10) contractor delivery requests and delivery patterns. By far, the largest uncertainty exists in the forecasted runoff, but many of the other variables are somewhat correlated with or dependent on the runoff. For runoff projections, the Projects utilize disaggregated watershed exceedance forecasts associated with the development and publication of DWR's Bulletin 120 (B-120). This

provides a wide range of probable outcomes early in the water year. As the water year develops, the uncertainty in the future forecast narrows, but still remains significant. For example, 2012 was a near average year in terms of precipitation and the February B-120 that year estimated an 80% probability range of 1.530 to 4.845 million acre-feet (MAF) of runoff into Lake Oroville from the upper Feather River watershed – a difference of 3.315 MAF (equal to the capacity of Lake Oroville when nearly full). In the May 2012 B-120, that estimate had narrowed to an 80% probability range of 2.685 to 3.350 MAF. To be prudently conservative, the SWP uses the lower end of the runoff forecast ranges throughout the Sacramento watershed when making water allocation decisions to their water supply contractors. These lower end forecasts have a 90% chance of being exceeded, or in other words, there is a 90% chance that actual observed runoff will be higher. Even with a narrowed range in the May forecast, the remaining water year runoff forecast for Lake Oroville still had more than 600 TAF of uncertainty, which is equivalent to a one and a half months of permitted SWP exports during the summer months.

There remains additional uncertainty beyond that in the runoff forecast. Export restrictions for the protection of fish can continue through the end of June. When making allocation decisions for its water supply contractors, the SWP assumes a conservative estimate of these restrictions. In addition, conservative estimates are assumed for other obligations including deliveries to meet settlement contractor deliveries and the amount of water necessary to meet the water quality requirements.

For the summer months, the SWP uses the conservative estimate of inflow into Lake Oroville to plan releases of stored water for SWP export and delivery south-of-the Delta in an effort to meet the end of year carryover storage target. However, at times, the stored water necessary to meet other obligations will result in end of year storages being pulled below the target. These other necessary releases to meet other Project obligations will be described in more detail later under Section IV.

For the SWP, the initial allocation is made in December, based on the variables

previously listed. Early in the year (winter and spring), the exports are typically operated to export surplus water within the constraints of the biological opinions and maintaining Delta requirements. These exports are used to either satisfy real-time demand or are stored in San Luis Reservoir. The upstream reservoirs are typically operated to capture runoff for future beneficial uses while also providing flood protection. The water supply in the snow pack also develops throughout the early part of the year. As the year progresses the allocation is reevaluated on a monthly basis and allocations are updated based on updated runoff forecasts, storages and demands. By May, the SWP has typically provided its final allocation. After the final allocation there is a significant difference between how much water supply was allocated and how much supply is actually exported. The conservative nature of the allocation process more often than not results in San Luis Reservoir storages that are higher than necessary to meet that year's allocated supply. The additional storage, if any, is available for the SWP's allocation in the following year.

Mr. Bourez does not make assumptions in a manner consistent with the criteria outlined in this section, and for a fuller critique of Mr. Bourez's assumptions see the modeling rebuttal testimony Exhibits DWR-79 and DWR-86.

III. SOURCE OF WATER FOR EXPORT

Mr. Nomellini asserts in his testimony that the Projects should not export water during the winter until it becomes clear that the current year will not be a dry year. [November 18, 2016 Transcript, Vol 30, pp.123:24-124:8.] The working assumption for the Project is that dry conditions will occur in the future. In fact, as previously stated, conservative assumptions of forecasted hydrology are always used when making allocation decisions for the coming year.

Project exports are generally supported during the winter and early spring months by runoff occurring from precipitation on the valley floor or by required flood releases from Project or other reservoirs upstream of the Delta. These excess flows are typically available intermittently even in the driest of years (e.g. 2015) and not exporting these flows

will not help upstream storage conditions. By definition, these flows are in excess of that needed to meet all legal diversions and Delta water quality objectives and not exporting under these conditions will represent a lost opportunity to utilize water supply for beneficial use.

During the wettest years, excess flows are available all year long including during the summer due to substantial snowpack that melts out into much of the summer months. In addition, CVP and SWP surface storages are generally high and may need to be reduced to provide adequate vacated storage space for flood control purposes into the late fall.

Exhibit DWR-850 illustrates three typical examples of the sources of water during a wet, critical, and near normal conditions. In both very wet and very dry years the highest percent of exports is from excess natural flow in the system. Of course in critically dry years this flow is very much reduced and therefore overall annual exports are a mere fraction of what is available in wetter years. During the more average or normal years the source of water is more evenly divided between excess flow and stored water released from upstream reservoirs. Some of the stored water that is exported at Banks Pumping Plant was originally released from Lake Oroville for Feather River flow requirements and not released specifically for export. This flow is only exported once it has served this other purpose and would otherwise flow out to the bay as excess to other requirements. The small amount of stored water that was released from Lake Oroville specifically for export at Banks Pumping Plant in the extremely dry years of 2014 and 2015 was for health and safety needs only. This supply must be delivered at Banks Pumping Plant for some cities contracting for SWP water because they can only access their SWP supplies directly from the Delta. They have no other way of receiving this supply because they have no SWP connection to San Luis Reservoir.

Therefore Mr. Nomellini's implication that upstream storages are being imprudently drafted early in the year to support exports is based on a false premise – that the source of

the Project's exports is upstream storage. In fact, the source of winter exports is predominately surplus flows that would end up as excess Delta outflow if not exported and put to beneficial use by the Projects.

IV. PRIMARY REASONS FOR RELEASES FROM LAKE OROVILLE

Witnesses during the California Sportfishing Protection Alliance (CSPA) case-in-chief [Exhibit CSPA -4-Rev, p.15] indicated that the Project releases too much storage in drier years which results in periods when insufficient storage is available to meet water quality objectives. Exhibit DWR-851 shows the primary reasons for releases from Lake Oroville during three different types of years. Lake Oroville is a multi-purpose facility and Exhibit DWR-851 indicates the multiple reasons for release – the vast majority of which are non-discretionary.

In wet years, a significant volume of water is released in order to maintain the required amount of vacated storage necessary to absorb excessive inflow from extreme storm events, thereby attenuating the magnitude of flows impacting downstream levee systems.[1]

In years when the primary reason for Lake Oroville releases includes a significant portion that is explicitly for Delta export at Banks Pumping Plant, other release requirements still make up the majority of releases. In 2012, over 40 percent of the releases were needed for Feather River flow requirements,[2] Delta requirements[3] or pass through of natural flow to meet downstream water rights diversions of other users. Nearly 30 percent of the releases from the lake were made to meet local settlement contracts.[4] The remaining 27 percent was released to help meet discretionary SWP water supply contractors' deliveries south of the Delta. This amount was moderated in order to maintain

[1] United States Corps of Engineers flood control requirements

[2] Federal Energy Regulatory Commission license requirements and National Marine Fishery Service maximum ramping rates

[3] State Water Board Decision 1641 flow and water quality objectives

[4] Specific volumes of delivery out of Thermalito Afterbay as specified by DWR settlement agreements with pre-existing Feather River users.

reasonable levels of carryover storage in the event dry conditions occurred in subsequent years. The tempering of releases for this purpose in this year (and all years where a significant amount of stored water is released for export) is confirmed by the fact that some of the SWP export capability was not fully utilized in that year during the summer months.

The SWP moderates the releases from Lake Oroville to meet the SWP water supply contractors demands. The Project balances the needs of the current year with the risks for meeting the many requirements and beneficial purposes of storage in subsequent years. In this balancing process, the SWP policy is to incrementally increase conserved storage for subsequent years as the available water for water supply deliveries in the current year increases.

As evidenced in my direct testimony [Exhibit DWR-61], the track record of the Projects for meeting water quality standards has been excellent other than for recent examples of exceptional drought. I will discuss addition extenuating circumstances which challenged the system in section VIII below. Based on this record, I find the broad assertion by CSPA that the Projects systematically leave insufficient water in storage to meet water quality standards to be without merit.

V. USE OF EXISTING PUMPING CAPACITY

During the CSPA case-in-chief [Exhibit CSPA-4-Rev, p.3], the contention is made that Oroville operations in releasing stored water for export is unrealistic as depicted in the modeling for CWF. CSPA asserts that, in the absence of current south Delta export constraints[5] on Banks Pumping Plant, SWP operation should be expected to be more aggressive in releasing additional stored water from Lake Oroville for delivery south of Delta during the summer months.

In addition during the SVWU's case-in-chief [Transcript, Vol 20, p. 68:20-22.] Mr. Bourez states that the Central Valley Project would be expected to utilize joint point of diversion (JPOD) more frequently with the CWF than modeled by the petitioners.

[5] Such as the current permitted United States Army Corps of Engineer's Clifton Court Gate intake limits from the existing SWP south Delta diversion location.

In theory, the addition of the proposed north Delta diversion associated with the CWF when combined with existing Clifton Court Forebay intake permit capacity would increase the opportunities to utilize full Banks Pumping Plant capabilities for both the export of Lake Oroville stored water and use of JPOD to export CVP upstream stored water.

Exhibit DWR-852 depicts historical use of CVP and SWP export capacity. The dashed red line depicts the maximum volume of combined CVP and SWP exports over the summer months (July – September) given existing south Delta permitted capacity. The solid red line represents the actual volume used each year over the time period from 2000 through 2016. The dotted red line indicates the volume of CVP export that was conveyed using JPOD through the SWP Banks Pumping Plant during each of these years. The red dotted line is therefore a subset of the volumes depicted by the solid red line. The solid grey line depicts cumulative unmet demand of both the CVP and SWP over this same time period. With the exception of 2006, there was always some amount of unmet demand in every year. Sacramento valley year types are characterized by a color scheme transitioning from blue in wet years, greens for above and below normal, yellow for dry and red for critically dry.

The chart indicates that maximum export capacity was utilized in both wet years (2006 and 2011) and one of the above normal year types (2005). During all three of these years, excess flows were available for export throughout the summer period. For 2005, this was the case primarily because 2005 was classified as a wet year with regard to the San Joaquin Valley index. During the two additional above normal year types (2000 and 2003), something short of full capacity was utilized during these years. In all remaining years from below normal to critically dry, a significant amount of unused capacity existed. The grey line indicates that there was always unmet demand in years when the full export capacity was not being fully utilized – this demonstrates that the Project operators were limiting the amount of stored water released for export.

Based on the foregoing, it is my opinion that the assertions by protestants, in

particular Mr. Shutes for CSPA and Mr. Bourez for SVWU, that a more aggressive release and export of stored water operation would occur with the CWF's increased conveyance capacity are without merit. Their assertion does not in any respect comport with the end of year carryover policies nor the historical practice of limiting the release of stored water for export even when unused capacity exists.

VI. INCREASED OPPORTUNITIES TO CAPTURE EXCESS FLOWS AS A SUBSTITUTE FOR STORED WATER WITH CWF

Assertions by Mr. Bourez [Exhibits SVWU-100 and 107] on behalf of SVWU and assertions by Mr. Shutes on behalf of CSPA [Exhibit CSPA-4-Rev, p.15] indicated a more aggressive use of stored water than the petitioner's modeling results for CWF.

Comparative modeling for the CWF (that was prepared in the BA, the EIR/EIS, and exhibits for this hearing), as illustrated by Exhibit DWR-853 indicates that a higher percentage of source water for exports will come from excess flows than from stored water for the SWP with the proposed project as compared with the no action alternative (NAA). The modeling indicates that with CWF the SWP will be less reliant upon stored water from Oroville to meet the same or better levels of water deliveries. Exhibit DWR-853 shows that although total exports increase as a result of the proposed CWF project, there is actually a decrease in the volume of stored water from upstream Sacramento Valley reservoirs to be exported from the Delta. This modeling result is consistent with the SWP policy of leaving higher levels of carryover storage in Lake Oroville as current year delivery capability increases. Greater emphasis is given to the next year's objectives as the current year's objectives are increasingly satisfied. This supplementary storage is in addition to providing a reasonable level of carryover storage necessary to meet Project obligations should the following year be dry.

The modeling results of Mr. Bourez which show a more aggressive use of stored water with the CWF (Exhibit DWR-854) are diametrically inconsistent with this policy.

Operations under CWF would be a step toward returning to the flexibility available

prior to the export restrictions resulting from implementation of the 2008 and 2009 biological opinions. Under a pre-biological opinion, i.e. the D-1641 regulatory environment, the Projects were allowed to use more surplus water to supply south of Delta demands – similar to what benefits will be realized by a CWF.

Mr. Shutes describes how the SWP and CVP system has been stressed twice since 2006 [Exhibit CSPA-4-Rev, p. 15]. This change is in alignment with the implementation of OMR restrictions on the exports. Exhibit DWR-855 shows the shift in export pattern from the 2005 to 2011 Delivery Reliability Report. This comparison shows that the ability to export available spring flows has been severely reduced. Some of this pre-existing ability to export excess flows would be restored with the CWF. This return of flexibility would make the Projects less reliant on upstream storages to meet Project objectives.

VII. DIFFICULTIES IN MEETING STANDARDS IN SOME YEARS

Mr. Shutes on behalf of CSPA [Exhibit CSPA-4-Rev, p.4] and Ms. Paulsen on behalf of the City of Brentwood [Exhibit Brentwood-100, pp. 3:26-4:4] assert that it is unreasonable for the CWF to rely on Temporary Urgency Change Petitions (TUCPs) in meeting Bay-Delta standards in successive dry years and adverse hydrologic changes associated with climate change.

Although the Projects attempt to carryover sufficient storage in their major upstream reservoirs to meet needs in subsequent dry years, no level of storage is an absolute guarantee to meet all water needs during a succession of dry years considering California's extreme volatility in annual precipitation. In addition to the threat of exceptionally dry years, competition for scarce water supplies to meet competing beneficial uses can produce unforeseen emergency management decisions which force compromised results.

For example, during the most recent drought in the dry year 2013, the Projects began cutting back on discretionary releases when confronted with what was developing into the driest calendar year in recorded history. In what is a rare occurrence, the SWP reduced previous allocated deliveries to its water supply contractors by over two hundred

thousand acre feet in late spring to increase Lake Oroville storage for anticipated requirements in 2014. The thirteen months between December 2012 and February 2014 turned out to be utterly unprecedented in terms of lack of precipitation for any similar length period historically.

Calendar year 2014 proceeded to be arguably the most extreme calendar year in terms of a combination of warmth and dryness on record and calendar year 2015 was a never seen before year with next to no appreciable snowpack. The challenges associated with cold water pool management at Shasta Reservoir in 2014 and 2015 forced enormous pressure on Oroville and Folsom to meet a significantly higher proportion of the Delta water quality and outflow objectives than had been previously anticipated. Because Lake Shasta is by far the largest SWP/CVP reservoir it has been expected to provide the brunt of the stored water to meet these objectives. So, although the Projects ceased all discretionary releases of stored water months earlier, regulatory (some unforeseen) and contractual requirements threatened to drain the reservoirs to the extent that salinity control of the Delta and therefore health and safety supplies to much of the State's cities were at an unacceptable level of risk. Faced with this risk State and federal water managers and regulators were forced to implement emergency management actions to balance the impacts to beneficial uses. This list of actions included the granting of temporary urgency change petitions to modify implementation of some of the more resource intense objectives, voluntary and mandatory curtailing of water use statewide, and installation of a physical rock barrier in the Delta to control salinity intrusion.

Arguably sacrifices were shared by all beneficial uses. Although various interest groups could find fault with the balancing, these emergency policy and management actions are completely independent of the decisions before the Board during this hearing as it relates to the proposed CWF project.

Although the CWF project would be neutral in relation to water management during the exceptional droughts of which we have just experienced or in the event of adverse

climatic changes, it would provide increased opportunities to capture excess flows in average to wet years over the long-term.

Essentially the CWF project is a storm water capture program writ large. By increasing opportunities to capture excess Delta flows in wetter periods will result in increased rates of recovery of depleted surface water and groundwater storages south of the Delta. The CWF better prepares the State's cities and industries for the inevitable drought periods.

Although exceptional droughts and adverse hydrologic changes associated with climate change do present severe challenges to the future of water management in California, Mr. Shutes and Ms. Paulsen fail to link these concerns with the petitioned project before the Board. These circumstances are wholly independent of the CWF; by contrast the CWF will better sustain water supply in the state when faced with these challenges.

VIII. INCREASED EFFICIENCY OF DELTA FLOW REGIME WITH CWF

In his testimony [December 1, 2016 Transcript, Vol. 32, p.20:1], Mr. Brodsky of Save the California Delta Alliance, said: "This [operations with CWF] is a big change to the way water is flowing in the Delta. And when questioned Mr. Leahigh on that, he was not willing to admit that – that troubles me deeply that he would be that dishonest." Other protestants generally alleged large changes in Delta hydrodynamics as well.

In response, I would like to explain why at its core the flow regime necessary to maintain a fresh water corridor in the Delta does not change with the CWF. Continued maintenance of this fresh water corridor during lower flow (balanced) conditions is necessary to meet the municipal and industrial as well as agricultural salinity standards required as part of D-1641. These standards require a minimum cross Delta flow (through the Delta Cross Channel, Georgiana Slough, and Three Mile Slough) in order to bring fresh Sacramento flow to the central and south Delta [See Exhibit DWR-856]. In fact, the Delta Cross Channel was designed and constructed to bring fresh water across the Delta and it will continue to serve that function. Some level of negative flow in the Old and Middle

Rivers south of Franks Tract as partially provided by the SWP exports is necessary to bring this fresh water flow into the CCWD's Rock Slough, Old River, and Middle River pumping plants as well as the SWP and CVP export facilities all of which have M&I water quality requirements under existing D-1641. This minimum level of export is probably in the range of 2000 cfs to 5000 cfs depending on tidal conditions. Exports higher than these rates cause negative flows on the lower San Joaquin River from Sherman Island to Franks Tract in the western Delta, which begin to have an adverse effect on Delta salinities by bringing Bay salinity into the interior Delta. The Projects must compensate for this effect by providing higher than required net Delta outflow (NDO) via the release of additional flow from the upstream reservoirs to push fresh water further west in the Sacramento-San Joaquin River confluence region. This addition of "carriage water" is a means to negate salt water intrusion effect caused by high south Delta pumping.

Operations with the CWF will continue to require some base level of export to bring fresh water supplies across the Delta, but use of the proposed North Delta Diversion will allow for higher export rates without subjugating the interior Delta to salinity intrusion caused by high western Delta reverse flows and the need for higher than required NDO supported by additional upstream reservoir releases.

As I indicated under my direct testimonly [Exhibit DWR-61] and in slide 37 of my power point [Exhibit DWR-4-errata], during high flow conditions with excess outflow, the proposed North Delta Diversions will have an insignificant effect on Delta hydrodynamics by skimming a mere fraction of the flows from large storm events.

So, in summary, the core hydrodynamics in the Delta to meet water quality objectives under low to moderately low export levels will remain the same as today with CWF. The hydrodynamics for higher export levels will improve in efficiency by lessening the reliance on upstream storages of both the SWP and CVP. Under high flow conditions the Delta hydrodynamics will remain essentially unchanged.

IX. TERM 91 NOT EXPECTED TO CHANGE WITH CWF OPERATION

In his testimony [Exhibits SVWU 100, slide 47, and SVWU 107, pp. 4-5, 30-31, 62-63 and 79-80], Mr. Bourez tries to illustrate that the post-processed MBK modeling shows a higher frequency of Term 91 curtailments. This result does not make logical sense when one examines the purpose of Term 91. Term 91 is a standard permit term applicable to water right permits issued by the State Water Board since 1965. Term 91 prohibits these water right holders from diverting water when the Projects are making supplemental storage releases to meet water quality objectives and other in-basin requirements in the Sacramento-San Joaquin Delta Watershed. These supplemental storage releases are necessary when available natural flows are not sufficient to meet the in-basin uses and Delta requirements. The MBK modeling shows that Term 91 will be implemented roughly 5% more often April through September. However, in order for this to be true, an increase in either in-basin use or Delta requirements would need to exist. The only changes in existing Delta requirements proposed by the CWF are increased limitations on the Projects' diversions from the south Delta. The use of stored water to meet Delta outflow and salinity objectives would be unchanged, and in fact less water may be required (as explained in the previous section). It appears there may be flaw in the MBK analysis. I do not expect the frequency of Term 91 curtailments to change with construction of the CWF facilities.

Executed on 22 day of March, 2017 in Sacramento, California.

John Leahigh