Summary of Results for WSIP 2030 and WSIP 2070 Model Updates

Following an extensive review of the Water Storage Investment Program (WSIP) Climate Change and Sea Level Rise Statewide datasets, CalSim-II and DSM2 model products, the technical team recommended some corrections and revisions to the products published on September 9, 2016 (model runs dated 9-3-16). These corrections and revisions are limited to the climate change modifications to the hydrologic inputs to CalSim-II. The climate inputs of precipitation and temperature, and Variable Infiltration Capacity (VIC) model results of runoff, snow water equivalent, evapotranspiration, and soil moisture for the climate conditions are unaffected. Updated CalSim-II and DSM2 model products have been released and posted on the California Water Commission's website. All WSIP applicants using CalSim-II and DSM2 shall use the updated versions.

Due to the correction of a data processing error in the "bias correction" of VIC generated streamflows, and other miscellaneous adjustments, inputs have been adjusted for the following stream inflow: Sacramento River, Feather River, American River, Mokelumne River, Calaveras River, Stanislaus River, Tuolumne River, Merced River, Chowchilla River, Fresno River, and San Joaquin River. In the updated models, February flows are increased by 1% to 20% and March flows are decreased by 1% to 20% for both the 2030 and 2070 conditions in comparison to the September 9, 2016 version. When simulated within CalSim-II, the February-March flow shifts lead to other changes in reservoir conditions and streamflows . The large changes in February and March flows and the smaller flow changes in other months generally offset each other over time so the resulting changes in annual volumes are small. Nevertheless, these changes in flows may be an important consideration for some proposed water storage projects.

Tables 1 through 4 compare summary results (metrics) of the updated models (10-24-16) to the previously-released models (9-3-16). Table 1 compares long-term averages for 2030, and Table 2 compares dry and critical year averages for 2030 conditions. Dry and critical years are defined based on the historical climate record. Similarly, Tables 3 and 4 compare results for the 2070 condition.

The summary system-wide metrics do not reveal some of the changes in the underlying results. The following points summarize findings from a detailed review of the model results given the change in inflow volumes and monthly distribution as a result of the update:

- Changes in storage volumes at the end-of-May and end-of-September are generally decreased and within 1% for most reservoirs including State Water Project (SWP) and Central Valley Project (CVP) reservoirs
- Delta inflows reflect the range of changes in stream inflows as noted above; the effect of this is changes in regulation of flows related to X2 (X2 is a measure of salinity conditions in the Delta and is used as the basis of Delta outflow requirements under SWRCB D-1641)
    - Increased February flows cause a reduction in February's X2 position by 0.4 and 0.3 km on average for WSIP 2030 and 2070, respectively;
    - Decreased March flows cause an increase in March's X2 position by 0.3 km on average for both climate scenarios; small changes in X2 position persist into the following months of April, May and June
- Water supply allocations and related Delta exports for the State Water Project (SWP) and Central Valley Project (CVP) are slightly reduced due to the decrease in storage volumes and the shift in inflows on forecasting functions used for setting allocation levels

  - Allocations generally decrease for both SWP and CVP Agriculture and M&I water service contracts by 0.01% or less of the total contract amounts; this indicates a general reduction in water supplies available of 0.5% and 1% or less for WSIP 2030 and 2070, respectively; CVP Ag water service contracts are the most sensitive to these decreases
  - Increased February flows allow for increased exports for the SWP and CVP and decreased March flows reduce exports; generally these changes balance out; however, due to resultant changes in storage and salinity effects, Delta exports generally decrease by 0.5% and 1% or less for WSIP 2030 and 2070, respectively
- All the changes noted above tend to balance out and result in little or no changes to Delta outflow over the average year, and a small reduction in dry and critical years

Tables 1 – 4 present average annual changes in storage volumes for SWP and CVP, Sacramento Valley, and San Joaquin Valley reservoirs, and flow volumes for Delta Inflow, SWP and CVP Delta exports, and Delta Outflow for both WSIP 2030 and 2070 conditions for both the long-term and the average of dry and critical years as classed under SWRCB D-1641 40-30-30 index under equivalent historical records. The following Figures 1 – 8 present monthly pattern and annual exceedance charts for a selection of these parameters.

Table 1. Summary Results and Comparison, 2030 Long-Term Averages

Description of Metric	Measured as (in TAF)	Original Models (9-3-16)	Revised Models (10-24-16)	Difference	Percent Difference
SWP and CVP System Storage	End-of-September Volume	6,200	6,224	24	0.4%
Sacramento Valley Storage	End-of-September Volume	5,821	5,842	21	0.4%
San Joaquin Valley Storage	End-of-September Volume	3,390	3,375	-15	-0.5%
Delta Inflow	Annual Volume	22,645	22,615	-30	-0.1%
SWP and CVP Delta Export	Annual Volume	4,733	4,710	-23	-0.5%
Delta Outflow	Annual Volume	16,808	16,801	-7	0.0%

Table 2. Summary Results and Comparison, 2030 Dry and Critical Year Type Averages *(using historical climate for year type designations)*

Description of Metric	Measured as (in TAF)	Original Models (9-3-16)	Revised Models (10-24-16)	Difference	Percent Difference
SWP and CVP System Storage	End-of-September Volume	4,817	4,797	-20	-0.4%
Sacramento Valley Storage	End-of-September Volume	4,526	4,514	-12	-0.3%
San Joaquin Valley Storage	End-of-September Volume	2,275	2,254	-21	-0.9%
Delta Inflow	Annual Volume	11,905	11,885	-20	-0.2%
SWP and CVP Delta Export	Annual Volume	3,577	3,545	-32	-0.9%
Delta Outflow	Annual Volume	7,072	7,085	12	0.2%

Table 3. Summary Results and Comparison, 2070 Long-Term Averages

Description of Metric	Measured as (in TAF)	Original Models (9-3-16)	Revised Models (10-24-16)	Difference	Percent Difference
SWP and CVP System Storage	End-of-September Volume	5,559	5,577	18	0.3%
Sacramento Valley Storage	End-of-September Volume	5,134	5,157	23	0.5%
San Joaquin Valley Storage	End-of-September Volume	3,079	3,073	-6	-0.2%
Delta Inflow	Annual Volume	23,282	23,265	-17	-0.1%
SWP and CVP Delta Export	Annual Volume	4,250	4,243	-7	-0.2%
Delta Outflow	Annual Volume	17,944	17,934	-10	-0.1%

Table 4. Summary Results and Comparison, 2070 Dry and Critical Year Type Averages *(using historical climate for year type designations)*

Description of Metric	Measured as (in TAF)	Original Models (9-3-16)	Revised Models (10-24-16)	Difference	Percent Difference
SWP and CVP System Storage	End-of-September Volume	4,119	4,112	-7	-0.2%
Sacramento Valley Storage	End-of-September Volume	3,838	3,851	13	0.3%
San Joaquin Valley Storage	End-of-September Volume	2,011	1,994	-17	-0.8%
Delta Inflow	Annual Volume	11,727	11,726	-1	0.0%
SWP and CVP Delta Export	Annual Volume	3,045	3,050	5	0.2%
Delta Outflow	Annual Volume	7,451	7,445	-6	-0.1%

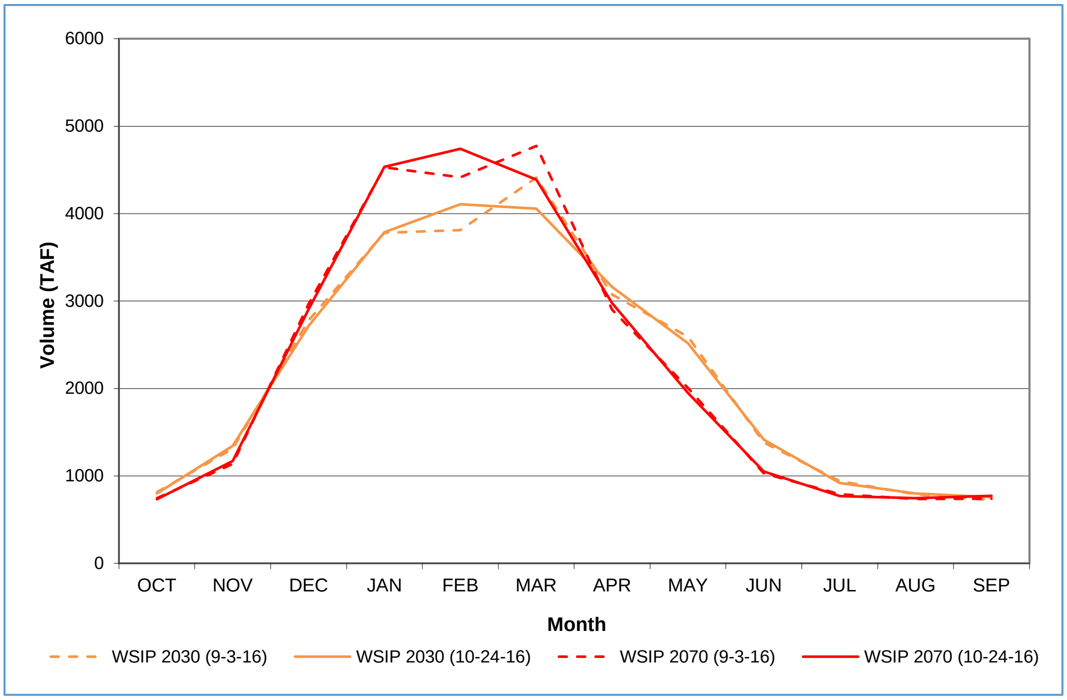

Figure 1. Long-Term Monthly Average Volumes for the Sum of All CalSim-II Modeled Inflows Modified for WSIP 2030 and 2070 Climate Conditions (units in TAF)

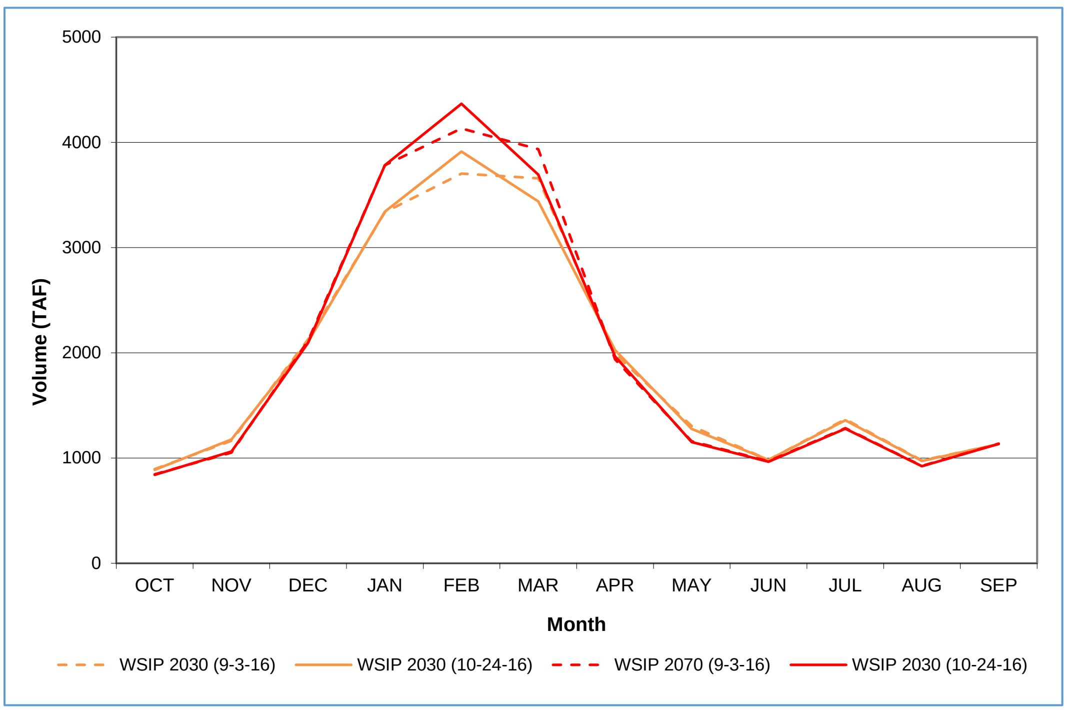

Figure 2. Long-Term Monthly Average Volumes for CalSim-II Modeled Delta Inflow for WSIP 2030 and 2070 Climate Conditions (units in TAF)

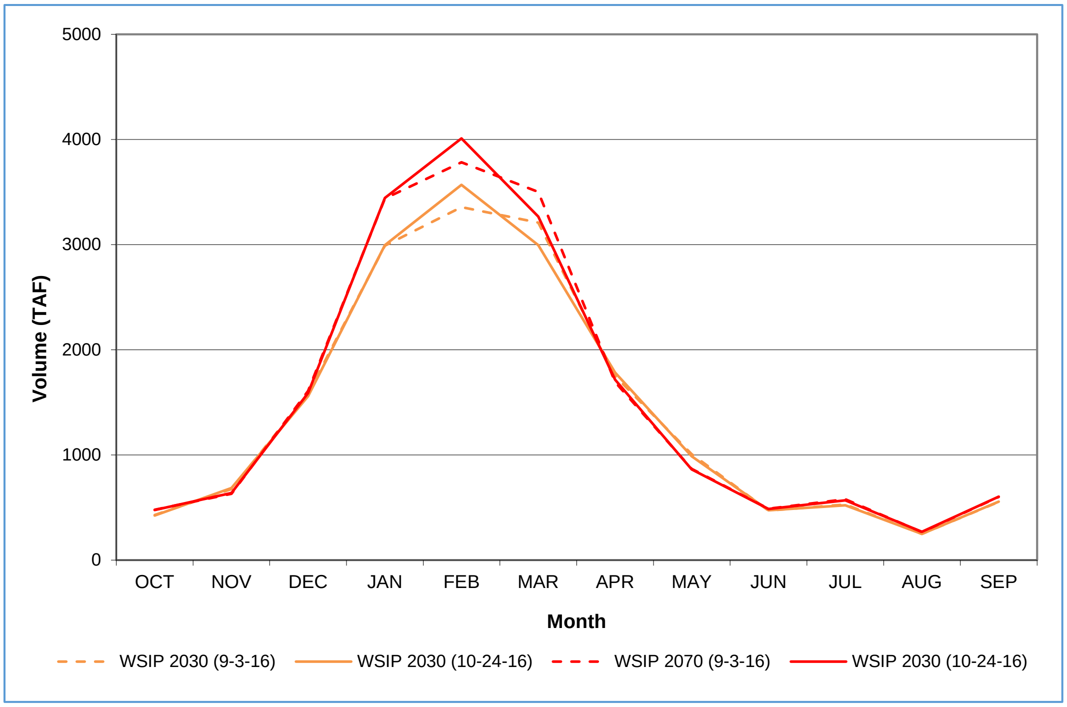

Figure 3. Long-Term Monthly Average Volumes for CalSim-II Modeled Delta Outflow for WSIP 2030 and 2070 Climate Conditions (units in TAF)

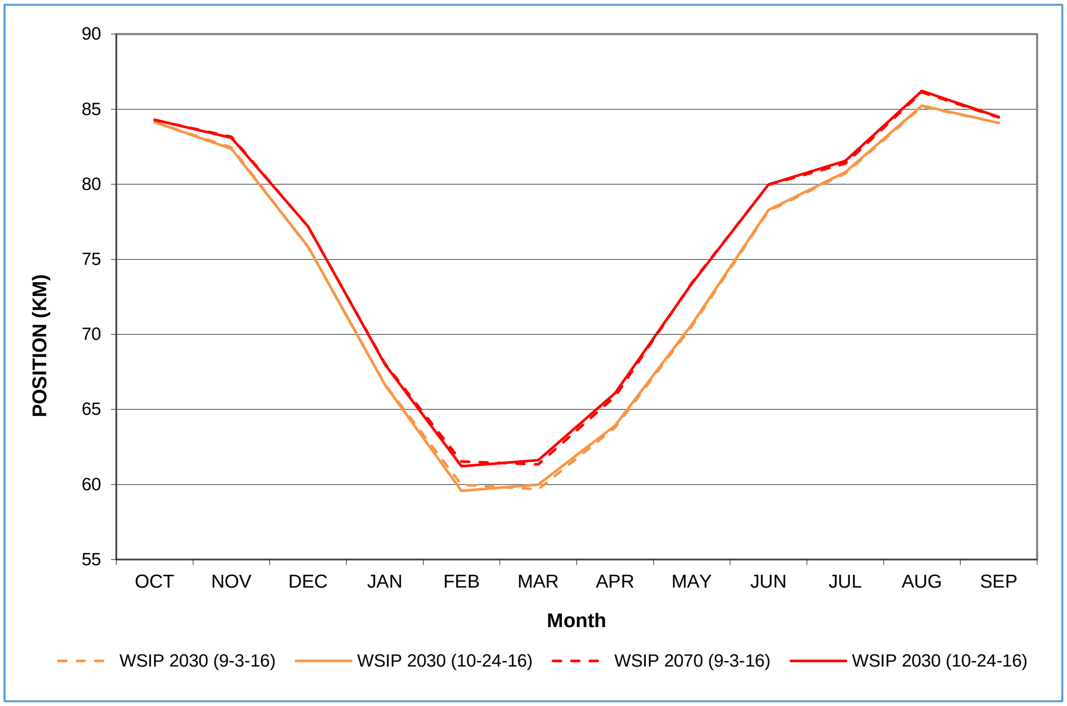

Figure 4. Long-Term Monthly Average Location for CalSim-II Modeled X2 Position for WSIP 2030 and 2070 Climate Conditions (units in KM)

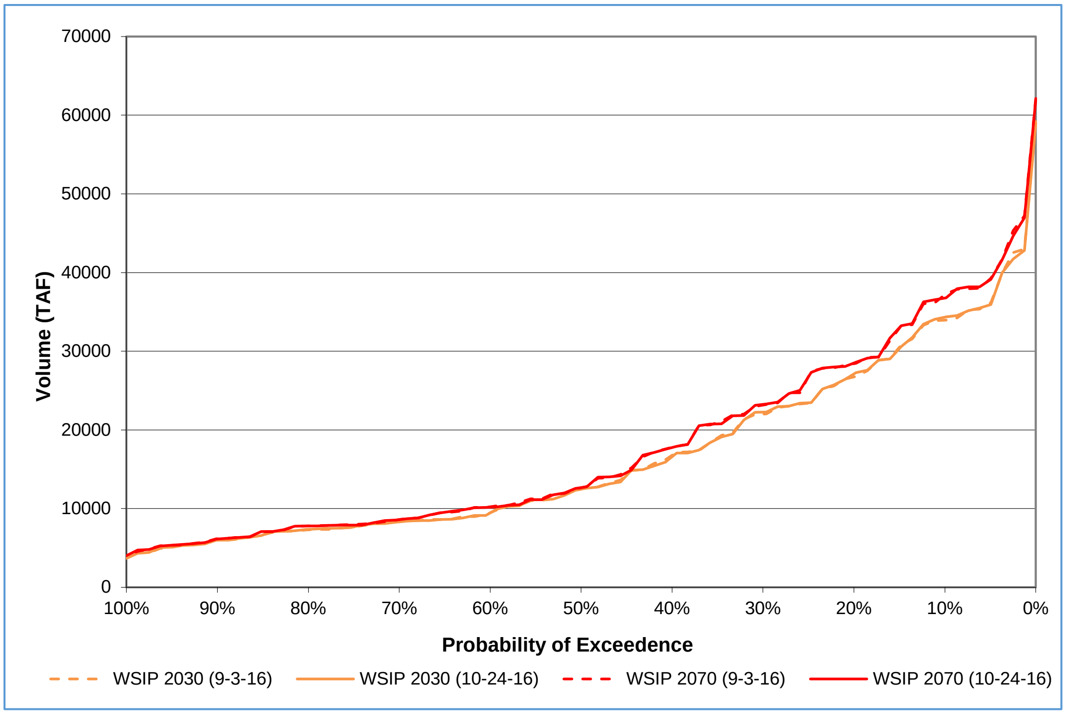

Figure 5. Probability of Exceedence of Annual Volumes for CalSim-II Modeled Delta Outflow for WSIP 2030 and 2070 Climate Conditions (units in TAF)

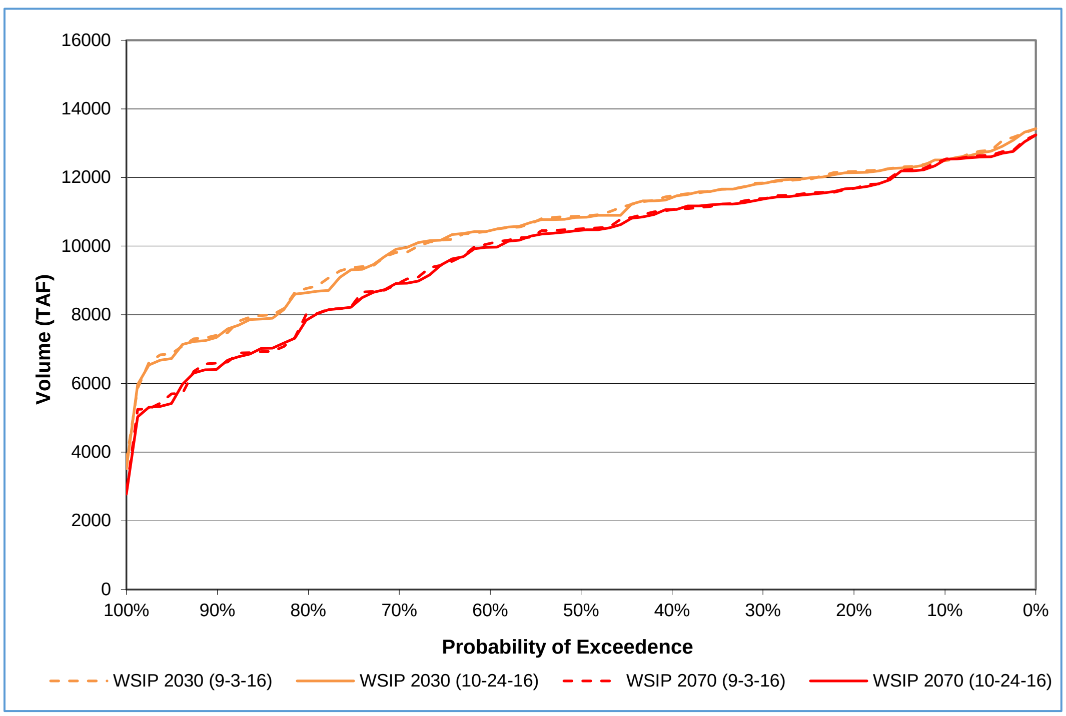

Figure 6. Probability of Exceedence of End-of-May Storage Volumes for the Sum of All CalSim-II Modeled SWP and CVP Reservoirs for WSIP 2030 and 2070 Climate Conditions (units in TAF)

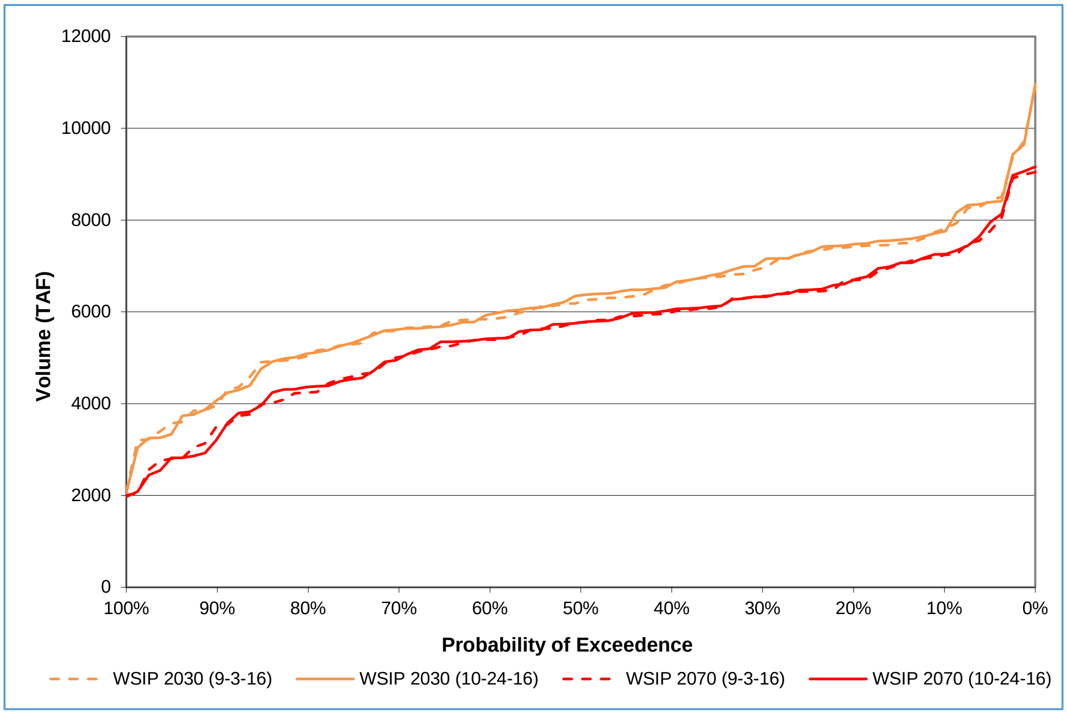

Figure 7. Probability of Exceedence of End-of-September Storage Volumes for the Sum of All CalSim-II Modeled SWP and CVP Reservoirs for WSIP 2030 and 2070 Climate Conditions (units in TAF)

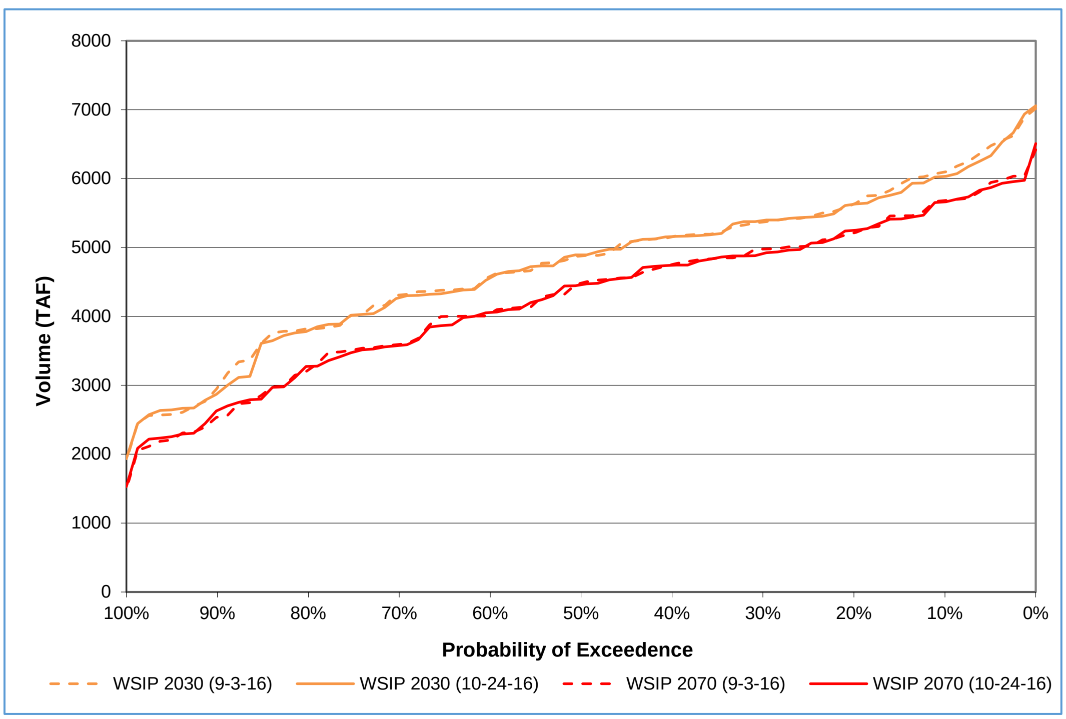

Figure 8. Probability of Exceedence of Annual Volumes for CalSim-II Modeled SWP and CVP Delta Exports for WSIP 2030 and 2070 Climate Conditions (units in TAF)