CALIFORNIA WATER FIX

EXAMPLE EFFECT OF CALIFORNIA WATER FIX ON UPSTREAM RESERVOIR STORAGE

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Overview

This technical memorandum provides an example of how California Water Fix (CWF) and the additional capacity it would create, to convey the Delta water released from storage in Central Valley Project (CVP) and State Water Project (SWP) reservoirs upstream of the Delta, have the potential to increase risk of impacts to other legal users of water. A two-year period was analyzed to provide an example of these risks, in modeling performed by MBK Engineers (MBK). Modeling performed by CWF proponents does not consider or address these types of risks.

MBK performed a modeling analysis using the MBK No Action Alternative (NAA) and MBK Alternative 4A (Alternative 4A) model scenarios described in the *CWF Modeling Review Report*, MBK, August 2016. For the analysis described in this memorandum, model simulations of the Alternative 4A and NAA scenarios were started in January 1993 with the same initial conditions of reservoir storage and Delta salinity. Both model scenarios were simulated for the period from January 1993 through September 1994 (the end of water year 1994). These two simulations, which start with identical initial conditions and simulate the same period of historical hydrology (one with the CWF and one without the CWF), provide an example of some of the potential risks of the CWF to end of September (carryover) storage in North of Delta (NOD) CVP and SWP reservoirs .

Background

The additional export capacity that the CWF would provide through the North Delta Diversion (NDD) could be used to increase water supplies to south of the Delta (SOD) SWP and CVP contractors in two ways. The first is through the diversion of surplus Delta outflow. Surplus Delta outflow (Delta Surplus) is defined here as, *outflow that is in excess of what is needed to meet existing Delta requirements, and cannot be exported through the existing South Delta Diversion (SDD) facilities*. Delta Surplus typically occurs in winter and early spring months. Diversion of Delta Surplus is sometimes referred to as the "Big Gulp" at the NDD.

The second potential mechanism for increasing water supplies to SOD SWP and CVP contractors, is through exports of water released from storage in upstream CVP and SWP reservoirs, which could not be conveyed to SOD contractors without the NDD. Such releases and conveyance of stored water can occur when the Delta is in balanced conditions, as defined by the Coordinated Operations Agreement (COA), and there is water stored in upstream CVP and SWP reservoirs above the amounts needed to satisfy all upstream requirements. Balanced conditions typically occur in the late spring, summer, and fall months.

Under current conditions, the United States Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR) release water from storage in upstream CVP and SWP reservoirs for conveyance through the Delta to SOD CVP water service contractors and SOD SWP Table A contractors, and for deliveries to North of Delta (NOD) CVP water service contractors and NOD SWP Table A contractors. Factors considered by CVP and SWP operators include forecasted inflows, existing and forecasted upstream CVP and SWP reservoir storage, and forecasted capacity to convey water from NOD CVP and SWP reservoirs through the Delta to SOD contractors. CWF, and specifically the NDD, would increase the capacities of the CVP and SWP to convey water from NOD CVP and SWP reservoirs through the Delta to SOD contractors.

Results

The following figures compare simulated operations under the January 2016 Draft Biological Assessment Alternative 4A (Alternative 4A) with No Action Alternative (NAA) from January 1993 to September 1994. These two years were classified as above normal, and critical, water years, respectively, under the Sacramento Valley Water Year Hydrologic Classification Index. The figures show an example of Delta exports under Alternative 4A and NAA scenarios. Because Alternative 4A includes the NDD (the NAA does not include NDD), this comparison shows the increases in the abilities of the CVP and SWP to convey additional water from NOD CVP and SWP reservoirs through the Delta to SOD CVP water service contractors, in addition to the SOD SWP Table A contractors that would result from the NDD.

As shown in **Figure 1,** modeled exports under Alternative 4A in January, February, March, June, July, August, and September of 1993 are higher than modeled exports under the NAA, during the same months. For January, February, March and June, modeled SDD exports under the NAA were limited by Old and Middle River (OMR) flow requirements, despite the fact that the Delta was in surplus. For Alternative 4A, the NDD was simulated as being used to divert Delta Surplus when OMR requirements would restrict the use of the SDD. Increased exports during this period are labeled as the "Big Gulp" in these figures.

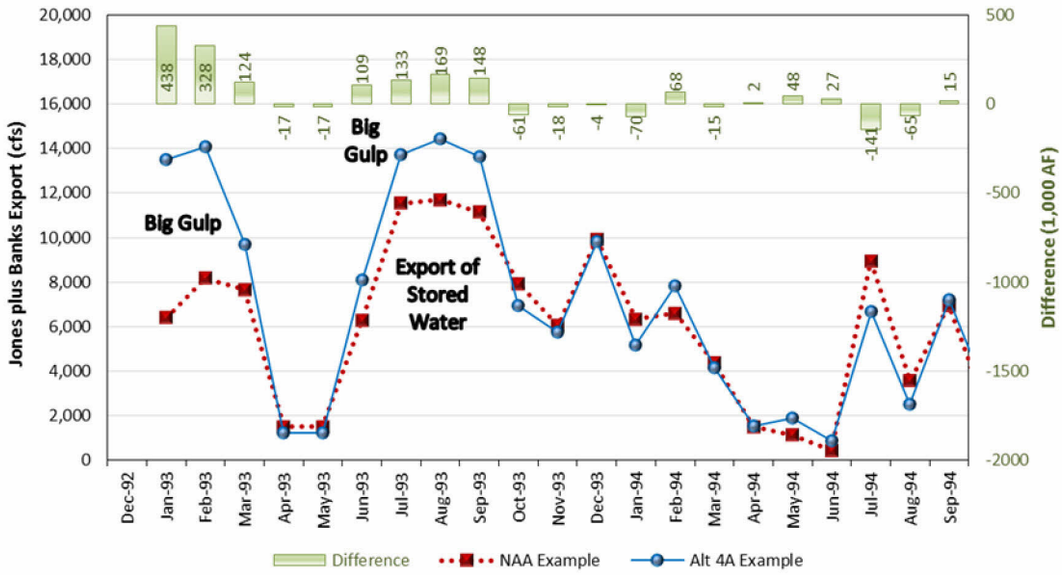

Figure 1: Combined CVP and SWP Exports at Both NDD and SDD

The increased exports for July, August, and September of 1993 shown in **Figure 1** for the Alternative 4A scenario, are modeled to occur when the Delta is in balanced conditions under both the NAA and Alternative 4A. These modeled increases in exports represent the second mechanism under which the CWF could increase water supplies to SOD CVP and SWP contractors: through the conveyance and export of water released from storage in NOD CVP and SWP reservoirs. Changes in CVP and SWP exports in other months are as follows:

- Decreases in exports in January 1994 are due to more restrictive OMR requirements in Alternative 4A, under which the OMR requirement is -3,500 cfs, compared to -5,000 cfs under the NAA, and NDD could not be increased because of NDD bypass requirements.

- In February 1994, the OMR requirement is -5,000 cfs in the NAA and -4,000 cfs for Alternative 4A. Although SDD is lower under Alternative 4A than under the NAA, the NDD diverts over 2,000 cfs under Alternative 4A. The combination of decrease in SDD and increase in NDD results in 68 thousand acre-feet (TAF) more export during the month.
- In May 1994, OMR requirements in the NAA and Alternative 4A are the same. The NDD is constrained to pump only 488 cfs under Alternative 4A because of NDD bypass requirements and can be used to increase exports only by this amount. The San Joaquin River Inflow to Export ratio (SJR I/E) is limiting SDD in Alternative 4A, but not in NAA. However, Alternative 4A has an operable gate at the Head of Old River (HORB) that is open 50% of the month, whereas in the baseline, it is assumed that the barrier is in place all month. The operable HORB allows additional SDD exports in Alternative 4A.
- Exports are lower under Alternative 4A than under the NAA in July and August 1994 due to lower storage in NOD CVP and SWP reservoirs.

Figure 2 shows Delta outflows for both the NAA and Alternative 4A and the differences in Delta outflows between these two scenarios. Delta outflows are lower under Alternative 4A for January, February, March, and June 1993 in comparison to Delta outflows for these months under the NAA, because modeled diversions of Delta Surplus, the "Big Gulp", reduce Delta outflows during these months under the Alternative 4A in comparison to the NAA. However, for July through September 1993, Delta outflow is not lower under the Alternative 4A in comparison to the NAA, because water stored in NOD CVP and SWP reservoirs is modeled as being released, and re-diverted during July through September 1993. Changes in Delta outflow during January, February, and May of 1994 are caused by changes in exports, as described above.

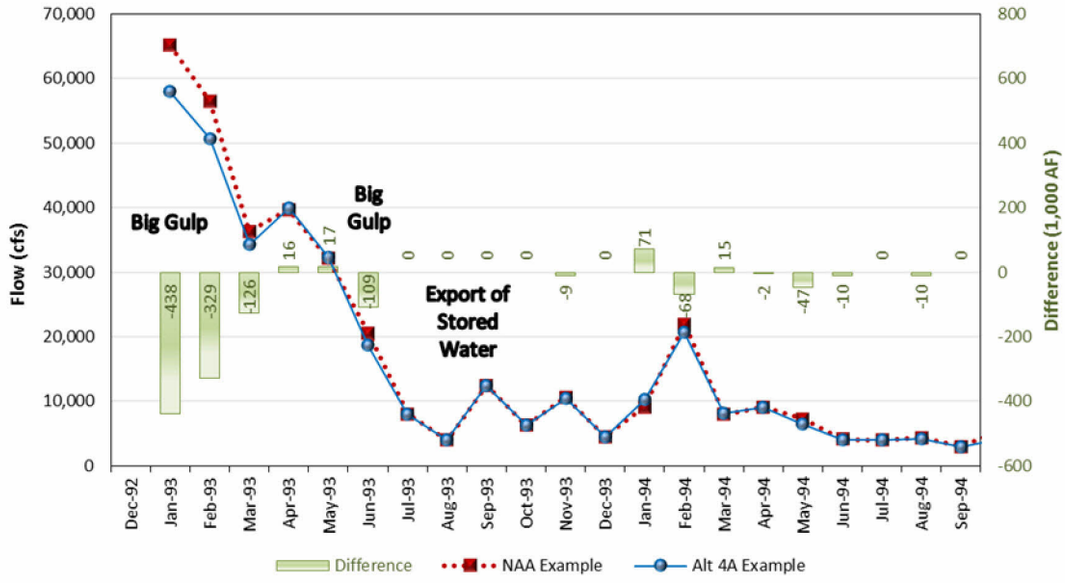

Figure 2. Delta Outflow

Figure 3 shows modeled monthly total storage in NOD CVP and SWP reservoirs (the sum of Trinity, Shasta, Oroville, and Folsom reservoirs) under Alternative 4A and the NAA. As shown by this figure, modeled storage for January through June 1993 is the same under both scenarios. Starting in July 1993, total modeled NOD CVP and SWP storage is lower under the Alternative 4A scenario than under the NAA. By the end of September, modeled NOD storage is 457 thousand acre-feet (TAF) lower under the Alternative 4A scenario than under the NAA. This lower total storage is the result of the higher July through September exports shown in Figure 1.

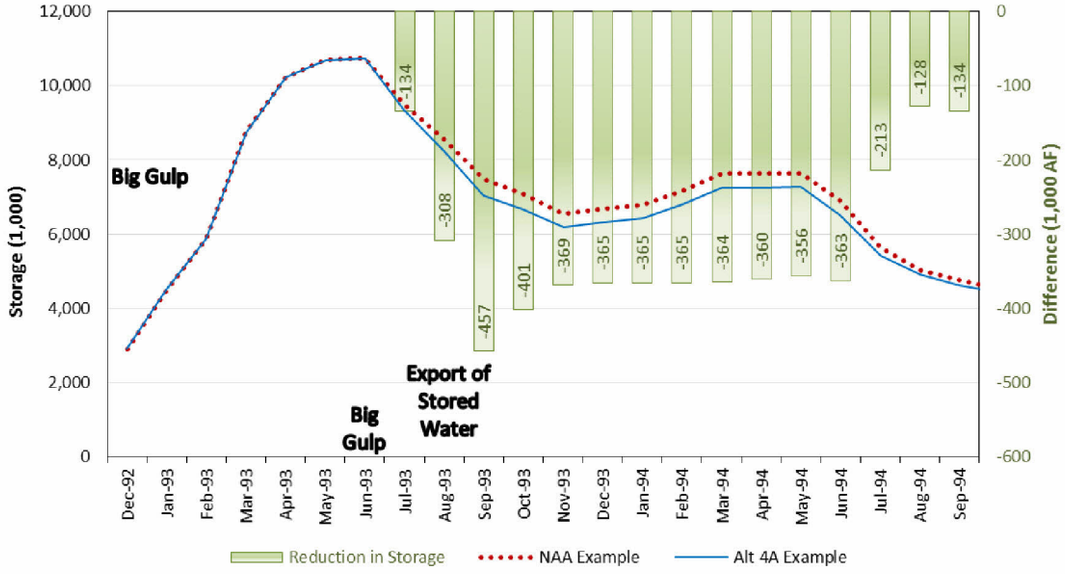

Figure 3. Combined CVP and SWP NOD Reservoir Storage

Exports of additional amounts of water released from NOD CVP and SWP storage can affect CVP and SWP operations and water supplies during subsequent years until the NOD CVP and SWP reservoirs are refilled during wetter hydrologic periods. If subsequent hydrologic conditions remain dry, then it may be necessary to change operations of NOD CVP and SWP reservoirs to meet CVP and SWP requirements and objectives. With the lower modeled carryover storage in 1993 under Alternative 4A, simulated CVP system operations were different in 1994. The modeling studies indicate that, in 1994, the lower reservoir releases necessary to conserve water would result in reduced water supply allocations to NOD and SOD CVP, as well as to SWP contractors. The reduced reservoir storage also could impact Reclamation's and DWR's abilities to meet regulatory requirements for protection of fisheries.

CalSim II is used for this modeling analysis, and although CalSim II simulates changes in Delta exports, Delta outflows, river flows, and CVP and SWP reservoir storage levels, it does not impose 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. For the purpose of CalSim II, the model runs out of water when a reservoir reaches dead pool.

Because CalSim II does not reduce water use by non-Project water right holders or reduce deliveries to Settlement contractors to comply with regulatory requirements, effects must be determined by evaluating the model output. Lower storage during spring of dry and critical years would likely result in operational changes to protect cold water in Shasta Reservoir. For this example, lower storage during the spring of 1994, would likely result in changes in CVP and SWP operations to protect cold water resources in Shasta Reservoir.

For July and August of 1994, modeled Delta exports are 141 TAF and 65 TAF lower, respectively, under the Alternative 4A scenario, than under the NAA. Modeled reservoirs releases for 1994 are lower under the Alternative 4A scenario, than under the NAA, due to lower modeled storage levels at the end of 1993. Such reductions may be necessary to recover storage, to meet regulatory requirements, or to avoid adverse impacts to the environment and third parties. Although modeled exports are lower in 1994 under the Alternative 4A scenario than under the NAA as a result of lower modeled storage at the end of 1993, these reductions are not enough to recover reservoir storage.

Figure 4 compares combined Shasta and Trinity storage under the Alternative 4A and NAA scenarios, while **Figure 5** makes the same comparison for Shasta storage. As shown in these figures, end-of-September combined Shasta and Trinity storage is 254 TAF lower under the Alternative 4A scenario, than under the NAA, and almost all of this lower storage (252 TAF) is modeled as occurring in Shasta Reservoir. CalSim II balances storage in Trinity and Shasta reservoirs based on simplified rules that model imports of water from the Trinity River system. Combined Shasta and Trinity storage is a reasonable metric of water supply and effects.

Modeled Keswick releases for July and August 1994 are lower under the Alternative 4A scenario than under the NAA, to avoid impacts due to the lower modeled storage in the Shasta - Trinity system at the end of 1993. These lower storage levels for 1994 could affect NOD water contractor deliveries and Delta exports during 1994. A 200 TAF reduction in combined Shasta and Trinity storage during a Shasta Critical Year could affect operations for Sacramento River temperatures. For example, during water years 2014 and 2015, when severe actions were imposed on the operation of Shasta that affected many water users, an additional 200 TAF reduction would have been significant.

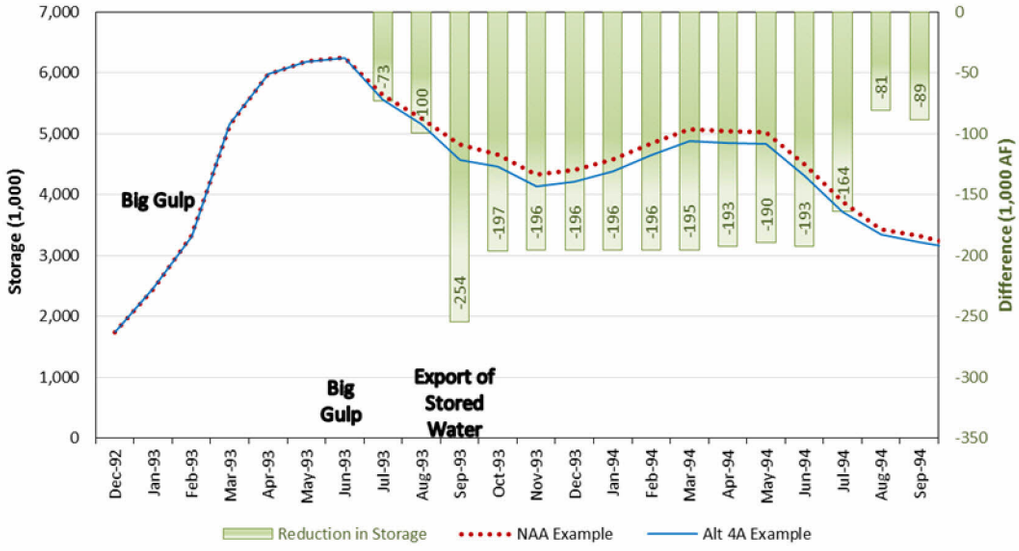

Figure 4. Combined Shasta and Trinity Reservoir Storage

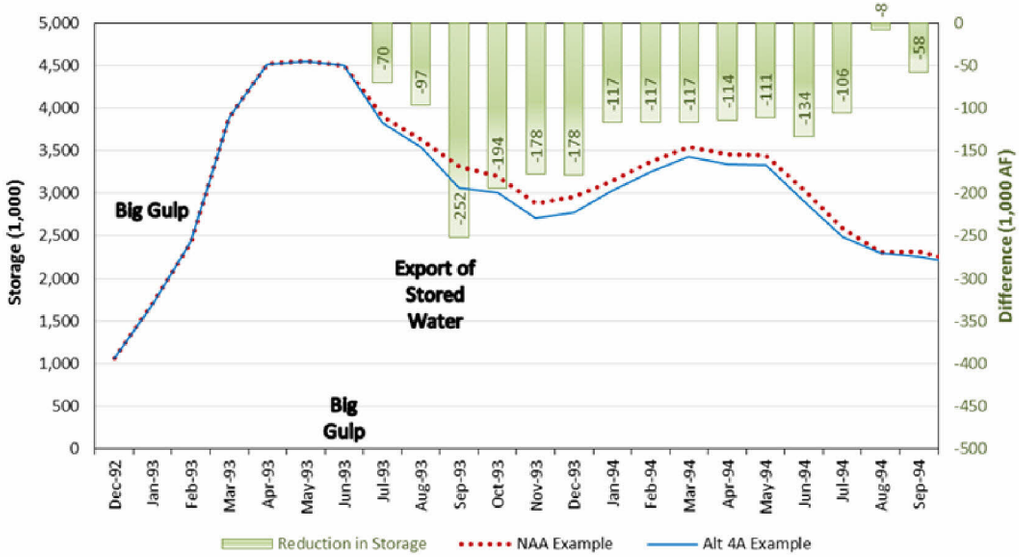

Figure 5. Shasta Reservoir Storage

Figure 6 shows modeled Folsom Reservoir storage for the NAA and Alternative 4A. Folsom Reservoir storage is 71 TAF lower at the end of 1993 under the Alternative 4A scenario than under the NAA, and is about 35 TAF lower in the spring of 1994. Figure 7 shows that modeled Oroville Reservoir storage is 132 TAF lower in the spring of 1994 under the Alternative 4A scenario than under the NAA.

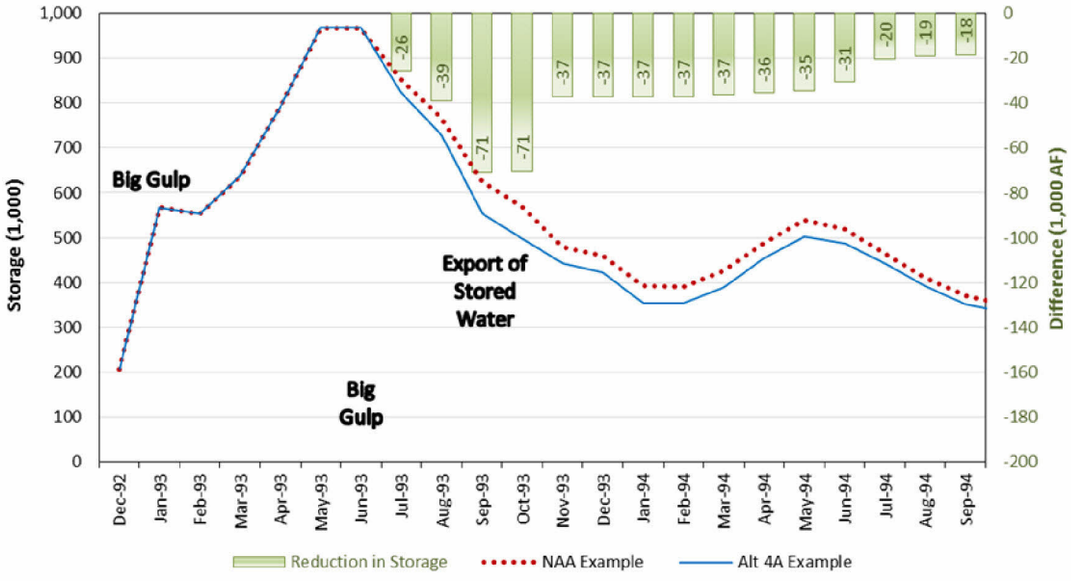

Figure 6. Folsom Reservoir Storage

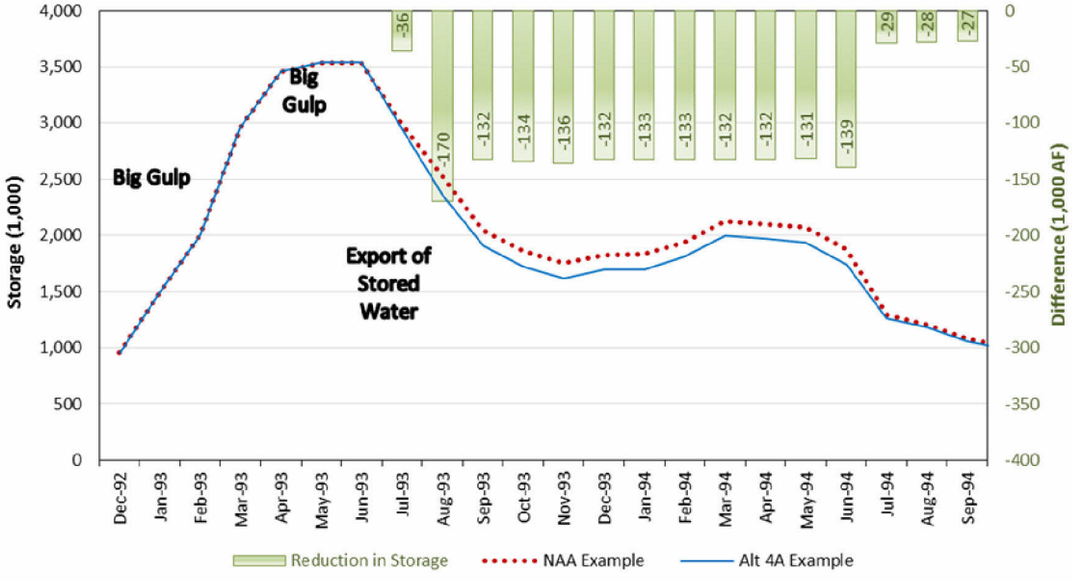

Figure 7. Oroville Reservoir Storage

In this comparative example, the NAA CVP NOD agricultural water service (Ag service) contract allocation is 100 percent and the CVP SOD Ag service contract allocation is 65 percent. CVP policy is to maintain equal allocations between NOD and SOD contractors, except when limitations on the ability to convey water SOD result in lower allocations to SOD contractors. Lower CVP SOD allocations, as compared to CVP NOD allocations in the NAA, indicate a limitation on the ability to convey water SOD in 1993, not a limitation on the available water supply. For the Alternative 4A scenario, the NDD provides additional export capacity to the CVP through Banks Pumping Plant, and the use of Joint Point of Diversion. This additional export capacity would be considered in the spring when CVP allocation

decisions are made, and would allow for CVP SOD Ag service contract allocations of 90 percent with the CWF.

A similar effect occurs in the modeled SWP operations under the NAA and the Alternative 4A scenario. Modeled SWP Table A allocations increase from 69 percent under the NAA, to 86 percent under the Alternative 4A scenario, due to the additional capacity that the NDD would provide to convey water released from storage in Oroville Reservoir through the Delta to SOD SWP Table A contractors.

Table 1 summarizes CVP and SWP allocations for both the NAA and Alternative 4A (labeled as CWF) scenarios for both CVP and SWP contractors.

Table 1: Change in CVP and SWP Contract Allocations

		1993			1994		
		NAA	CWF	Difference	NAA	CWF	Difference
CVP South of Delta	Ag	65%	90%	25%	25%	20%	-5%
	M&I	90%	100%	10%	75%	70%	-5%
CVP North of Delta	Ag	100%	100%	0%	25%	20%	-5%
	M&I	100%	100%	0%	75%	70%	-5%
SWP Table A		69%	86%	17%	41%	33%	-8%

Conclusions

The CVP and SWP could use the additional export capacity that would be provided by CWF through the NDD to release additional amounts of water from NOD CVP and SWP reservoir storage and to export this water from the Delta. As shown in Figure 3, the scenarios described in this memorandum for 1993 show that such additional releases and exports resulted in modeled carryover storage in NOD CVP and SWP reservoirs at the end of 1993 being 457 TAF lower under the Alternative 4A scenario than under the NAA. The reduction of upstream storage of 360 TAF in the spring of 1994, of which about 200 TAF would be from the Shasta/Trinity system, would make it more difficult for Reclamation to meet the temperature standards contained in the BiOp RPAs. It is likely Reclamation would attempt to satisfy those RPA standards before allocating water to its water contractors. Even if Reclamation were to eliminate all releases for export to SOD water service contractors and delivery to NOD water service contractors, it would still be more difficult to meet the RPA standards and also make adequate water available to the Sacramento River Settlement Contractors as required under their contracts.