Appendix 4I

Operations Sensitivity to Drought Conditions

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4I.1 Preface

The Proposed Project does not assume any specific actions in response to future dry conditions. It would be speculative to predict with specificity hydrology, timing, and demands that would be considered in those circumstances. It also would be speculative to predetermine any discretionary actions or regulatory approvals. Such actions require real-time coordination with many agencies and interested parties.

In light of changing climate conditions and to further transparency efforts related to drought planning, DWR has modeled sensitivity runs that include Temporary Urgency Change Petitions (TUCPs) under the following scenarios:

- Alternative 1 plus Central Valley Project (CVP) Proposed Action (PA), including Sacramento and Feather River Voluntary Agreements (VAs), under historical climate conditions.
- Alternative 1 without the Interim Operating Plan (IOP) under future climate change conditions centered on 2022 with 15 centimeters (cm) of sea level rise.

Additional description of these scenarios, as well as scenarios used for comparison, is provided in further detail below.

DWR has included such modeling information in this appendix for informational purposes only. DWR has not made any decisions regarding the likelihood of seeking temporary urgency changes to D-1641. Furthermore, DWR is not seeking CEQA or CESA coverage for any temporary urgency change petitions that might be filed in the future. DWR also is not requesting an ITP from CDFW for actions identified in the Drought Toolkit.

4I.2 Introduction

TUCPs have been petitioned by DWR and Reclamation in challenging hydrologic years. In recent TUCPs, D-1641 requirements have been adjusted to prevent severely impairing public water supply. TUCPs are not modeled in either the Baseline Conditions or Proposed Project for this EIR. For Alternative 1 scenarios in this analysis that include TUCPs, triggering criteria for this action is based on the Sacramento River Valley Water Year Index and/or Lake Shasta storage levels. While both of these criteria are considered, extremely dry conditions for one criterion can outweigh conditions for the other and trigger TUCPs. During these years, TUCPs would be assumed to relax the criteria that drive releases from storage for Delta outflow and D-1641 requirements between February and April; this is modeled as a 4,000 cfs Net Delta Outflow Index (NDOI) requirement. If water quality requirements were to be relaxed in February through April, they would not be initiated until May and only if challenging conditions have dissipated. If these conditions persist in May and continued relaxation of D-1641 requirements were warranted, TUCPs would be assumed to be enabled through September and shift to a 3,000 cfs NDOI requirement in June through September. Furthermore, the D-1641 requirement for Emmaton would be assumed to be moved to Threemile Slough. Exports would be assumed to be limited to health and safety conditions if NDOI were less than the full regulatory standard.

This document summarizes key findings from a sensitivity analysis of operational changes to Alternative 1 scenarios with and without TUCP conditions. Alternative 1 is used in place of the Proposed Project for reasons described in Appendix 4J. Potential changes associated with TUCPs were assessed under two settings:

1. Comparison of Alternative 1 plus CVP PA, including Sacramento and Feather River VAs, under historical climate conditions with and without TUCPs. With this set of scenarios, the potential modeled effect of TUCPs can be isolated under historical climate conditions.
2. Comparison of Alternative 1 under future climate change conditions centered on 2022 with 15 cm of sea level rise, with and without the IOP and TUCPs. Here, the potential modeled effect of TUCPs under future climate change and sea level rise must be considered in conjunction with either the inclusion (i.e., without TUCPs) or exclusion (i.e., with TUCPs) of the IOP. An Alternative 1 scenario under future climate change and sea level rise conditions with both the IOP and TUCPs was not modeled for this EIR.

Operations results from these simulations were analyzed to understand if changes between the Alternative 1 scenarios in the two settings described above remain similar with the inclusion of TUCPs. The CalSim 3 model was used for quantifying the changes in river flows, delta channel flows, exports, and water deliveries. The following sections summarize key CalSim 3 output parameters for these scenarios under each setting.

4I.3 Comparison under Historical Climate Conditions

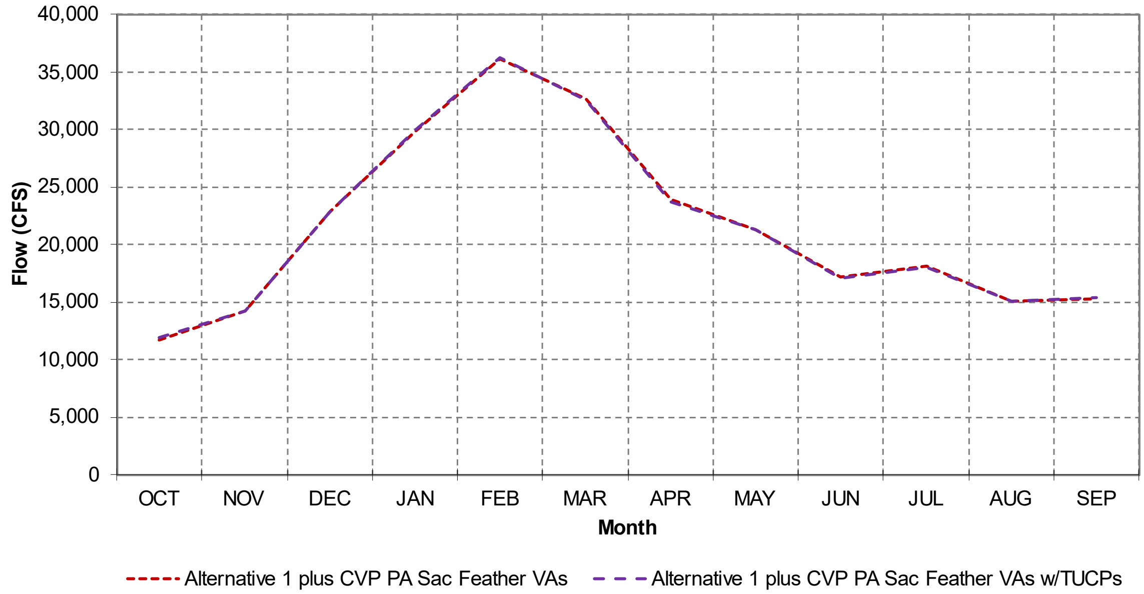
For this comparison, Alternative 1 scenarios were generated using historical climate conditions and include the CVP PA as well as Sacramento and Feather River VAs. CalSim 3 simulations for the Alternative 1 scenarios in this comparison only differ with respect to TUCPs. None of the other system parameters have been changed. A full description of model assumptions and results for these scenarios is provided in Appendix 4F.

4I.3.1 Key Observations

Figure 4I-I-1 through Figure 4I-I-9 show CalSim 3 simulation results for Alternative 1 plus CVP PA and Sacramento and Feather River VAs with (purple lines) and without (red lines) TUCPs. Results for both monthly long-term and Critically Dry water year averages are shown to provide an assessment of average changes over the entirety of the simulation period as well as well as the water year type where TUCPs are most likely to be active. Shifts in the long-term average are primarily driven by changes to patterns for Critically Dry water years. The plots presented in this document are relevant to assessing whether the conclusions in the hydrology, water quality and aquatic biological resources analyzed in the EIR hold under potential drought conditions. Several key observations can be made based on these simulations:

- Examining long-term monthly patterns shows little to no differences between these scenarios across the assessed parameters. Monthly patterns for Critically Dry water years show minor decreases in flow (relative to the non-TUCP Alternative 1 scenario) during some months where TUCPs are active (i.e., February through September) at most locations. Changes are most notable during April and May. In some cases, minor increases in flow for the with-TUCP scenario can be noted in October for some parameters (for example, Sacramento River at Freeport, Old and Middle River flow and total exports). These changes are likely a modeled response to more conservative use of reservoir storage during months when TUCPs are active.
- Simulated exports show similar patterns with and without TUCPs. However, the inclusion of TUCPs results in lower minimum annual exports due to exports being limited to health and safety requirements under sub-regulatory standard NDOI conditions.

Overall, the changes due to the inclusion of TUCPs in these Alternative 1 scenarios are minimal. TUCPs appear to have limited influence on long-term monthly patterns for selected parameters and simulated exports under these conditions. This is largely driven by the infrequency of the occurrence (5% of the simulation period) and the low-flow conditions during which TUCPs occur (i.e., operationally challenging years) under modeled historical climate conditions and with the CVP PA and Sacramento and Feather River VAs.



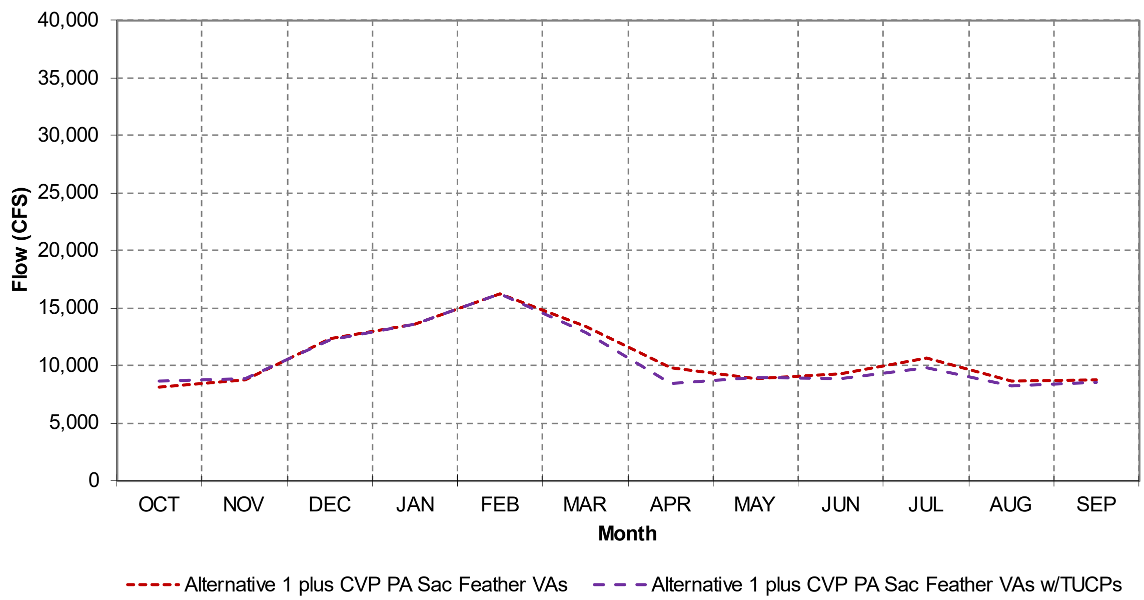
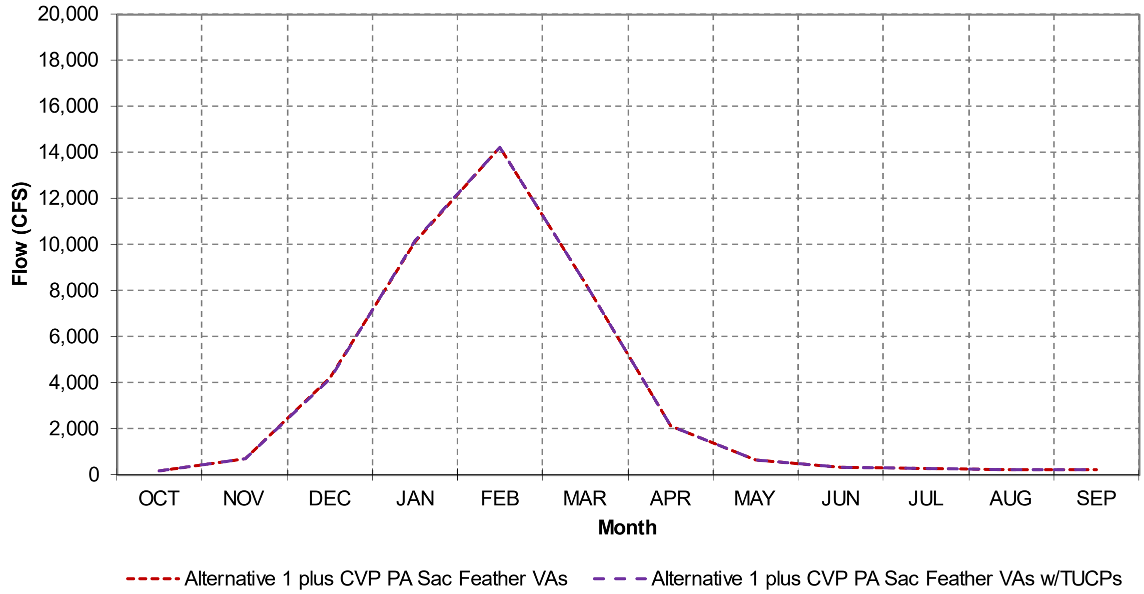


Figure 4I-I-1. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Sacramento River at Freeport Flow for Alternative 1 plus CVP PA and Sacramento and Feather River VAs (with and without TUCPs)



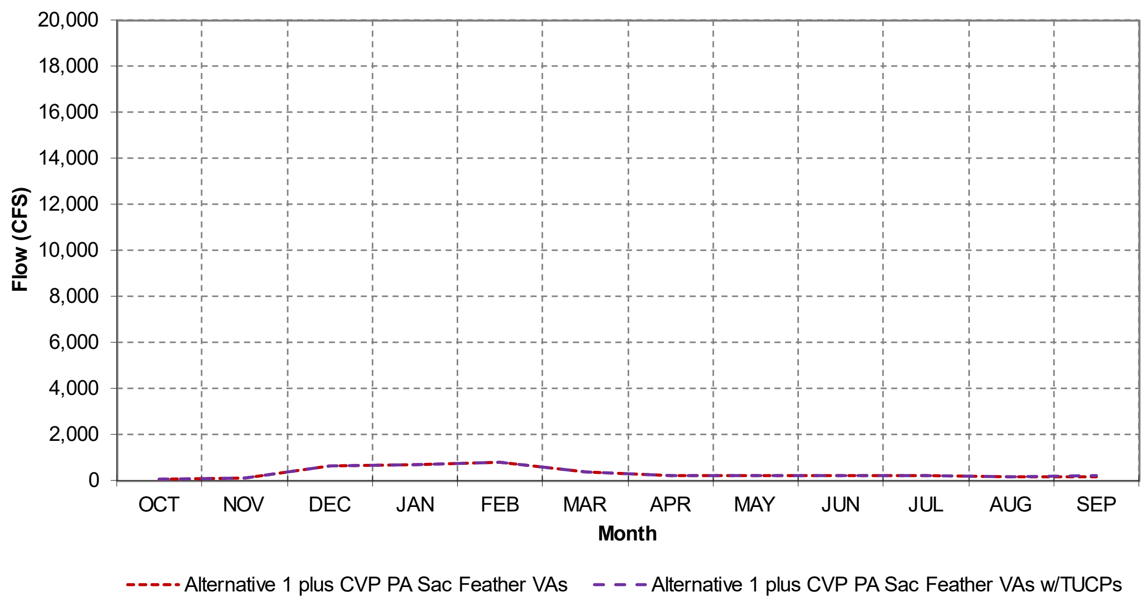
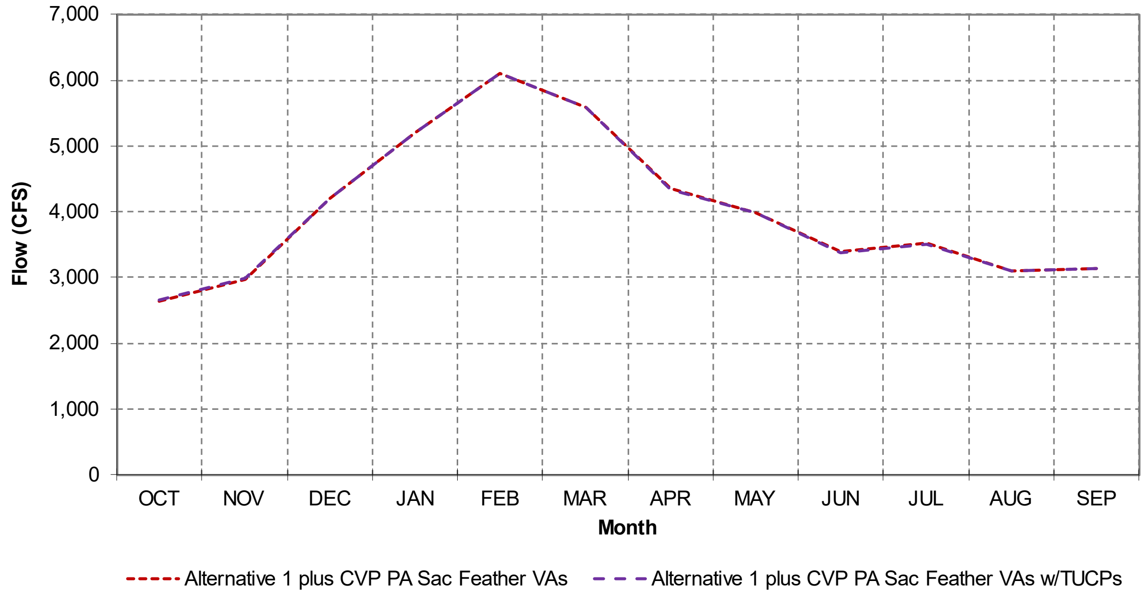


Figure 4I-I-2. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Yolo Bypass Flow for Alternative 1 plus CVP PA and Sacramento and Feather River VAs (with and without TUCPs)



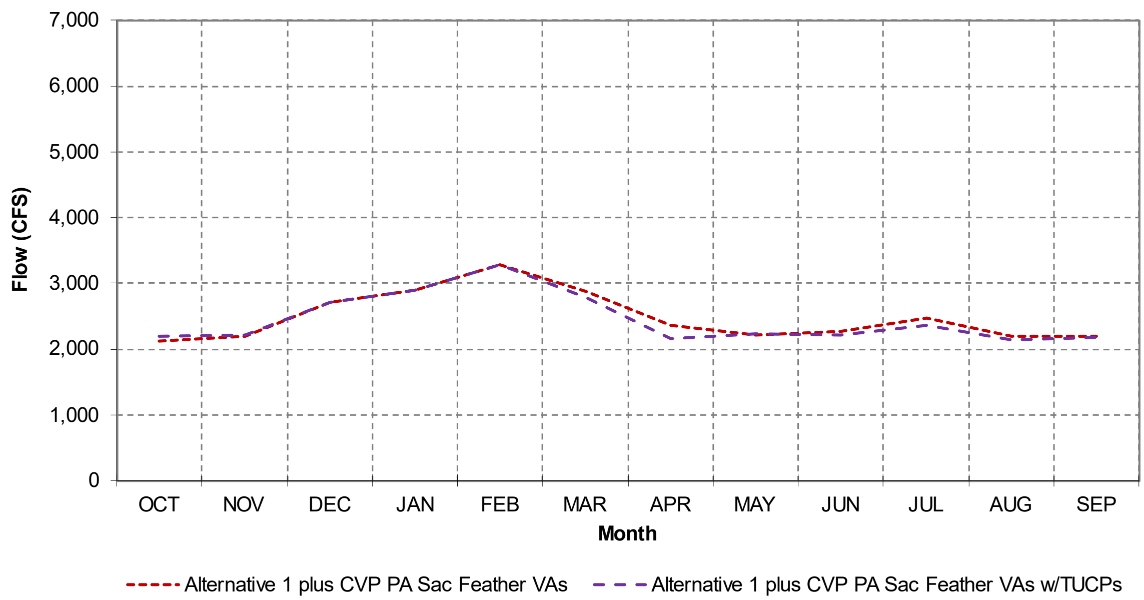
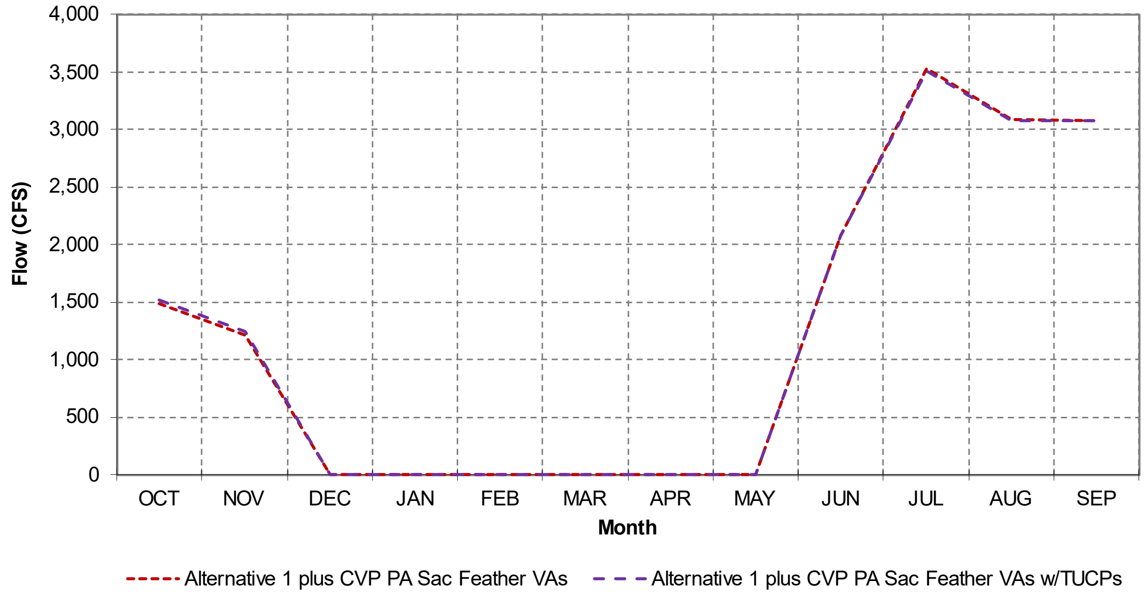


Figure 4I-I-3. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Georgiana Slough Flow for Alternative 1 plus CVP PA and Sacramento and Feather River VAs (with and without TUCPs)



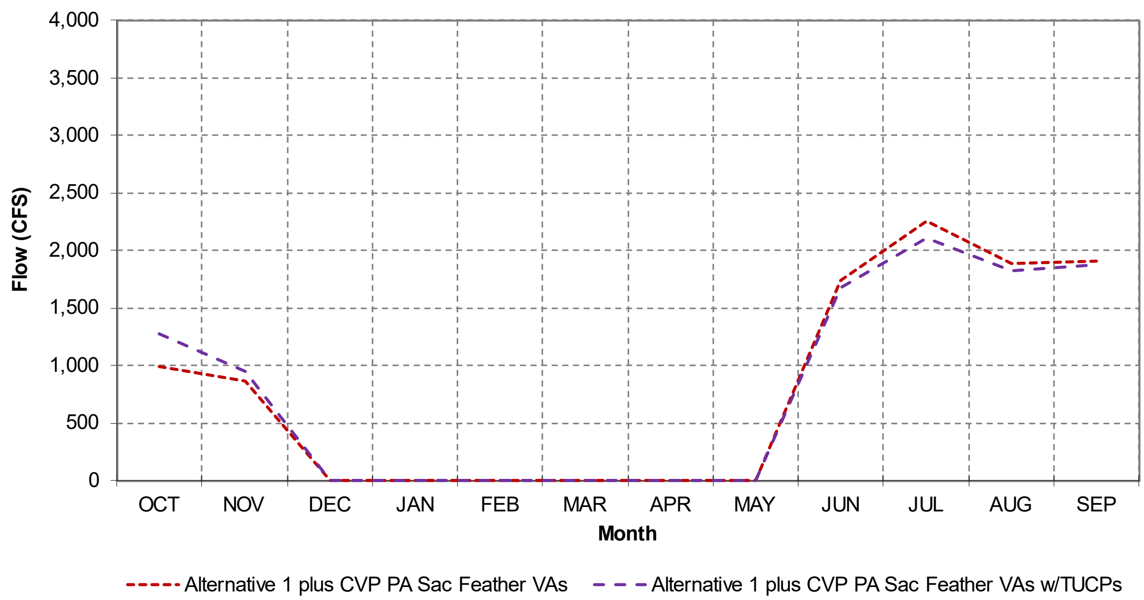


Figure 4I-I-4. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Delta Cross Channel Flow for Alternative 1 plus CVP PA and Sacramento and Feather River VAs (with and without TUCPs)

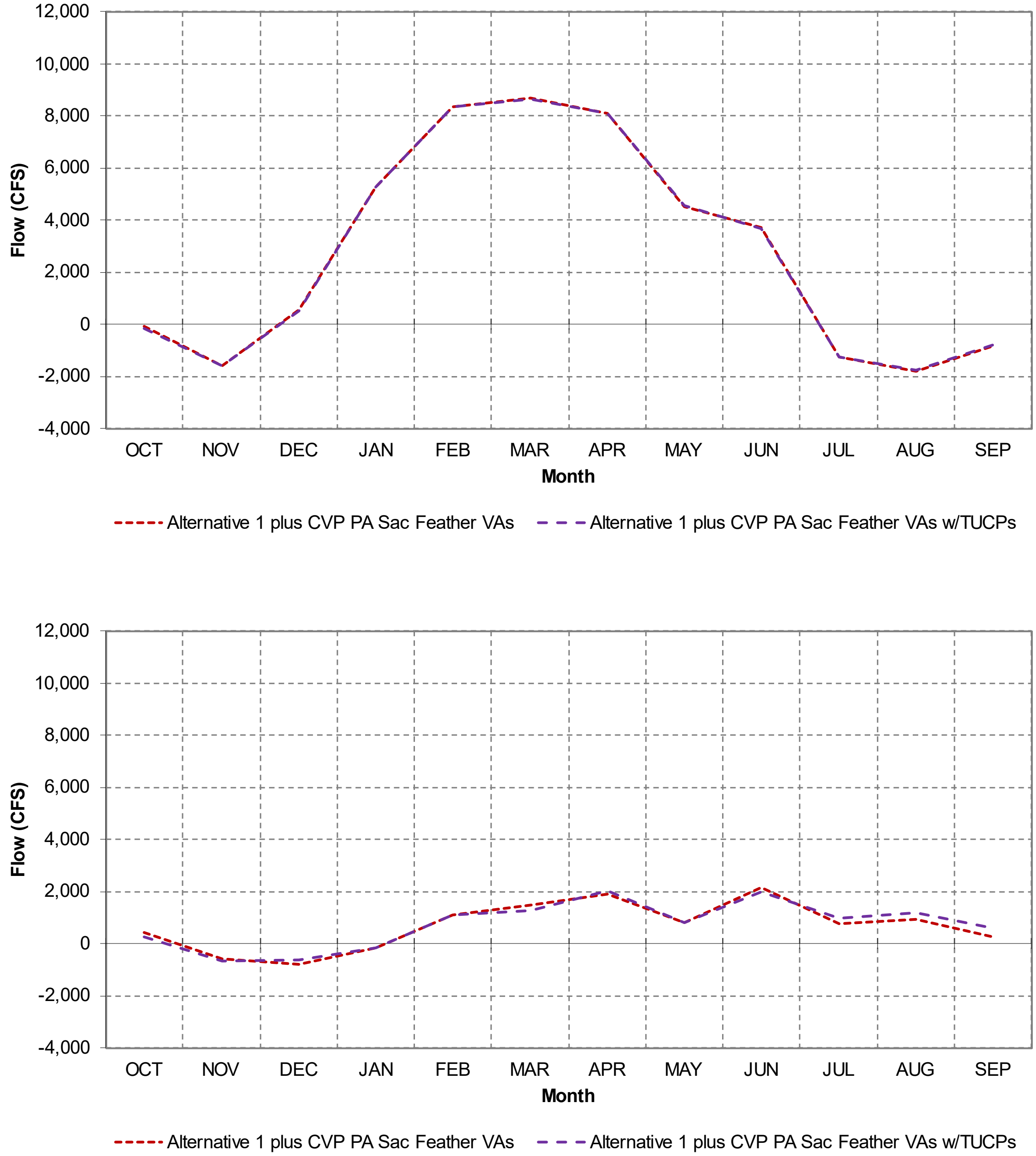


Figure 4I-I-5. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Qwest Flow for Alternative 1 plus CVP PA and Sacramento and Feather River VAs (with and without TUCPs)

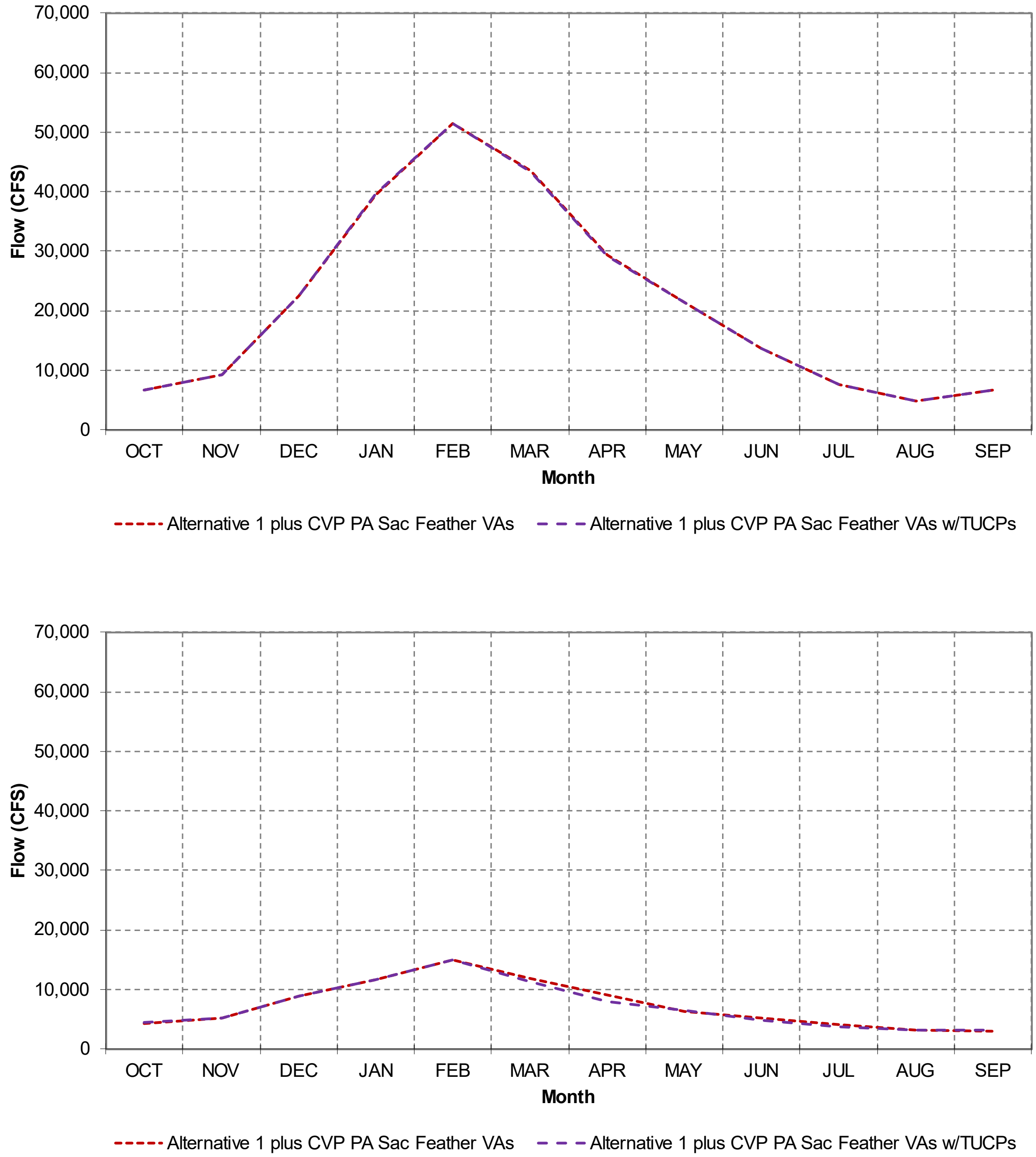


Figure 4I-I-6. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Delta Outflow for Alternative 1 plus CVP PA and Sacramento and Feather River VAs (with and without TUCPs)

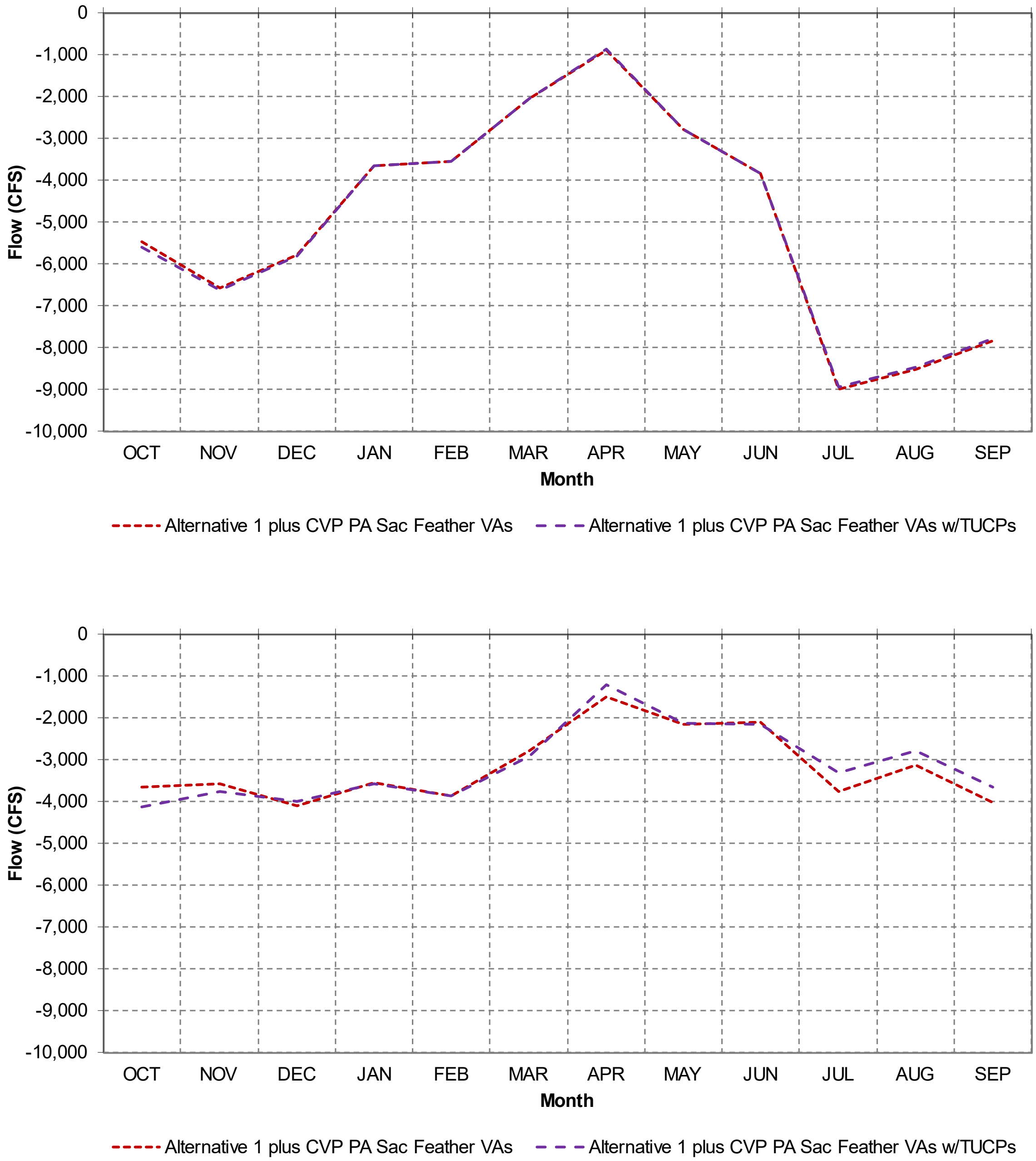
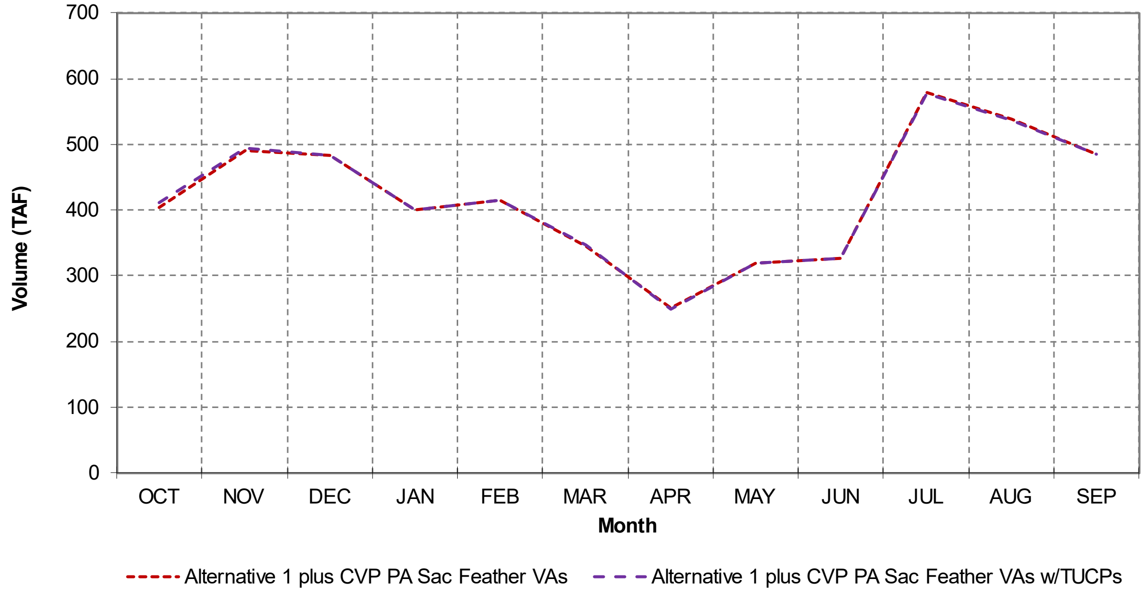


Figure 4I-I-7. Combined Old and Middle River Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Flow for Alternative 1 plus CVP PA and Sacramento and Feather River VAs (with and without TUCPs)



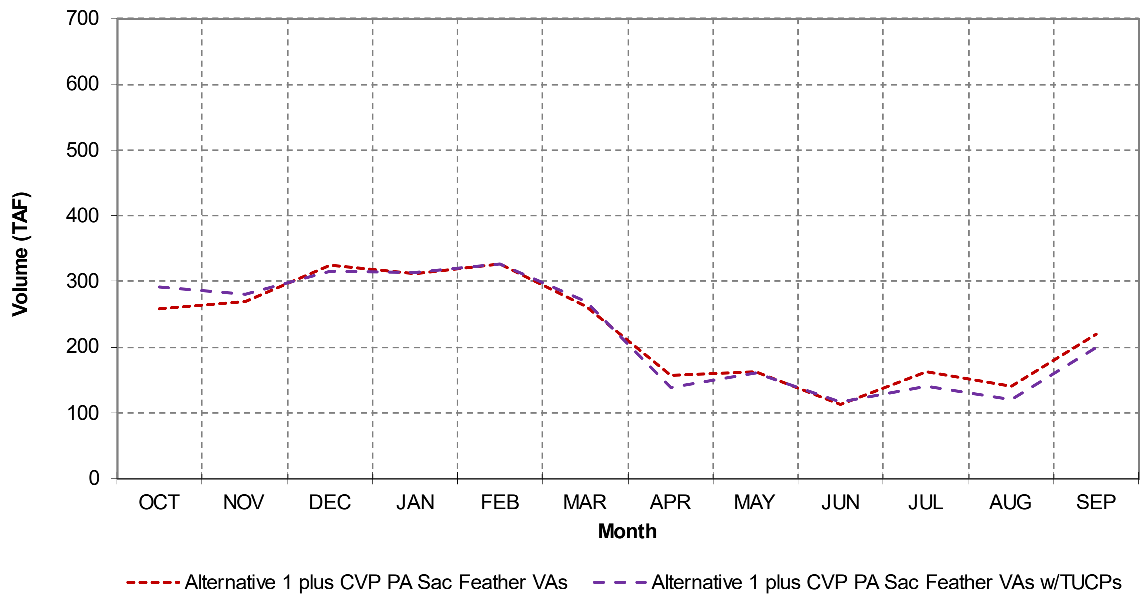


Figure 4I-I-8. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Delta Exports for Alternative 1 plus CVP PA and Sacramento and Feather River VAs (with and without TUCPs)

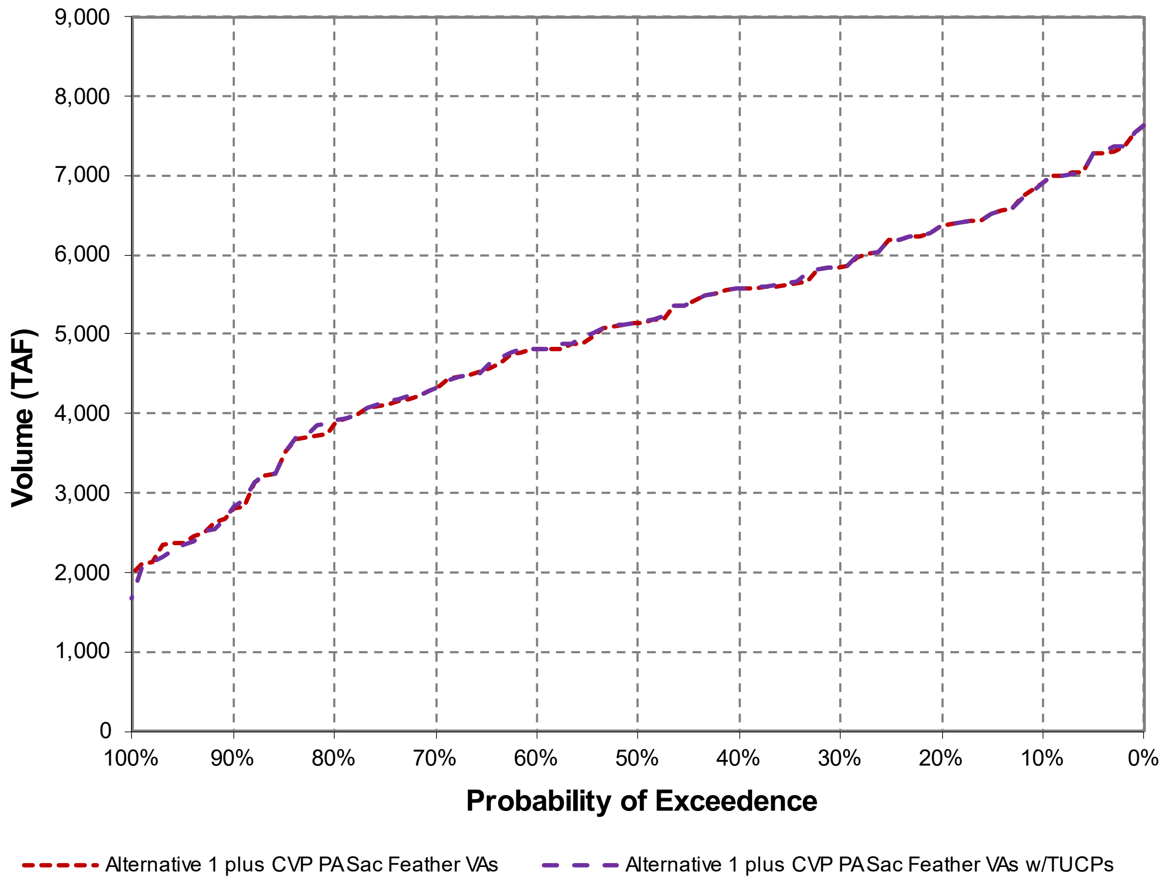


Figure 4I-I-9. Annual Delta Exports for Alternative 1 plus CVP PA and Sacramento and Feather River VAs (with and without TUCPs)

4I.4 Comparison under Climate Change and Sea Level Rise Conditions

For this comparison, two Alternative 1 scenarios were simulated using CalSim 3. These scenarios were modeled using modified hydrologic inputs based on the projected runoff changes under a future climate scenario centered around 2022 with 15 cm of sea level rise. Additional information on model assumptions, changes to CalSim 3 inputs, climate projections, and sensitivities for these climate change conditions are provided in Appendices 4D and 4E. In addition to climate change conditions, one of these Alternative 1 scenarios was also modeled to incorporate TUCPs and exclude the IOP. As such, the effects of TUCPs under future climate and sea level rise conditions cannot be completely isolated. Additional detail on assumptions pertaining to IOP is included in the subsection below.

4I.4.1 Interim Operating Plan

Under the Alternative 1 scenario without TUCPs under 2022 climate change conditions and 15 cm of sea level rise, the Spring Maintenance Flow is modeled as the maximum allowable SWP export of 600 cubic feet per second (cfs) or up to 40% of the total permittable export under the following San Joaquin River: Inflow to Export (SJR IE) ratio regulations. SWP export limitations only occur when Delta Outflow is less than 44,500 cfs. The Spring Maintenance Flow may limit SWP exports by up to 150 TAF in San Joaquin Valley 60-20-20 wet years. The following SJR IE regulations are in effect from April to May when San Joaquin River flow is less than 21,750 cfs:

- For Wet and Above Normal years, SJR IE is modeled as a 4 to 1 ratio.
- For Below Normal years, SJR IE is modeled as a 3 to 1 ratio.
- For Dry years, SJR IE is modeled as a 2 to 1 ratio.
- For Critical years, SJR IE is modeled as a 1 to 1 ratio.

Under the IOP, the CVP also operates to the Spring Outflow Requirement in April and May when Delta Outflow is less than 44,500 cfs. However, the CVP export is the maximum of 900 cfs or up to 60% of the total permittable export under the same SJR IE regulations listed above.

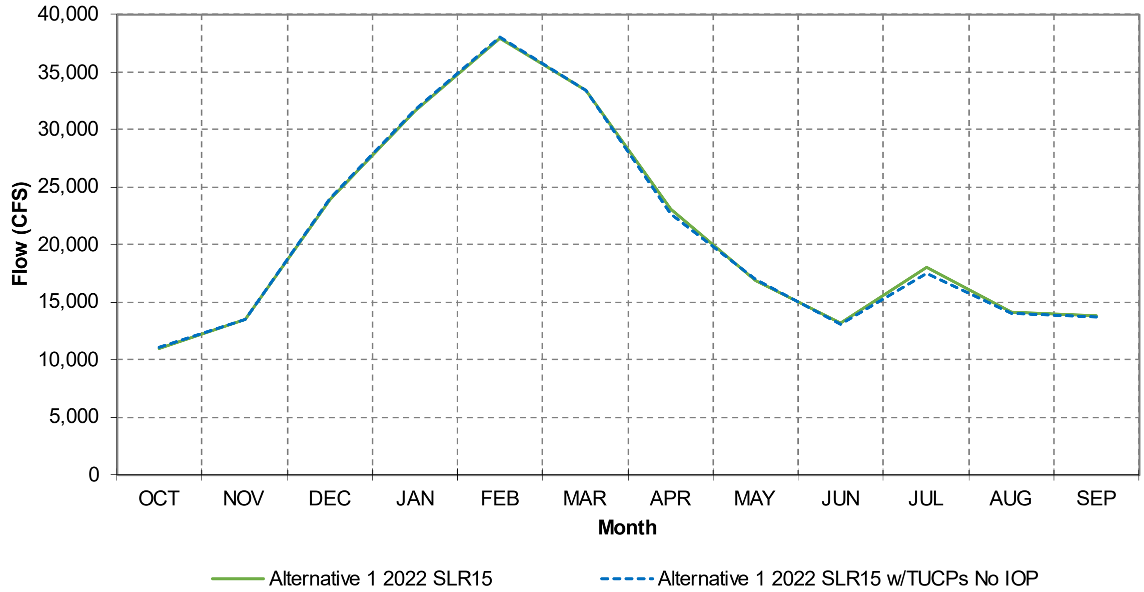
Given these assumptions, modeled export-related changes in months other than April and May can be attributed to the inclusion of TUCPs. There is potential for effects of TUCPs and the exclusion of the IOP to overlap during April and May. However, the changes in operations due to the IOP occur much more frequently than the changes in operation due to TUCPs.

4I.4.2 Key Observations

Figure 4I-I-10 through Figure 4I-I-18 show CalSim 3 simulation results for Alternative 1 under future climate change conditions centered on 2022 with 15 cm of sea level rise. The green lines (Alternative 1 2022 SLR15) represent a scenario without TUCPs with the IOP, and the blue lines (Alternative 1 2022 SLR15 w/TUCPs No IOP) represent a scenario with TUCPs and without the IOP. CalSim 3 simulations for this comparative analysis only differ with respect to TUCPs and the IOP. None of the other system parameters have been changed. The plots presented in this document are relevant to assessing whether the conclusions in the hydrology, water quality and aquatic biological resources analyzed in the EIR hold under potential drought conditions. Several key observations can be made based on these simulations:

- Across all parameters, monthly long-term patterns show minimal changes as a result of TUCPs and the exclusion of the IOP between August and March. For some locations, decreases in monthly long-term average flows (relative to Alternative 1 2022 SLR15) are most apparent in July due to the effects of TUCPs. Changes to monthly patterns are more pronounced for Critically Dry water years (particularly in April, June, and July), similar to the changes described above for historical climate conditions. Increases in flow for Alternative 1 with TUCPs and without the IOP (Alternative 1 2022 SLR15 w/TUCPs No IOP) in October are also noted and can be attributed to the same factors described above for historical climate conditions.
- For Qwest flow, decreases in long-term monthly average flow for April and May can be observed for the scenario including TUCPs and excluding the IOP (Alternative 1 2022 SLR15 w/TUCPs No IOP). The reduction in flow is largely driven by the exclusion of the IOP in this scenario. These patterns remain similar for Critically Dry water years as well.
- For Old and Middle River flow and Delta exports, less restrictive pumping conditions in April and May without the IOP result in a greater magnitude of flow and exports, respectively, during these months, even with the inclusion of TUCPs. As such, it can be assumed that the relative influence of the IOP on the effects of Delta exports outweighs the potential effects of TUCPs over the entire simulation period as well as Critically Dry water years.
- Infrequent (i.e., greater than 30% occurrence) annual exports show similar patterns under 2022 climate change and 15 cm of sea level rise with TUCPs and no IOP. While the inclusion of TUCPs results in lower minimum annual exports due to exports being limited to health and safety requirements under sub-regulatory standard NDOI conditions, the exclusion of the IOP results in an relative increase to annual exports in some years (i.e., between 95 to 30% exceedance).

Overall, changes in these Alternative 1 scenarios under 2022 climate and sea level rise conditions are largely driven by the exclusion of the IOP (for exports in April and May, specifically) rather than the inclusion of TUCPs. TUCPs occur in 9% of the simulation period and only affect low-flow conditions in the channels. Conversely, the IOP operations may affect operations in the majority of years. For all other parameters, there appears to be minimal changes between these scenarios, particularly over the long-term.



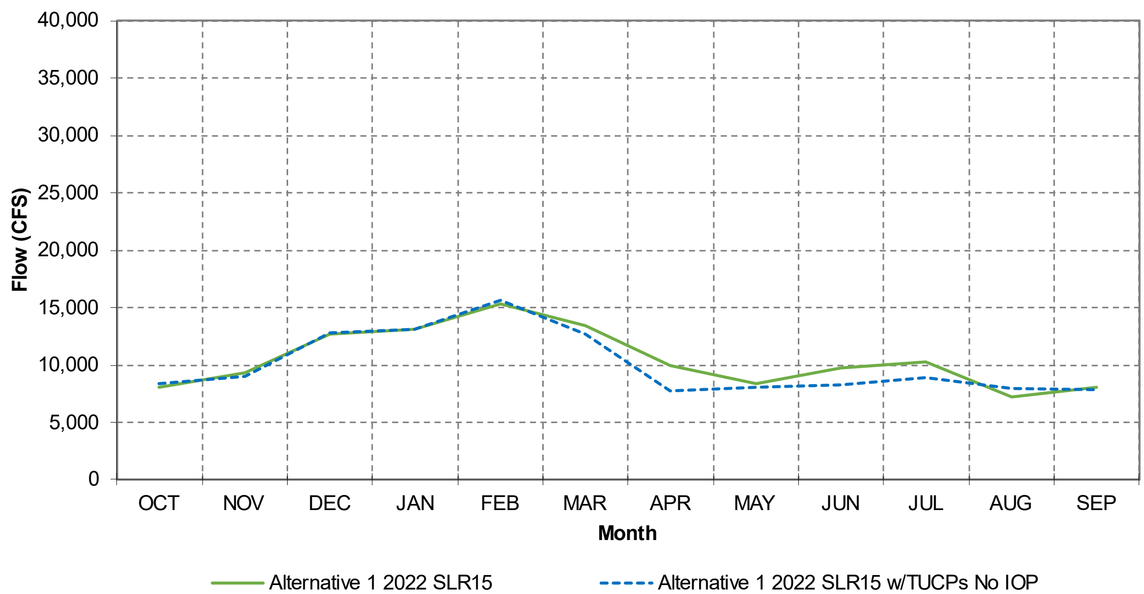
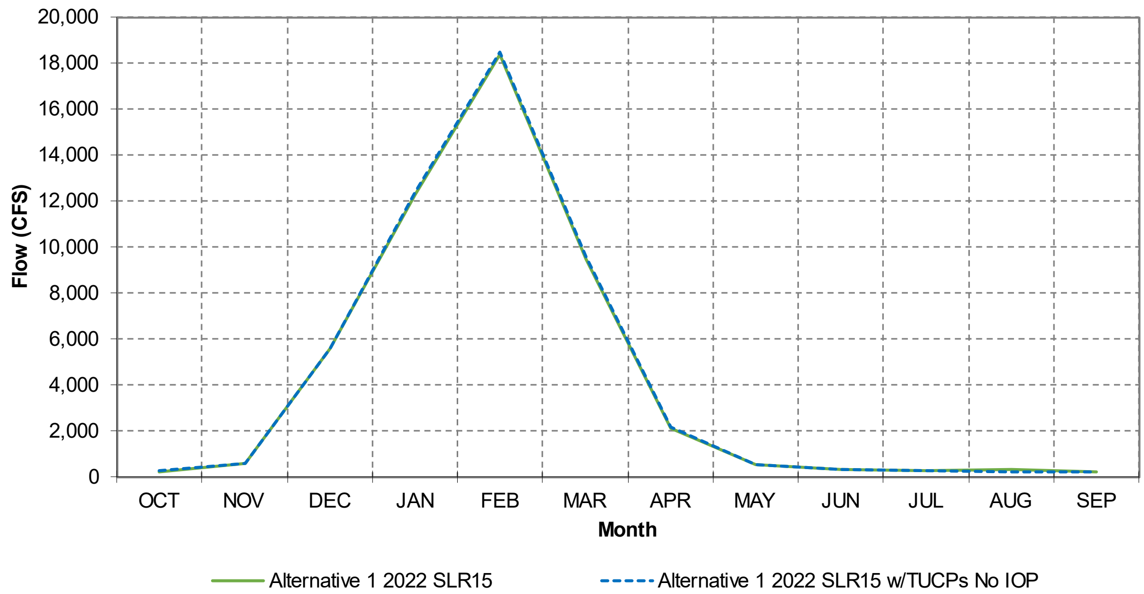


Figure 4I-I-10. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Sacramento River at Freeport Flow for Alternative 1 under Future Climate Centered around 2022 with 15 cm of Sea Level Rise (with and without TUCPs and the IOP)



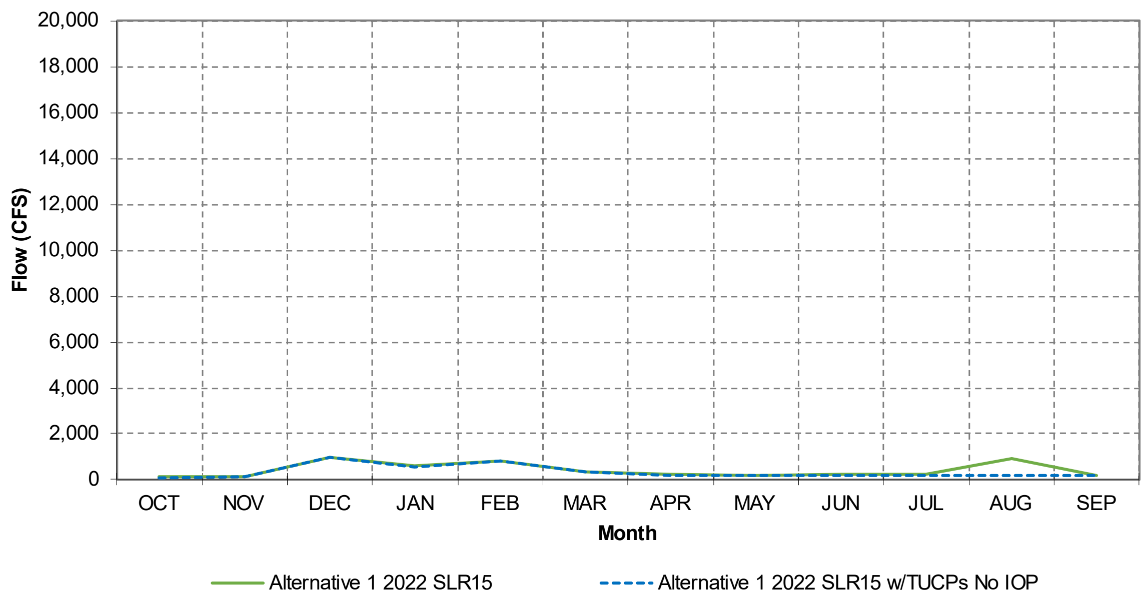


Figure 4I-I-11. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Yolo Bypass Flow for Alternative 1 under Future Climate Centered around 2022 with 15 cm of Sea Level Rise (with and without TUCPs and the IOP)

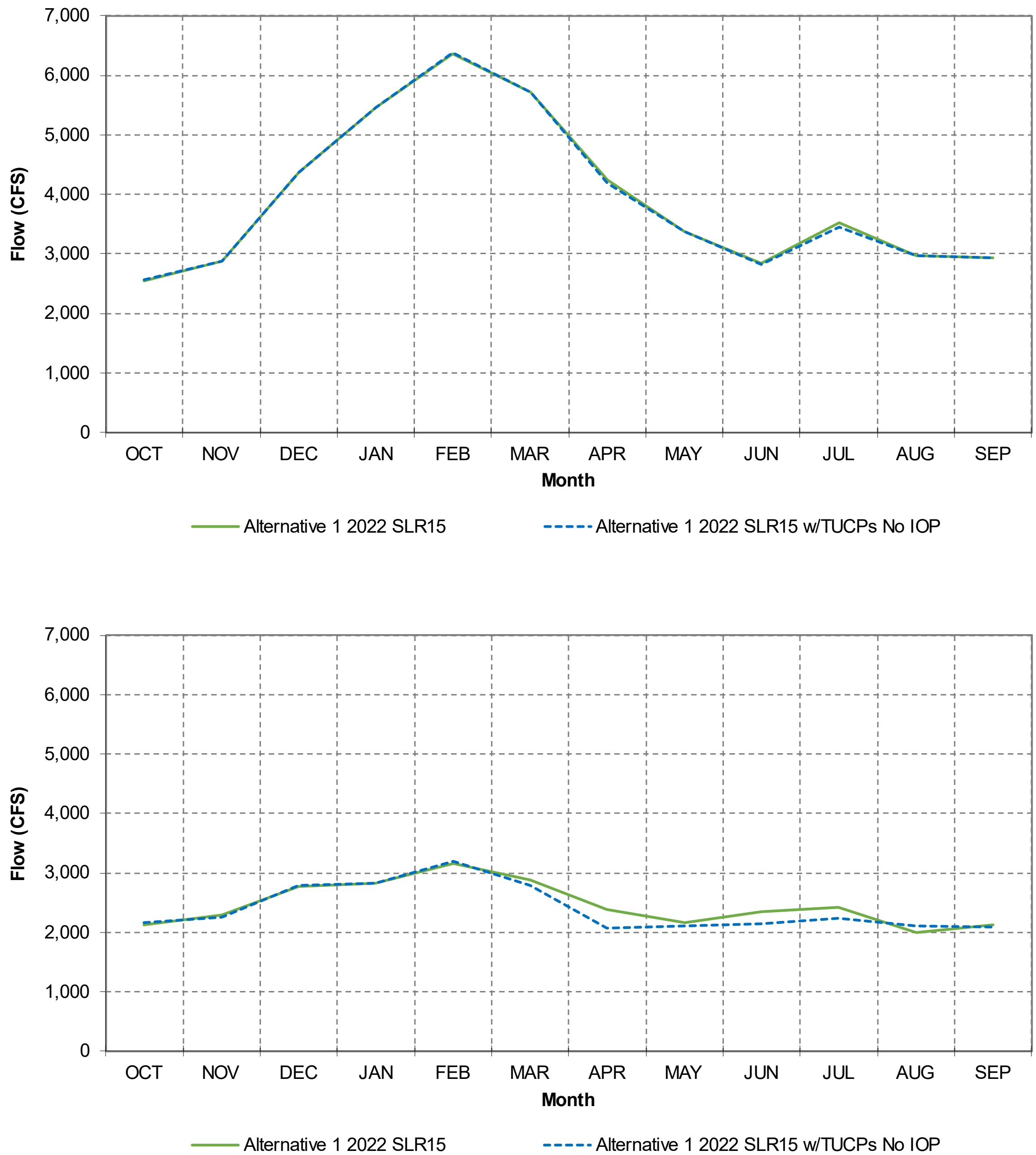
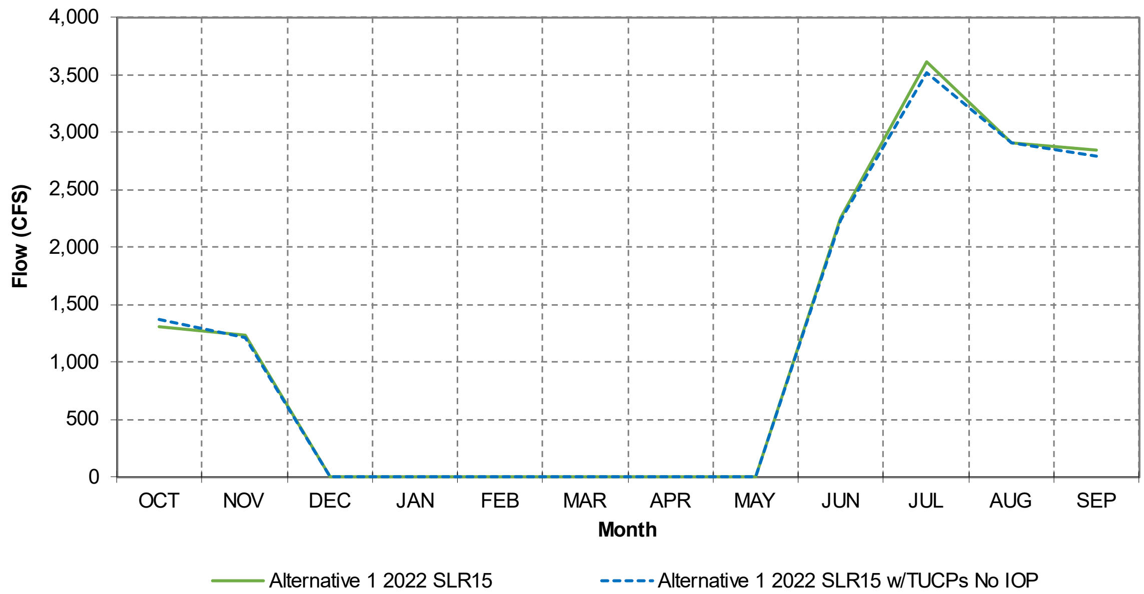


Figure 4I-I-12. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Georgiana Slough Flow for Alternative 1 under Future Climate Centered around 2022 with 15 cm of Sea Level Rise (with and without TUCPs and the IOP)



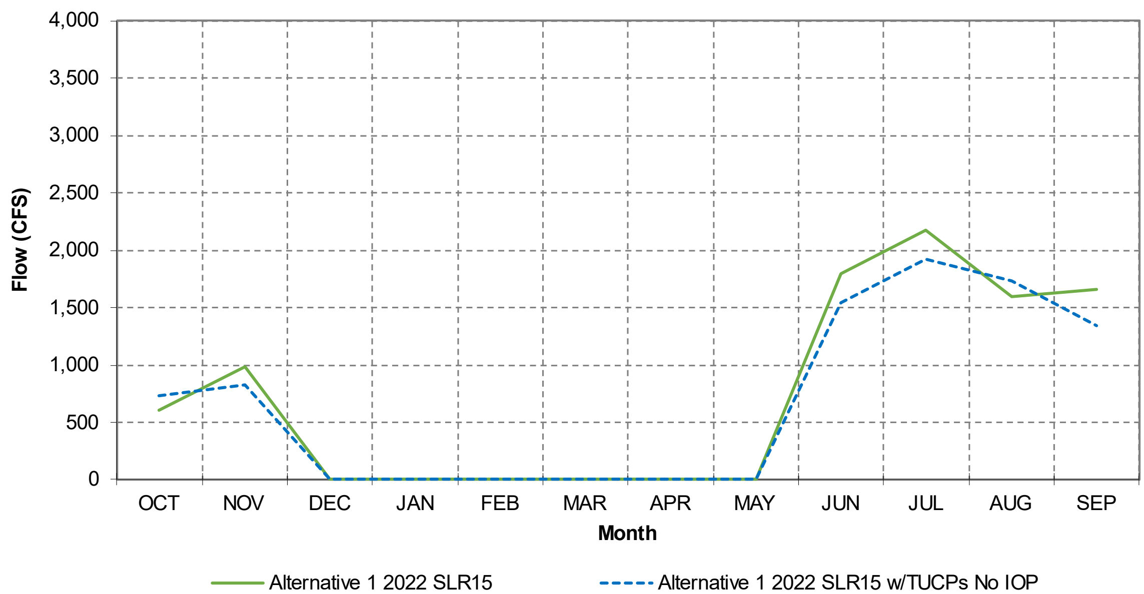
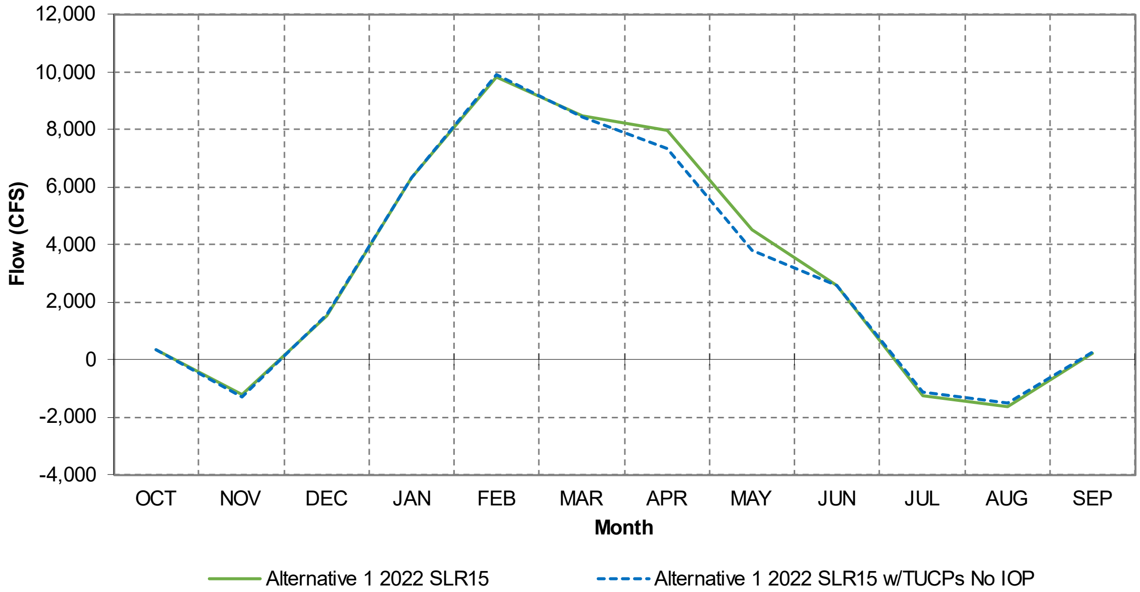


Figure 4I-I-13. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Delta Cross Channel Flow for Alternative 1 under Future Climate Centered around 2022 with 15 cm of Sea Level Rise (with and without TUCPs and the IOP)



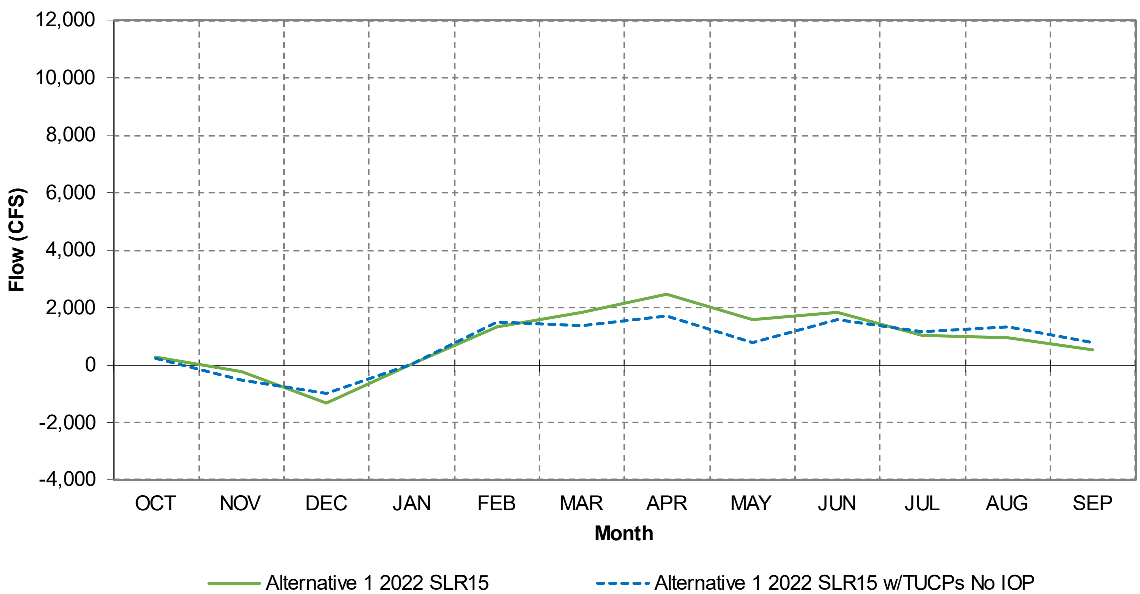


Figure 4I-I-14. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Qwest Flow for Alternative 1 under Future Climate Centered around 2022 with 15 cm of Sea Level Rise (with and without TUCPs and the IOP)

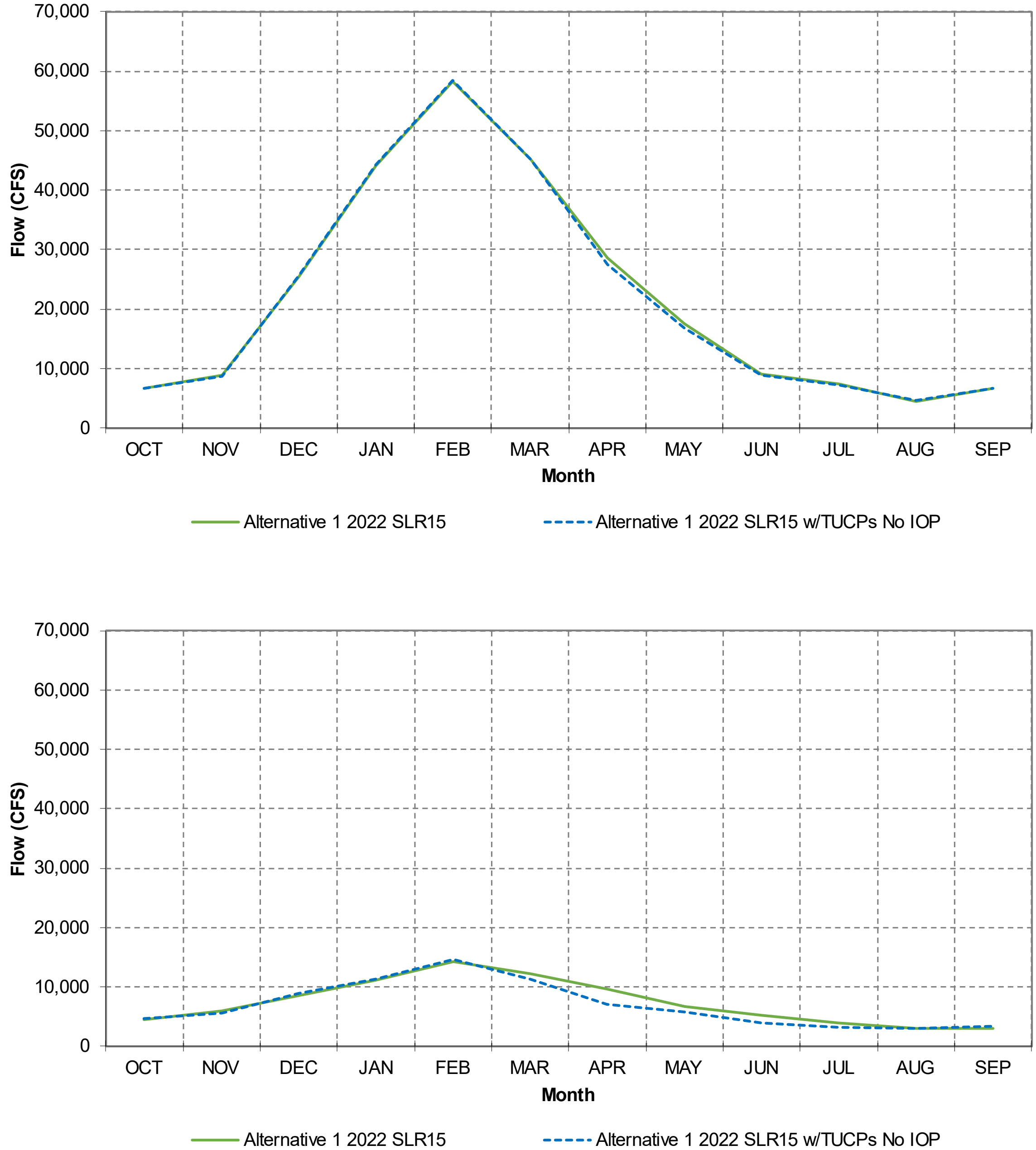


Figure 4I-I-15. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Delta Outflow for Alternative 1 under Future Climate Centered around 2022 with 15 cm of Sea Level Rise (with and without TUCPs and the IOP)

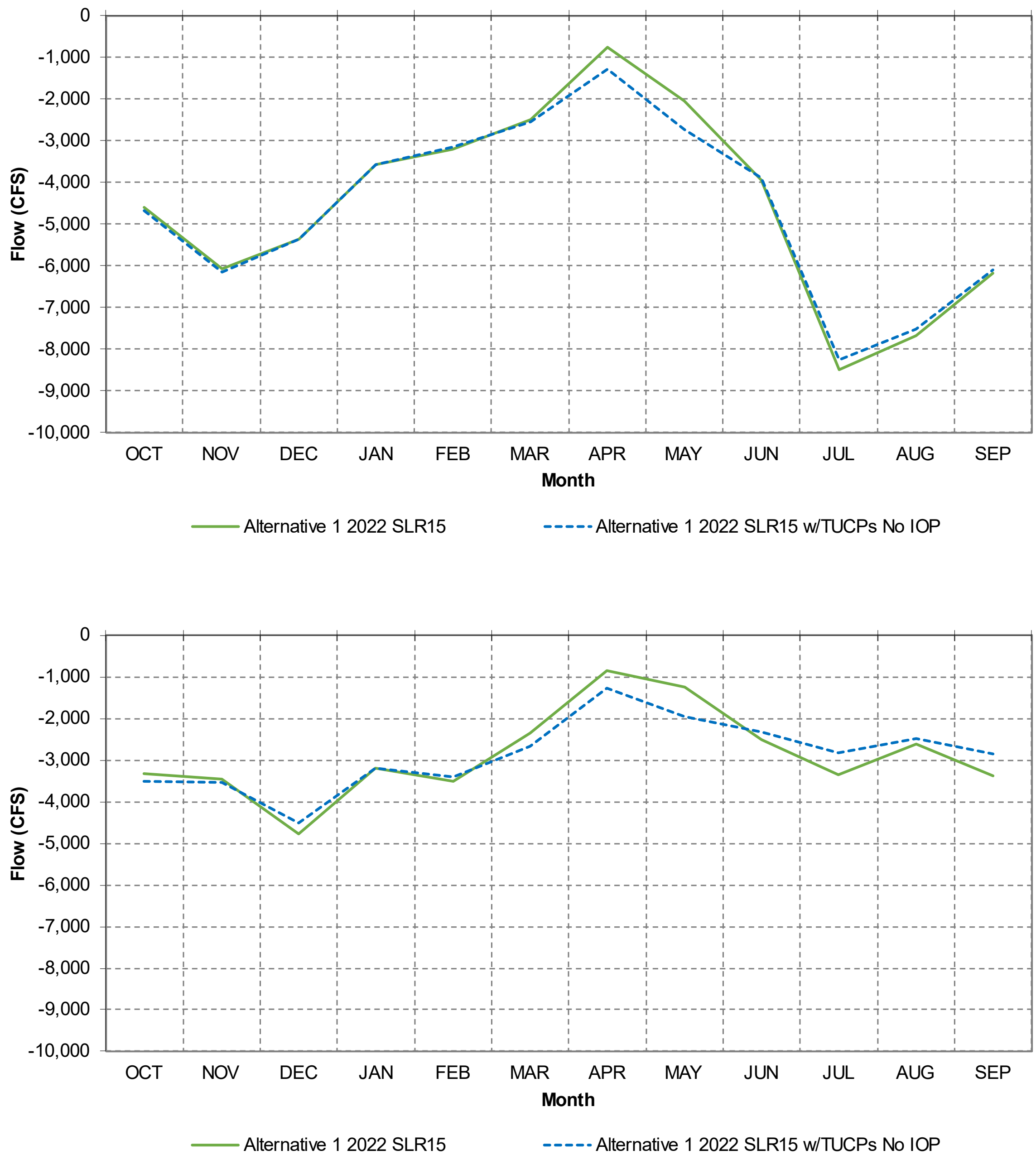
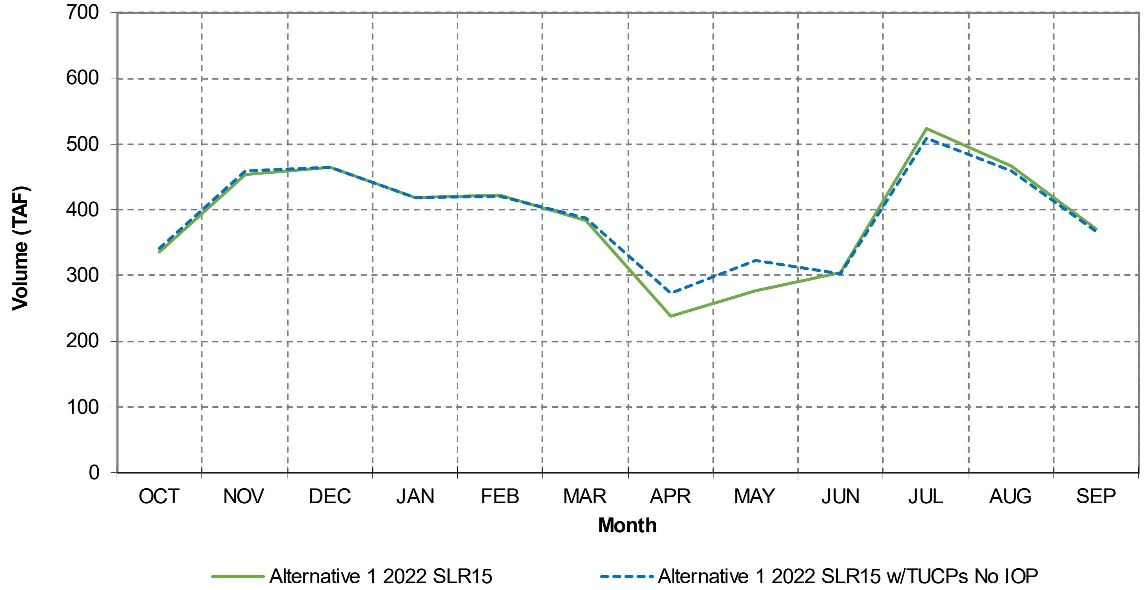


Figure 4I-I-16. Combined Old and Middle River Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Flow for Alternative 1 under Future Climate Centered around 2022 with 15 cm of Sea Level Rise (with and without TUCPs and the IOP)



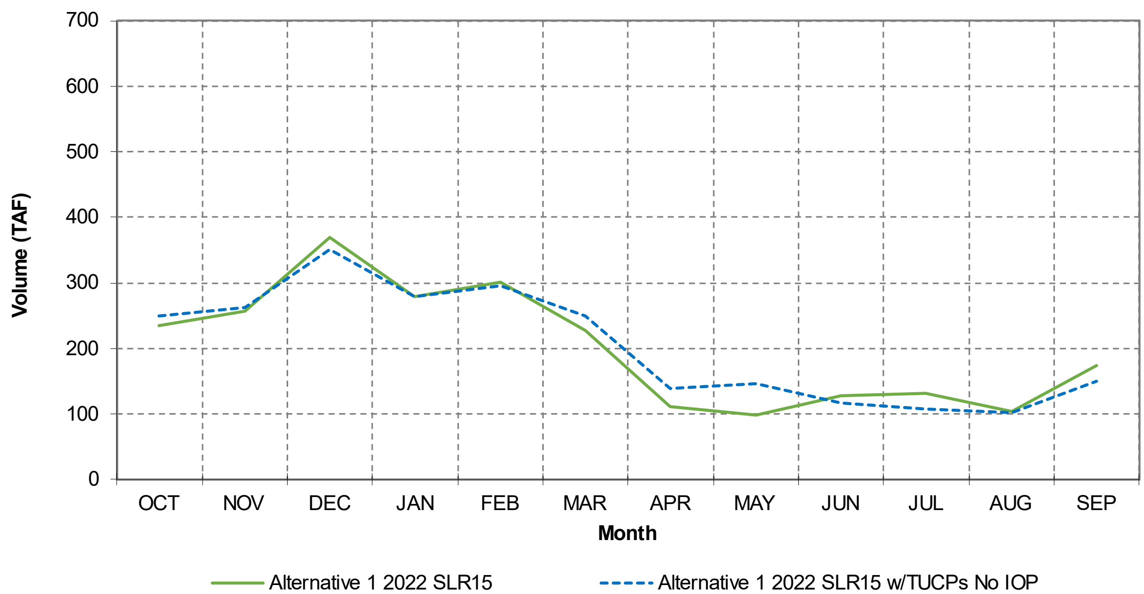


Figure 4I-I-17. Monthly Long-term (Top) and Critically Dry Water Year (Bottom) Average Delta Exports for Alternative 1 under Future Climate Centered around 2022 with 15 cm of Sea Level Rise (with and without TUCPs and the IOP)

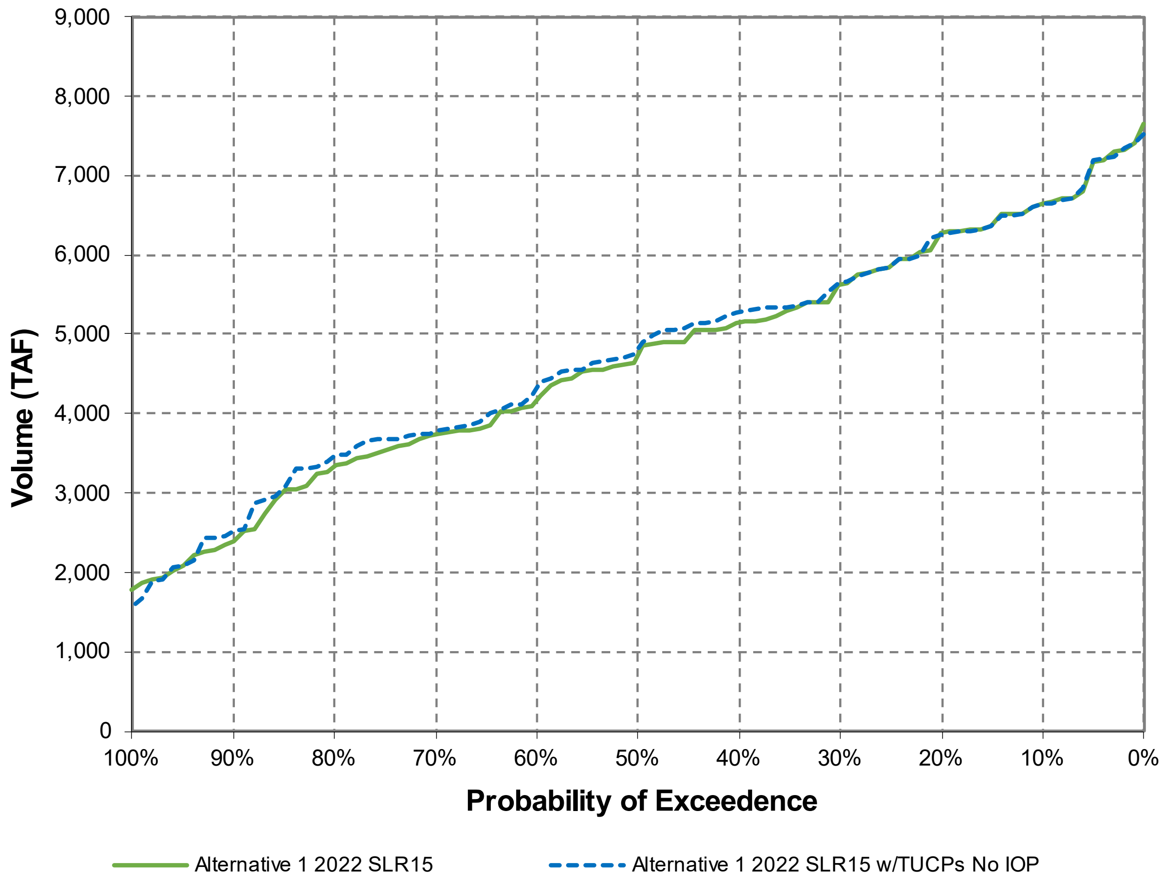


Figure 4I-I-18. Annual Delta Exports for Alternative 1 under Future Climate Centered around 2022 with 15 cm of Sea Level Rise (with and without TUCPs and the IOP)