

**North State Water Alliance (NSWA) Comments on
Cal WaterFix and RDEIR/SDEIS
Exhibits A-D
October 30, 2015**

EXHIBIT A

**List of Commenting Parties
Cal WaterFix and RDEIR/SDEIS
October 30, 2015**

Anderson-Cottonwood Irrigation District
Biggs-West Gridley Water District
Browns Valley Irrigation District
Butte Water District
El Dorado County Water Agency
El Dorado Water & Power Authority
City of Folsom
Glenn-Colusa Irrigation District
Meridian Farms Water Company
Natomas Central Mutual Water Company
Nevada Irrigation District
Northern California Water Association
Pacific Realty Associates, LP (M&T Chico Ranch)
Paradise Irrigation District
Pelger Mutual Water Company
Placer County Water Agency
Plumas Mutual Water Company
Princeton Codora Glenn Irrigation District
Provident Irrigation District
Reclamation District 108
Reclamation District 1004
Regional Water Authority
Richvale Irrigation District
River Garden Farms
City of Roseville
City of Sacramento
Sacramento County Water Agency
Sacramento Municipal Utility District
Sacramento Suburban Water District
San Juan Water District
South Feather Water and Power Agency
South Sutter Water District
South Yuba Water District
Sutter Extension Water District
Sutter Mutual Water Company
Western Canal Water District
Yolo County Flood Control & Water Conservation District
Yuba County Water Agency

Report on Review of Bay Delta Conservation Program Modeling

Foreword

Since December 2012, MBK Engineers and Dan Steiner (collectively “Reviewers”) have assisted various parties in evaluating the operations modeling that was performed for the Bay Delta Conservation Plan (BDCP). To assist in understanding BDCP and the potential implications, stakeholders¹ requested that the Reviewers review the CalSim II modeling studies performed as part of the BDCP (hereafter “BDCP Studies” or “BDCP Model”).

An initial review led the Reviewers to conclude that the BDCP Model, which serves as the basis for the environmental analysis contained in the BDCP Environmental Impact Report/Statement (EIR/S), provides very limited useful information to understand the effects of the BDCP. The BDCP Model contains erroneous assumptions, errors, and outdated tools, which result in impractical or unrealistic Central Valley Project (CVP) and State Water Project (SWP) operations. The unrealistic operations, in turn, do not accurately depict the effects of the BDCP.

The Reviewers revised the BDCP Model to depict a more accurate, consistent version of current and future benchmark hydrology so that the effects of the BDCP could be ascertained. The BDCP Model was also revised to depict more realistic CVP and SWP operations upon which to contrast the various BDCP alternatives. The Reviewers made significant efforts to coordinate with and inform the U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR) managers and modelers, and CVP and SWP operators of the Reviewers’ modifications, assumptions, and findings. Where appropriate, the Reviewers also used Reclamation and DWR’s guidance and direction to refine the Reviewers’ analysis.

This Report summarizes: (1) the Reviewers’ independent analysis and review of the BDCP Model, publicly released for the BDCP’s Draft EIR/S in December 2013, (2) the Reviewers’ updates and corrections made to the BDCP Model, and (3) comparisons between the original BDCP Model and the independent Model as revised by the Reviewers.

¹ The entities who funded this report are Contra Costa Water District, East Bay Municipal Utility District, Friant Water Authority, Northern California Water Association, North Delta Water Agency, San Joaquin River Exchange Contractors Water Authority, San Joaquin Tributaries Authority, and Tehama Colusa Canal Authority.

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1 EXECUTIVE SUMMARY

Purpose of this Report

The CalSim II model is the foundational model for analysis of the BDCP, including the effects analysis in the Draft BDCP and the impacts evaluation in the Draft BDCP Environmental Impact Report/Statement (EIR/S). Results from CalSim II are used to examine how water supply and reservoir operations are modified by the BDCP. The results are also used by subsequent models to determine physical and biological effects, such as water quality, water levels, temperature, Delta flows, and fish response. Any errors and inconsistencies identified in the underlying CalSim II model are therefore present in subsequent models and adversely affect the results of later analyses based on those subsequent models.

The purpose of this Report is to examine the underlying CalSim II model used in support of the BDCP EIR/EIS and to analyze proposed operational scenarios contained in the BDCP. In undertaking the analysis for this Report, the Reviewers examined the model used in support of BDCP, the 2010 version of the CalSim II Model (BDCP Model), as well as the information contained in the Public Review Draft BDCP, released in December 2013. There are three basic reasons why the BDCP Model cannot be used to determine the effects of the BDCP: 1) the no action alternatives do not depict reasonable operations due to climate change assumptions, 2) operating criteria used in the BDCP Alternative 4 result in unrealistic operations, and 3) updates to CalSim II since the BDCP modeling was performed almost 4 years ago alter model results.

Given that it was not possible to determine how the BDCP may affect CVP and SWP operations or water system flows and conditions using the BDCP Model, independent modeling was performed to assess the potential effects of the BDCP. The first phase of this independent modeling effort was development of an updated without project baseline, which is similar to the no action alternative but with current, improved assumptions. The 2010 version of the CalSim II Model was used as the basis for the BDCP Model. The most recent version of CalSim II is the 2013 version used by DWR in its 2013 State Water Project Water Delivery Reliability Report (2013 CalSim II Model), and has undergone significant revision to not only correct errors in the 2010 model, but also to reflect regulatory changes that adversely affect the accuracy and dependability of the 2010 CalSim II Model. The BDCP was developed and analyzed using the 2010 CalSim II Model, and the changes and improvements reflected in the 2013 CalSim II Model were not used for the BDCP. For the purpose of the Reviewers' analysis and this Report, the 2013 CalSim II Model was further modified to incorporate additional updates, assumptions, and fixes. Some of these most recent Reviewer modifications have been accepted by both DWR and Reclamation, and are now incorporated into the CalSim II models that DWR and Reclamation use in conducting their own analyses. The second phase of the independent modeling effort (described in Section 4.2) incorporated the facilities and operations for the BDCP described as Alternative 4 H3 in the Draft EIR/EIS.

The manner in which the CVP and SWP are operated in the "With Project" and "Without Project" modeling scenarios significantly influences the BDCP "effects analysis". Modeling scenarios must depict how the actual system operates or how it might operate so that realistic effects can be determined. Modeling results from CalSim II are used to examine the effects of BDCP on water supply and reservoir operations, and the modeling results are also used by subsequent models to determine physical and biological effects, such as water quality, water levels, temperature, Delta flows, and fish response. If CalSim II modeling does not appropriately characterize operations in both the "With Project" and "Without Project" scenarios, the effects based on CalSim II will also not be appropriately characterized. The independent model provides a more accurate platform to assess the operations of the BDCP and isolates the effects of the BDCP from climate change. Comparing the results of the independent model to those of the BDCP model reveals significant differences in water operations and potential environmental impacts.

Key Conclusions

Assumptions, errors, and outdated tools used in the BDCP Model results in impractical or unrealistic CVP and SWP operations. Therefore, the BDCP Model provides very limited useful information to illustrate the effects of the BDCP.

Methodology used to incorporate climate change contains errors and does not incorporate reasonably foreseeable adaptation measures:

Climate change assumptions were incorrectly applied, yielding non-sensible results.

Climate change hydrology in the Upper San Joaquin River basin was incorporated incorrectly into the BDCP Model. Although inflow to Millerton Lake is expected to *decrease* under future climate scenarios, the error in the BDCP Model causes the amount of stored water in Millerton Lake to *increase* by inappropriately reducing water deliveries to the Friant Division. BDCP erroneously overestimates Millerton Lake storage, which causes an overestimation of reservoir releases and available water downstream. Because overall CVP operations and the San Joaquin River are interconnected, this error causes problems throughout the CVP system. With the coordinated operations of the CVP and SWP, this error can affect the SWP system.

Incorporation of climate change ignores reasonably foreseeable adaptation measures.

The BDCP Model uses assumed future climate conditions that obscure the effects of implementing the BDCP. The future conditions assumed in the BDCP model include changes in precipitation, temperature, and sea level rise. The result of this evaluation is that the modeled changes in water project operations and subsequent environmental impacts are caused by three different factors: (1) sea level rise; (2) climate change; and (3) implementation of the alternative that is being studied.

Including climate change, without adaptation measures, results in insufficient water needed to meet all regulatory objectives and user demands. For example, the BDCP Model results that include climate change indicate that during droughts, water in reservoirs is reduced to the minimum capacity possible. Reservoirs have not been operated like this in the past during extreme droughts and the current drought also provides evidence that adaptation measures are called for long in advanced to avoid draining the reservoirs. In this aspect, the BDCP Model simply does not reflect a real future condition. 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; and (3) if droughts become more frequent, the CVP and SWP would likely revisit the rules by which they allocate water during shortages and operate more conservatively in wetter years. The modifications to CVP and SWP operations made during the winter and spring of 2014 in response to the drought supports the likelihood of future adaptations. The BDCP Model is, however, useful in that it reveals that difficult decisions must be made in response to climate change. But, in the absence of making those decisions, the BDCP Model results themselves are not informative, particularly during drought conditions. With future conditions projected to be so dire without the BDCP, the effects of the BDCP appear positive simply because it appears that conditions cannot get any worse (i.e., storage cannot be reduced below its minimum level). However, in reality, the future condition will not be as depicted in the BDCP Model. The Reviewers recommend that Reclamation and DWR develop more realistic operating rules for the hydrologic conditions expected over the next half-century and incorporate those operating rules into any CalSim II Model that includes climate change.

The BDCP Model does not accurately reflect reasonably foreseeable conditions and changes in CVP and SWP operations due to the BDCP:

BDCP's "High Outflow Scenario" is not sufficiently defined for analysis.

The effects of many critical elements of the BDCP cannot be analyzed because those elements are not well-defined. The Reviewers recommend that the BDCP be better defined and a clear and concise operating plan be developed so that the updated CalSim II model can be used to assess effects of the BDCP.

The High Outflow Scenario (HOS) requires additional water (Delta outflow) during certain periods in the spring. The BDCP Model places most of the responsibility for meeting this new additional outflow requirement on the SWP. However, the SWP may not actually be responsible for meeting this new additional outflow requirement. This is because the Coordinated Operations Agreement ("the COA") would require a water allocation adjustment that would keep the SWP whole. Where one project (CVP or SWP) releases water to meet a regulatory requirement, the COA requires a water balancing to ensure the burden does not fall on only one of the projects. The BDCP Model is misleading because it fails to adjust project operations, as required by the COA, to "pay back" the water "debt" to the SWP due to these additional Delta outflow requirements. Unless there is a significant revision to COA, the BDCP Model overstates the impacts of increased Delta outflow on the SWP and understates the effects on the CVP.

Furthermore, after consulting with DWR and Reclamation project operators and managers, the Reviewers conclude that there is no apparent source of CVP or SWP water to satisfy both the increased Delta outflow requirements and pay back the COA "debt" to the SWP without substantially depleting upstream water storage. It appears, through recent public discussions regarding the HOS, that BDCP anticipates additional water to satisfy the increased Delta outflow requirement and to prevent the depletion of cold water pools will be acquired through water transfers from upstream water users. However, this approach is unrealistic. During most of the spring, when BDCP proposes that Delta outflow be increased, agricultural water users are not irrigating. This means that there is not sufficient transfer water available to meet the increased Delta outflow requirements and therefore, additional release of stored water from the reservoirs would be required. Releasing stored water to meet the increased Delta outflow requirements could potentially impact salmonids on the Sacramento and American River systems due to reductions in the available cold water pool.

Simulated operation of BDCP's dual conveyance, coordinating proposed North Delta diversion facilities with existing south Delta diversion facilities, is inconsistent with the project description.

The Draft BDCP and associated Draft EIR/EIS specify criteria for how much flow can be diverted by the new North Delta Diversion (NDD) facilities and specify when to preferentially use either the NDD facilities or the existing South Delta diversion (SDD) facilities. However, the BDCP Model contains an artificial constraint that prevents the NDD facilities from taking water as described in the BDCP project description. In addition to affecting diversions from the NDD, this artificial constraint contains errors that affect the No Action Alternative (NAA) operation. This error has been fixed by DWR and Reclamation in the more recent 2013 CalSim II Model; however, the error remains in the BDCP Model. Additionally, the BDCP Model does not reflect the summer operations of the SDD that are described in the Draft EIR/EIS as a feature of the BDCP project intended to prevent water quality degradation in the south Delta. The net effect of these two errors is that the BDCP Model significantly underestimates the amount of water diverted from the NDD facilities and overestimates the amount of water diverted from the SDD. The

further decrease in flows through the Delta, in comparison to what is presented in the BDCP Draft EIR/EIS, would likely result in even greater degradation in Delta water quality than reported.

The BDCP Model contains numerous coding and data issues that significantly skew the analysis and conflict with actual real-time operational objectives and constraints

Operating rules used in the BDCP Model, specifically regarding Alternative 4, result in impractical or unrealistic CVP and SWP operations. Reservoir balancing rules cause significant drawdown of upstream reservoirs during spring and summer months while targeting dead pool level in San Luis from September through December resulting in artificially low Delta exports and water shortages. CVP allocation rules are set to artificially reduce south of Delta allocations during wetter years resulting in underestimates of diversions at the NDD and the SDD. Operating rules for the Delta Cross Channel Gate do not reflect how the gates may be operated in “With Project” conditions.

Operational logic is coded into the CalSim II model to simulate how DWR and Reclamation would operate the system under circumstances for which there are no regulatory or other definitive rules. This attempt to specify (i.e., code) the logic sequence and relative weighting so that a computer can simulate “expert judgment” of the human operators is a critical element to the CalSim II model. In the BDCP version of the CalSim II model, some of the operational criteria for water supply allocations and existing facilities such as the Delta Cross Channel and San Luis Reservoir are inconsistent with real-world conditions.

The BDCP Model, as modified by the Reviewers, corrected some of the inconsistencies between the operational criteria in the BDCP Model and real-world conditions, and confirmed these changes with CVP and SWP operators. By correcting the operational criteria, the modified BDCP model (Independent Model) output is more accurate and consistent with real-world operational objectives and constraints.

Independent modeling of the BDCP revealed differences in CVP and SWP operations and water deliveries from the analysis disclosed for the Draft EIR/EIS.

The independent model provides a more accurate platform to assess the operations of the BDCP and isolates the effects of the BDCP from climate change. Comparing the results of the independent model to those of the BDCP model reveals significant differences in water operations and potential environmental impacts. The independent model “Without Project” baseline was compared to the independent model’s version of Alternative 4 H3-ELT of the BDCP. The updated changes in water operations from the independent model are compared to changes in operations reported in the BDCP Draft EIR/EIS for the equivalent alternatives. The difference between the updated independent model results and those reported in the BDCP Draft EIR/EIS are presented below.

- The amount of water exported (diverted from the Delta) may be approximately 200 Thousand Acre-Feet (TAF) per year *higher* than the amount disclosed in the Draft EIR/S. This total represents:
 - approximately 40 TAF/yr more water diverted and delivered to the SWP south of Delta contractors, and
 - approximately 160 TAF/yr more water diverted and delivered to the CVP south of Delta contractors.
- The BDCP Model estimates that, under the No Action Alternative at the Early Long Term (NAA – ELT) (without the BDCP), total average annual exports for CVP and SWP combined are estimated to be 4.73 million acre-feet (MAF) and in the Independent Model Future No Action (FNA) combined exports are 5.61 MAF. The BDCP Model indicates an increase in exports of approximately 540 TAF and the Independent Model shows an increase of approximately 750 TAF in Alt 4.

- Delta outflow would decrease by approximately 200 TAF/yr compared to the quantity indicated in the Draft EIR/S.
 - This lesser amount of Delta outflow has the potential to cause more significant water quality and supply impacts for in-Delta beneficial uses and additional adverse effects on species. To determine the potential effects of the reduced amount of Delta outflow, additional modeling is needed using tools such as DSM2.
- The BDCP Model does not accurately reflect the location of the diversions that the SWP and CVP will make from the Delta.
 - When the errors in the BDCP Model are corrected, the Independent Model reveals that the NDD could divert approximately 680 TAF/yr more than what is disclosed in the BDCP Draft EIR/S.
 - Conversely, the quantity of water diverted through the existing SDD would be approximately 460 TAF/yr less than what is projected in the BDCP Draft EIR/S.
 - This difference in the location of diversions has the potential to reduce water quality in the Central and South Delta in ways that were not analyzed in the BDCP Draft EIR/S

Additional Observations and Recommendations

This review identified and remedied several modeling deficiencies that should be used by others as the BDCP and other projects move forward. However, the work done to date by the Reviewers does not capture all of the improvements necessary to depict the effects of the BDCP accurately. There are many operational uncertainties in the BDCP that require attention and must be addressed. The Reviewers offer several recommendations so that future CalSim II modeling of the BDCP will yield more meaningful results.

1. Ensure model operations of existing facilities are consistent with contemporary real world operations to the extent possible.
 - a. Ensure reservoirs are not routinely drawn down to dead pool as part of 'normal' operations.
2. Given the expected changes in hydrologic conditions over the next half century, realistic operating rules for all CVP and SWP facilities, including the BDCP, must be developed.
 - a. Develop a 'drought' operations plan that includes adaptations.
 - b. Alter reservoir flood release operations to match the assumed shift in precipitation patterns.
 - c. Perform a sensitivity analysis using a range of possible future climates.
3. BDCP operations must be defined in a clear and concise manner.
 - a. Transfer water required to make an alternative feasible should be identified so the effects of that transfer can be determined.
 - b. Adaptive management limits and targets must be better defined
 - c. Changes to the existing COA to accommodate the BDCP must be defined.
 - d. Modeled export operations split between the north and south intakes must be consistent with the project description.
 - e. Changes in the DCC operations should be defined.
 - f. Refined reservoir balancing rules

The BDCP Model must be revised prior to drawing conclusions regarding the environmental effects of the BDCP. The BDCP Model is an outdated version of the CalSim II model, which contains known errors. Only by incorporating the changes made to date by the Reviewers, incorporating the additional recommended changes above, and potential additional refinements can the effects of the BDCP be determined. Reasonable conclusions can only be drawn once these changes are made to the BDCP Model; therefore, the Reviewers recommend that Reclamation and DWR make these changes.

2 INTRODUCTION

The Public Draft BDCP has been prepared by DWR, with assistance and input from Reclamation and various entities that receive water from the SWP and CVP. The BDCP is being prepared to comply with the federal Endangered Species Act, and certain other federal and state mandates. The BDCP proposes a number of Conservation Measures that, if implemented, are believed to provide some benefit to various species covered by the BDCP in the Delta. The Conservation Measures proposed in the Public Draft BDCP include new conveyance facilities and modified operations of the SWP and CVP, as well as other Conservation Measures addressing water quality, predation, and other habitat-related measures. The BDCP has been in development for several years. DWR also has prepared a Public Draft EIR/EIS in an attempt to satisfy CEQA and NEPA. Both the Public Draft BDCP and the Public Draft EIR/EIS were released for public review and comment in December 2013. This Report analyzes the BDCP as proposed and analyzed in the documents released in December 2013.

The Public Draft EIR/EIS considered several water facility and operational configurations, ultimately identifying “Alternative 4” as the preferred alternative under CEQA. (Public Draft EIR/EIS, Section 3.1.1) In addition to identifying physical facilities, the Public Draft EIR/EIS identifies an operational scenario (Alternative 4, Operation Scenario H) as the proposed operation regime for the new and existing facilities. (Public Draft EIR/EIS, Section 3.1.1, Section 5.3.3.9.) Alternative 4, Operational Scenario H is further divided into four sub-operational scenarios, which vary depending on Fall and Spring Delta outflow requirements. Those sub-scenarios are: Alternative 4 Operational Scenario H1 (Alternative 4 H1); Alternative 4 Operational Scenario H2 (Alternative 4 H2); Alternative 4 Operational Scenario H3 (Alternative 4 H3); and Alternative 4 Operational Scenario H4 (Alternative 4 H4). (Public Draft EIR/EIS, section 5.3.3.9.)

In general the differences between the various operational sub-scenarios are as follows. Alternative 4 H1 does not include enhanced spring outflow requirements or Fall X2 requirements. Alternative 4 H2 includes enhanced spring outflow requirements but not Fall X2 requirements. Alternative 4 H3 does not include enhanced spring outflow requirements but includes Fall X2 requirements. Alternative 4 H4 includes both enhanced spring outflow requirements and Fall X2 requirements. (Public Draft EIR/EIS, section 5.3.3.9.) This Report focuses on Alternative 4 H4 and Alternative 4 H3.

The task of the Reviewers was to review the CalSim II modeling which provides the foundational analysis of the BDCP. Results from CalSim II are used to examine how water supply and reservoir operations are modified by the BDCP, and the results are also used by subsequent models to determine physical and biological effects, such as water quality, water levels, temperature, Delta flows, and fish response. Any errors and inconsistencies identified in the underlying CalSim II model are therefore present in subsequent models and adversely affect the results of later analyses based on those subsequent models.

The model used in support of BDCP is the 2010 version of the CalSim II Model (BDCP Model), as well as the information contained in the Public Review Draft BDCP, released in December 2013. Since its development in 2010, the 2010 version of the CalSim II Model has undergone significant revision to not only correct errors in the model, but also to reflect regulatory changes that adversely affect the accuracy and dependability of the 2010 CalSim II Model. The updated version of CalSim II is the model used by DWR in its 2013 State Water Project Water Delivery Reliability Report (2013 CalSim II Model). The BDCP was developed and analyzed using the 2010 CalSim II Model; the changes and improvements reflected in the 2013 CalSim II Model were not used for the BDCP.

The initial review conducted by the Reviewers led to the conclusion that the BDCP Model provides very limited useful information to illustrate the effects of the BDCP. Assumptions, errors, and outdated tools used in the BDCP Model result in impractical or unrealistic CVP and SWP operations. Because of the unrealistic operations included in the BDCP Model, the Reviewers revised the BDCP Model to depict a more accurate, consistent version of

current and future benchmark hydrology. The BDCP Model was also revised to depict more realistic CVP and SWP operations upon which to contrast the various BDCP alternatives. The Reviewers made significant efforts to coordinate with or inform Reclamation and DWR managers and modelers, and CVP and SWP operators of the Reviewers' modifications, assumptions, and findings. Where appropriate, the Reviewers also used Reclamation's and DWR's guidance and direction to refine the Reviewers' analysis. Although there are many models used to evaluate various effects of BDCP, this analysis and review focused on water operations analysis using the BDCP Model (CalSim II).

Purpose and Use of the CalSim II Model

The CalSim II model is a computer program jointly developed by DWR and Reclamation. CalSim II presents a comprehensive simulation of SWP and CVP operations, and it is used by DWR as a planning tool to predict future availability of SWP water. CalSim II is widely recognized as the most prominent water management model in California, and it is generally accepted as a useful and appropriate tool for assessing the water delivery capability of the SWP and the CVP.

Broadly speaking, the model estimates, for various times of the year, how much water will be diverted, will serve as instream flows (e.g., flow in the rivers at various locations, such as Delta outflow), and will remain in the reservoirs. Within the context of the BDCP, the CalSim II model is also used to estimate the amount of water that will be diverted from BDCP's proposed NDD facilities. Thus, for BDCP, the CalSim II model estimates how much water will be diverted at the NDD facilities, how much flow will remain in the Sacramento River below Hood (the approximate location of the NDD facilities), how much water will be diverted through the existing SDD facilities at Tracy, how much flow will leave the Delta by flowing out to the Bay, and how much water will remain in storage in the reservoirs. The location and timing of the diversion and the amount of water remaining instream are significant because they can cause impacts on species, water quality degradation, and the like.

The coding and assumptions included in the CalSim II model drive the results it yields. Data and assumptions, such as the amount of precipitation runoff at a certain measuring station over time or the demand for water by specific water users over time, are input into the model. The criteria that are used to operate the CVP and the SWP (including current regulatory requirements) are included in the model as assumptions; because of the volume of water associated with the CVP and the SWP, these operational criteria significantly influence the model's results. Additionally, operational logic is coded into the CalSim II model to simulate how DWR and Reclamation would operate the system under circumstances for which there are no regulatory or otherwise definitive rules (e.g., when to move water from upstream storage to south of Delta storage). This attempt to specify (i.e., code) the logic sequence and relative weighting that humans will use as part of their "expert judgment" is a critical element to the CalSim II model.

The model's ability to reliably predict the effects of a proposed action depends on the accuracy of its coding and its representation of operations criteria. In other words, the model's results will be only as good as its data, coding, assumptions, and judgment and knowledge of the modelers. For this reason, a detailed operating plan of existing facilities and the proposed facility is essential to create an accurate model of how a proposed action will change – i.e., affect – existing water operations. In reviewing the BDCP Model it became apparent that coding errors and operating assumptions are inconsistent with the actual purposes and objectives of the CVP and SWP, thus limiting the utility and accuracy of the results. Through collaboration and verification with CVP and SWP operators, the BDCP Model flaws were corrected in the revised BDCP Model (Independent Model) and the potential effects of the BDCP were re-analyzed.

3 REVIEW OF BDCP CALSIM II MODELING

The CalSim II model is the foundational model for analysis of the BDCP, including the effects analysis in the Draft BDCP and the impacts evaluation in the Draft EIR/EIS. Results from CalSim II are used to examine how water supply and reservoir operations are modified by the BDCP, and the results are also used by subsequent models to determine physical and biological effects, such as water quality, water levels, temperature, Delta flows, and fish response. Any errors and inconsistencies identified in the underlying CalSim II model are therefore present in subsequent models and adversely affect the results of later analyses based on those subsequent models.

The Reviewers' analysis of the BDCP Model is summarized in three categories: (3.1) assessment of climate change assumptions, implementation, and effects; (3.2) assessment of general assumptions and operations; and (3.3) assessment of the assumptions and operational criteria for inclusion of the new BDCP facilities. The issues discussed in (3.1) and (3.2) are relevant for all modeling scenarios, both baseline scenarios that do not include BDCP and with project scenarios that evaluate BDCP or the Alternatives. The issues discussed in (3.3) are specific to the inclusion of the BDCP as defined in the Draft Plan and identified as Alternative 4 in the Draft EIR/EIS.

3.1 Climate Change

Implementation of Climate Change

The analysis presented in the BDCP Documents attempts to incorporate the effects of climate change at two future climate periods: the early long term (ELT) at approximately the year 2025; and the late long term (LLT) at approximately 2060. As described in the BDCP documents², other analytical tools were used to determine anticipated changes to precipitation and air temperature that is expected to occur under ELT and LLT conditions. Projected precipitation and temperature was then used to estimate runoff into from the watersheds over an 82-year period of variable hydrology; these time series were then used as inputs into the BDCP Model. A second aspect of climate change, the anticipated amount of sea level rise, is incorporated into the BDCP CalSim II model by modifying flow-salinity relationships that estimate salinity within the Delta based on sea level and flows within Delta channels.

This Report does not evaluate the analytical processes by which reservoir inflows and runoff were developed, nor does it evaluate the modified flow-salinity relationships that are assumed due to sea level rise; those items could be the focus of another independent review. This Report is limited to evaluating how the modified flows were incorporated into the BDCP Model and whether the operation of the CVP and SWP water system in response to the modified flows and the modified flow-salinity relationship is reasonable for the ELT and LLT conditions. This work reviews the assumed underlying hydrology and simulated operation of the CVP/SWP, assumed regulatory requirements, and the resultant water delivery reliability.

Assessment of Climate Change Assumptions and Implementation

To assess climate change, the three Without Project (or "baseline" or "no action") modeling scenarios were reviewed: No Action Alternative (NAA)³, No Action Alternative at the Early Long Term (NAA – ELT), and No Action Alternative at the Late Long Term (NAA –LLT). Assumptions for NAA, NAA-ELT, and NAA-LLT are provided in the Draft BDCP EIR/EIS Appendix 5A, Section B, Table B-8. The only difference between these scenarios is the climate-related changes made for the ELT and LLT conditions (Table 1).

² BDCP EIR/EIS Appendix 5A, Section A and BDCP HCP/NCCP Appendix 5.A.2

³ NAA is also called the Existing Biological Conditions number 2 (EBC-2) in the Draft Plan.

Table 1. Scenarios used to evaluate climate change

Scenario	Climate Change Assumptions	
	Hydrology	Sea Level Rise
No Action Alternative (NAA)	None	None
No Action Alternative at Early Long Term (NAA-ELT)	Modified reservoir inflows and runoff for expected conditions at 2025	15 cm
No Action Alternative at Early Long Term (NAA-LLT)	Modified reservoir inflows and runoff for expected conditions at 2060	45 cm

The differences between the NAA and NAA-ELT reveal the effects of the climate change assumptions under ELT conditions; similarly, the differences between the NAA and NAA-LLT reveal the effects of the climate change assumptions under LLT conditions. Numerous comparisons between NAA, NAA-ELT, and NAA-LLT are discussed in the Technical Appendix of this report; issues that shaped our conclusions are discussed below.

Climate change implementation is incorrect, yielding non-sensible results.

Climate change hydrology in the Upper San Joaquin River basin (above Friant Dam) was incorporated incorrectly into the BDCP Model, resulting in non-sensible results. Because overall CVP operations and the San Joaquin River are interconnected, this error causes problems throughout the CVP system. With the coordinated operations of the CVP and SWP, this error can affect the SWP system.

Specifically, under climate change, inflow to Millerton Lake is expected to decrease (BDCP DEIR/S, Appendix 29B). However, when climate change was implemented into the BDCP Model, it was done incorrectly such that: (1) the inflow into Millerton Lake *was not adjusted* for climate change and is thus overestimated, and yet (2) the flood control operations and water allocation decisions for Millerton Lake *were adjusted* for climate change as if the inflow was reduced. The net effect is that storage in Millerton Lake is overestimated; in fact, the BDCP model indicates that the amount of water stored in Millerton Lake will actually be increased as a result of climate change even though the inflow to the lake is projected to be reduced (i.e., non-sensible). This error results in the overestimation of Millerton Lake storage causing an overestimation of reservoir releases for flood control purposes and available water downstream at the Mendota Pool; these unreasonably high flood releases are then diverted by CVP exchange contractors in lieu of taking CVP Delta water, which means that either CVP Delta exports are reduced or the water is backed up into San Luis Reservoir (SLR), overestimating SLR storage. Furthermore, any excess water from the Millerton Lake that is not diverted at Mendota Pool would continue downstream and ultimately increase Vernalis flow, which subsequently affects Delta exports. Ultimately, changes in exports have the potential to affect upstream reservoir releases (i.e., from Lake Shasta) as well.

This is a situation where one seemingly minor error cascades through the entire system. This error exists in all BDCP Model scenarios (baselines and project alternatives) that have climate change incorporated at either ELT or LLT conditions. In other words, all model results reported in the BDCP and associated Draft EIR/S contain this error, with the only exception of the Existing Biological Conditions baselines numbers 1 and 2 (EBC1 and EBC2), which are evaluated in the BDCP.

Effects of climate change create unrealistic operations.

Review of the BDCP Model output for the Without Project condition with climate change assumptions for the ELT or LLT (NAA-ELT and NAA-LLT, respectively) reveal that the model is operated beyond its usable range. The purpose of CalSim II is to simulate how the CVP and SWP systems would be operated in order to meet regulatory requirements and water delivery objectives based on a certain amount of precipitation and runoff. When the precipitation patterns and resultant runoff were changed in the BDCP Model for climate change, the logic

regarding how the system is operated to meet the regulatory and water delivery objectives was not changed. The net effect is that neither the regulatory criteria nor the delivery objectives are met.

With rising temperatures and shifting precipitation patterns with less snow, temperature criteria on the Sacramento River will become increasingly more difficult to meet. For instance, the BDCP Model includes an assumption that equilibrium temperatures in the Sacramento River between Shasta and Gerber will increase on an average annual basis by 1.6°F by 2025 (ELT) by 3.3°F by 2060 (LLT). NMFS 2009 Biological Opinion specifies temperature targets of 56°F in the Sacramento River between Balls Ferry and Bend Bridge for the protection of salmon. Because of lower storage conditions in Shasta Lake and the magnitude of temperature increase in the assumptions is so large, the BDCP Model shows that the probability of exceeding the mortality threshold in the Sacramento River at Bend Bridge in August and September increases from approximately 80% in the No Action Alternative to 90% to 95% by 2025 (under ELT conditions) and to 95% to 100% by 2060 (under LLT conditions). This significant difference shows the overwhelming influence that the climate change assumptions have on the BDCP Model results.

Reservoir Storage: Under the climate change scenarios, reservoir storage (particularly in the CVP system) is operated very aggressively so that the reservoirs are drawn down to an extremely low level (termed “dead pool”) in approximately 1 of every 10 years, even without the BDCP. At dead pool level, little or no water can be released from the reservoir – not for fish, not for drinking water, not for agriculture. For example, since Folsom Reservoir became operational in 1955, the storage has never been drawn down to reach dead pool (which is approximately 100,000 acre-feet); the lowest storage level on record was 147,000 acre-feet at the end of September 1977. However, the BDCP Model predicts that, under climate change, the reservoir will be about 100,000 acre-feet or about 30% lower than its historical low in 10% of years. Some municipalities, such as the city of Folsom, are entirely dependent on reservoir releases for drinking water. Reaching dead pool would cut municipal deliveries below the level required to maintain public health and safety. In reality, and to avoid such dire circumstances, the CVP and SWP would likely request that regulatory agencies modify standards to conserve storage and would likely mandate conservation (or rationing) by water users. Similar steps were taken in early in 2014 to reduce water diversions and reservoir releases for fishery needs and Delta requirements. Emergency measures such as these are not simulated in the model, so the BDCP Model does not reflect reasonable future operations with climate change.

With the predicted changes in precipitation and temperature implemented in the BDCP Model, there is simply not enough water available to meet all regulatory objectives and water user demands. Yet the BDCP Model continues its normal routine and thus fails to meet its objectives. In this aspect, the BDCP Model simply does not simulate reality. For instance, if the ELT and LLT conditions actually occur, the CVP and SWP would likely adapt to protect water supplies and the environment. Examples of reactions to climate change would likely include: (1) updating operational rules regarding water releases 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 ; and (3) if droughts become more frequent, the CVP and SWP would likely revisit the rules by which they allocate water during shortages and operate more conservatively in wetter years. The likelihood of an appropriate operational response to climate change is supported by the many modifications to CVP and SWP operations made during the winter and spring of 2014 to respond to the current drought. The BDCP Model is, however, useful in that it reveals that difficult decisions must be made.

Conclusions Regarding Climate Change Assumptions and Implementation

Water Code section 85320, subdivision (b)(2)(C) requires consideration of, among other things, the “potential effects of climate change, possible sea level rise up to 55 inches, and possible changes in total precipitation and runoff patterns on the conveyance alternatives and habitat restoration activities considered in the environmental

impact report". In examining the possible effects of climate change, it is not appropriate to assume that current project operations will remain static and not respond to climate change. The BDCP's simplistic approach of assuming a linear operation of the CVP and SWP produces results that are not useful for dealing with the complex problem of climate change because it does not reflect the way in which the CVP and the SWP would actually operate whether or not the BDCP is implemented. The Reviewers recommend a sensitivity analysis be conducted to develop a better understanding of the range of possible responses to climate change by the CVP and SWP, and the regulatory structures that dictate certain project operations.

Including climate change, without adaptation measures, results in insufficient water needed to meet all regulatory objectives and user demands. For example, the BDCP Model results that include climate change indicate that during droughts, water in reservoirs is reduced to the minimum capacity possible. Reservoirs have not been operated like this in the past during extreme droughts and the current drought also provides evidence that adaptation measures are called for long in advanced to avoid draining the reservoirs. In this aspect, the BDCP Model simply does not reflect a real future condition. Foreseeable adaptations that the CVP and SWP could make in response to climate change include: (1) updating operational rules regarding water releases for flood protection; (2) during severe droughts, emergency drought declarations could call for mandatory conservation; and (3) if droughts become more frequent, the CVP and SWP would likely revisit the rules by which they allocate water during shortages and operate more conservatively in wetter years. The modifications to CVP and SWP operations made during the winter and spring of 2014 in response to the drought supports the likelihood of future adaptations. The BDCP Model is, however, useful in that it reveals that difficult decisions must be made in response to climate change. But, in the absence of making those decisions, the BDCP Model results themselves are not informative, particularly during drought conditions. With future conditions projected to be so dire without the BDCP, the effects of the BDCP appear positive simply because it appears that conditions cannot get any worse (i.e., storage cannot be reduced below its minimum level). However, in reality, the future condition will not be as depicted in the BDCP Model. The Reviewers recommend that Reclamation and DWR develop more realistic operating rules for the hydrologic conditions expected over the next half-century and incorporate those operating rules into the any CalSim II Model that includes climate change.

3.2 General Assumptions and Operations

BDCP CalSim II Assumptions

The assumptions for these runs are defined in the December 2013 Draft BDCP⁴ and associated Draft EIR/S.

Each of the no action alternatives assumes the same regulatory requirements, generally representing the existing regulatory environment at the time of study formulation (February 2009), including Stanislaus ROP the National Marine Fisheries Services (NMFS) Biological Opinion (BO) (June 2009) Actions III.1.2 and III.1.3, Trinity Preferred EIS Alternative, NMFS 2004 Winter-run BO, NMFS BO (June 2009) Action I.2.1, SWRCB WR90-5, CVPIA (b)(2) flows, NMFS BO (June 2009) Action I.2.2, ARFM NMFS BO (June 2009) Action II.1, no SJRRP flow modeled, Vernalis SWRCB D1641 Vernalis flow and WQ and NMFS BO (June 2009) Action IV.2.1, Delta D1641 and NMFS Delta Actions including Fall X2 Fish & Wildlife Service (FWS) BO (December 2008) Action 4, Export restrictions including NMFS BO (June 2009) Action IV.11.2v Phase II, OMR FWS BO (December 2008) Actions 1-3 and NMFS BO (June 2009) Action IV.2.3v.

The modeling protocols for the recent USFWS BO (2008) and NMFS BO (2009) have been cited as being cooperatively developed by Reclamation, NMFS, U.S. Fish and Wildlife Service (USF&WS), California Department of Fish and Wildlife (CDF&W), and DWR.

⁴ BDCP EIR/EIS Appendix 5A

Each of the BDCP no action alternatives (NAA, NAA-ELT, and NAA-LLT) uses the same New Melones Reservoir and other San Joaquin River operations. At the time of these studies' formulation, the NMFS BO (June 2009) had been recently released. Also, the San Joaquin River Agreement (SJRA), including the Vernalis Adaptive Management Program (VAMP) and its incorporation into D1641 for Vernalis flow requirements were either still in force or being discussed for extension. As a component of study assumptions, the protocols of the SJRA and an implementation of the NMFS BO for San Joaquin River operations (including New Melones Reservoir operations) are included in the studies. These protocols, in particular the inclusion of VAMP which has now expired, are not appropriate as an assumption within either the No Action or Alternative Scenarios within a full disclosure of BDCP impacts. Although appropriate within the identification of actions, programs and protocols present at the time of the NOI/NOP, they are not representative of current or reasonably foreseeable operations. Also, the BDCP Model assumes no San Joaquin River Restoration Program releases in the future operation of the Friant Division of the CVP. While assuming no difference in the current and future operation of the Friant Division avoids another difference in existing and projected future hydrology of the San Joaquin River, the assumption does not recognize the existence of the San Joaquin River Restoration Program. Results of CVP and SWP operations, in particular as affected by export constraints dependent on San Joaquin River flows and their effect on OMR, E/I and I/E diversion constraints, would be different with a different set of assumptions for San Joaquin River operations, in a manner similar to the cascading effect described above in connection with climate change.

Finally, the habitat restoration requirements in the 2008 FWS BO and the 2009 NMFS BO are not included in the NAA baselines. Although the restoration is required to be completed either with or without completion of the BDCP, the restoration was only analyzed as part of the with project scenarios.

Conclusions Regarding General Assumptions and Operations

The benchmark study upon which the BDCP Model was built contains inaccuracies that affect the analysis.

CalSim II is continuously being improved and refined. As the regulatory environment changes and operational and modeling staff work together to improve the model's capability to simulate actual operations, the model is continually updated. The BDCP Model relied upon a version of CalSim II that dates back to 2009, immediately after the new biological opinions (BiOps) from the NMFS and the United States Fish and Wildlife Service (USFWS) significantly altered the operational criteria of the CVP and SWP. In the last 4 to 5 years, DWR, Reclamation, and outside modeling experts have worked together to improve the model. Changes include better (more realistic) implementation of the new BiOps and numerous fixes to the code. Since CalSim II is undergoing continual improvements, there will always be "vintage" issues in that by the time a project report is released, the model is likely slightly out of date. However, in this case - with the major operational changes that have occurred in the new regulatory environment - many issues have been identified and fixed in the last 4 to 5 years that have a significant effect on model results. CalSim II modeling for the DWR 2013 Delivery Reliability Report contains numerous modeling updates and fixes that significantly alter results of the BDCP Model. A key modeling revision in the 2013 DWR modeling was fixing an error regarding artificial minimum instream flow requirements in the Sacramento River at Hood. An "artificial" minimum instream flow requirement had been specified; the requirement is artificial in that it does not represent a regulatory requirement, but rather is a modeling technique to force upstream releases to satisfy Delta needs.

3.3 Assumptions and Operational Criteria for inclusion of proposed BDCP facilities

To evaluate the assumptions and operations of the proposed BDCP facilities, the Reviewers analyzed the output from the BDCP Model and examined the internal workings of the models. This approach allows for evaluation of not only the possible effects of the BDCP, also but whether the assumptions and operational criteria are implemented appropriately to reflect the project description and reasonably foreseeable actions.

Assessment of Assumptions and Operations in coordination with new BDCP facilities

BDCP's Alternative 4 has four possible sets of operational criteria, termed the Decision Tree, that differ based on the "X2" standards⁵ that they contemplate:

- Low Outflow Scenario (LOS), otherwise known as operational scenario H1, assumes existing spring X2 standard and the removal of the existing Fall X2 standard;
- High Outflow Scenario (HOS), otherwise known as H4, contemplates the existing Fall X2 standard and providing additional outflow during the spring;
- Evaluated Starting Operations (ESO), otherwise known as H3, assumes continuation of the existing X2 spring and fall standards;
- Enhanced spring outflow only (not evaluated in the December 2013 Draft BDCP), scenario H2, assumes additional spring outflow and no Fall X2 standards.

While it is not entirely clear how the Decision Tree would work in practice, the general concept is that prior to operation of the new facility, implementing authorities would select the appropriate Scenario (from amongst the four choices) based on their evaluation of targeted research and studies to be conducted during planning and construction of the facility.

For this analysis, the Reviewers analyzed the HOS (or H4) scenario because the BDCP⁶ indicates that the initial permit will include HOS operations that may be later modified at the conclusion of the targeted research studies. The HOS includes the existing Fall X2 requirements but adds additional outflow requirements in the spring. The model code was reviewed and discussed with DWR and Reclamation, who acknowledged that although the SWP was bearing the majority of the responsibility for meeting the additional spring outflow in the modeling, the responsibility would need to be shared with the CVP⁷. In subsequent discussions, DWR and Reclamation have suggested that the additional water may be purchased from other water users. However, the actual source of water for the additional outflow has not been defined. While not how the projects would actually be operated, since the BDCP Model assumes that the SWP bears the majority of the responsibility for meeting the additional outflow, the Reviewers' analysis of the BDCP Model results for HOS is limited to the evaluation of how the SWP reservoir releases on the Feather River translate into changes in Delta outflow and exports.

Our remaining analysis examines the ESO (or H3) scenario (labeled Alt 4-ELT or Alt 4-LLT in this section) because it employs the same X2 standards as are implemented in NAA-ELT and NAA-LLT. This allowed the Reviewers to focus the analysis on the effects of the BDCP operations independent of the possible change in the X2 standard.

The differences between the without project scenario (NAA-ELT) and the corresponding with project scenario (Alt4 H3-ELT) should reveal the effects of the project under ELT conditions. However, as discussed above, implementation of climate change assumptions and the occurrence of unrealistic operations likely obfuscates the effects of the BDCP. Although the modeling approach may provide a relative comparison between equal foundational operations, the Reviewers are hesitant to place any confidence in the computed differences shown between the NAA-ELT and Alt4-ELT Scenarios. Numerous comparisons between NAA-ELT and Alt4 H3-ELT are discussed in the technical appendix of this report; issues that shaped our conclusions are discussed below.

⁵ X2 is a salinity standard that requires outflows sufficient to attain a certain level of salinity at designated locations in the Delta at certain times of year.

⁶ Draft BDCP, Chapter 3, Section 3.4.1.4.4

⁷ August 7, 2013 meeting with DWR, Reclamation, and CH2M HILL

Assumptions for the “High Outflow Scenario” are unrealistic.

The HOS is one branch of the BDCP Decision Tree, also identified as Alternative 4, operational scenario H4 in the DEIR/EIS. The HOS requires additional water (Delta outflow) during certain periods in the spring, in excess of the current regulatory requirements. The BDCP Model assumes that if the required additional Delta outflow cannot be met by reducing exports, this increased Delta outflow will be met by releases made by the SWP’s Oroville Reservoir. The assumptions regarding how much water to release from Oroville to attempt to meet the proposed regulations and how much and when to refill Oroville are unrealistic.

According to the Draft EIR/EIS⁸, the HOS will reduce SWP south of Delta water deliveries for municipal and industrial (M&I) water users 7% below the level that they would receive without the BDCP (on average). During dry and critical years, SWP south of Delta water deliveries for M&I and agricultural water users will drop 17% below the level that they would receive without the BDCP. In other words, according to the BDCP Model results SWP Contractors would get less water than they would otherwise get without BDCP.

CVP and SWP obligations for providing flow to satisfy Delta outflow requirements is described in the Coordinated Operations Agreement (COA). Because the CVP and SWP share responsibility for meeting required Delta outflow based on specific sharing in the agreement, it is not reasonable to conclude that CVP water supplies would increase an average of 70 TAF while SWP water supplies decrease on average of 100 TAF under the HOS. The manner in which this alternative is modeled is inconsistent with existing agreements and operating criteria. If the increases in outflow were met based on COA, there would likely be reductions in Shasta and Folsom storage that would likely cause adverse environmental impacts, which have not been modeled or analyzed in the BDCP EIR/S.

Furthermore, there is no apparent source of water to satisfy the increased outflow requirements and pay back the COA debt. It appears, through recent public discussions regarding the HOS that BDCP anticipates additional water to satisfy the increased Delta outflow requirement and to prevent the depletion of cold water pools will be acquired through water transfers from upstream water sources. However, this approach is unrealistic. During most of the spring, when BDCP proposes that Delta outflow be increased, agricultural water users are not irrigating. This means that there is not sufficient transfer water available to meet the increased Delta outflow requirements without releasing stored water from the reservoirs.

San Luis Reservoir operational assumptions produce results that are inconsistent with real world operations.

San Luis Reservoir (SLR) is an off-stream reservoir located south of the Delta and jointly owned and operated by CVP and SWP. The reservoir is used to store water that is exported from the Delta when available and used to deliver water to CVP and SWP Contractors when water demands exceed the amount of water that can be pumped from the Delta. The decision of when to move water that is stored in upstream reservoirs, such as Shasta, Folsom, or Oroville, through the Delta for export to fill SLR is based on the experience and expert judgment of the CVP and SWP operators.

CalSim II attempts to simulate the expert judgment of the operators by imposing artificial operating criteria; the criteria are artificial in the sense that they are not imposed by regulatory or operational constraints but rather imposed as a tool to simulate expert judgment. One such artificial operating criteria is the SLR target storage level: CalSim II attempts to balance upstream Sacramento Basin CVP and SWP reservoirs with storage in SLR by setting artificial target storage levels in SLR, such that the CVP and SWP will release water from upstream reservoirs to meet target levels in SLR. The artificial target storage will be met as long as there is ability to convey

⁸ Draft EIR/EIS, Appendix 5A-C, Table C-13-20-2

water (under all regulatory and physical capacity limits) and as long as water is available in upstream reservoirs. SLR target storage criteria are also sometimes described in section 4.2 as the “San Luis rule-curve”.

In the BDCP Model, CVP and SWP reservoir operating criteria for Alternative 4 H3 ELT differ from the corresponding without project scenario (e.g. NAA-ELT). The difference in criteria and result is primarily driven by changes to the artificial constraint used to determine when to fill SLR: the SLR target storage. In Alternative 4 H3 ELT, SLR target storage is set very high in the spring and early summer months, and then reduced in August and set to SLR dead pool from September through December. This change in SLR target storage relative to the no action alternative causes upstream reservoirs to be drawn down from June through August and then recuperate storage by cutting releases in September. This change to the artificial operating criteria SLR target storage causes changes in upstream cold water pool management and affects several resource areas.

In addition to changes in upstream storage conditions, changes in SLR target storage cause SLR storage to drop below a water supply concern level (300,000 acre-feet) in almost 6 out of every 10 years under ELT conditions and more than 7 out of every 10 years under LLT conditions for Alternative 4 H3. When storage in SLR drops below this 300,000 acre-foot level, algal blooms in the reservoir often cause water quality concerns for drinking water at Santa Clara Valley Water District. The change in SLR target storage also causes SLR levels to continue to drop and reach dead pool level for the SWP in 4 out of every 10 years and also dead pool level for the CVP in 1 out of every 10 years under the ELT conditions.

Reaching dead pool level in SLR creates shortages to water users south of the Delta. Although some delivery shortages are due to California Aqueduct capacity constraints, the largest annual delivery shortages are a result of inappropriately low SLR target storage. Average annual Table A shortages due to artificially low SLR storage levels increased from 3 TAF in the NAA-ELT scenario to 35 TAF in the Alt4-ELT scenario. Such shortages occurred in 2% of simulated years in the NAA-ELT scenario and 23% of years in the Alt4-ELT scenario. In addition to the inability to satisfy Table A allocations, low storage levels cause loss of SWP Contractors’ Article 56 water stored in SLR. Average annual Article 56 shortages were 43 TAF in the Alt4-ELT scenario because of low San Luis storage and 5 TAF in the NAA-ELT scenario. Low San Luis storage causes Article 56 shortages in 27% of simulated years in the Alt4-ELT scenario as compared to 5% of simulated years in the NAA-ELT. Another consequence of low storage levels in SLR is a shift in water supply benefits from Article 21 to Table A.

In summary, the operational assumptions for SLR are unrealistic in Alternative 4 because they create problems in upstream storage reservoirs and create shortages for south of Delta water users that would not occur in the real world. In reaching this conclusion, the Reviewers met with operators from CVP and SWP to review the BDCP Model results and discussed real-time operations. The operators provided guidance in selection of superior assumptions, which results in more realistic operations in the independent model (see Section 4).

Delta Cross Channel operational assumptions overestimate October outflow

When south Delta exports are low due to regulatory limits, and upstream reservoirs are making releases to meet the instream flow objectives at Rio Vista, operators have the ability to close the Delta Cross Channel (DCC) in order to reduce the required reservoir releases (by closing the DCC a greater portion of water released from the reservoirs stays in the Sacramento River to meet the Rio Vista requirements). As long as the Delta salinity standards are met, operators have indicated that they would indeed close the DCC in this manner (as was done in October and November 2013). In the BDCP Model, the DCC is not closed in this manner. The net result is that the BDCP Model overestimates outflow under such circumstances typically occurring in October.

The overestimated outflow leads to incorrect conclusions regarding the effects of BDCP. For instance, an actual increase in fall outflow could be beneficial for the endangered fish species delta smelt (USFWS, 2008). Therefore, by overestimating outflow in October, the BDCP studies likely overestimate the benefit to delta smelt (Mount

et al, 2013). Similarly, an actual increase in fall outflow would reduce salinity in the western Delta, which could be beneficial for in-Delta diverters; therefore, overestimating outflow in October artificially reduces salinity, incorrectly reducing the net impacts on in-Delta diverters.

Conclusions Regarding Assumptions and Operations in coordination with new BDCP facilities

BDCP’s “High Outflow Scenario” is not sufficiently defined for analysis.

The HOS requires additional water (Delta outflow) during certain periods in the spring. The BDCP Model places most of the responsibility for meeting this new additional outflow requirement on the SWP. However, the SWP may not actually be responsible for meeting this new additional outflow requirement. This is because the COA, as it is currently being implemented, would require a water allocation adjustment that would keep the SWP whole. Where one project (CVP or SWP) releases water to meet a regulatory requirement, the COA requires a water balancing to ensure the burden does not fall inappropriately among the projects. The BDCP Model is misleading because it fails to adjust project operations, as required by the COA, to “pay back” the water “debt” to the SWP due to these additional Delta outflow requirements. Unless there is a significant revision to COA, the BDCP Model overstates the impacts of increased Delta outflow on the SWP and understates the effects on the CVP.

Furthermore, after consulting with DWR and Reclamation project operators and managers, the Reviewers conclude that there is no apparent source of CVP or SWP water to satisfy both the increased Delta outflow requirements and pay back the COA “debt” to the SWP without substantially depleting upstream water storage. It appears, through recent public discussions regarding the HOS, that BDCP anticipates additional water to satisfy the increased Delta outflow requirement and to prevent the depletion of cold water pools will be acquired through water transfers from upstream water users. However, this approach is unrealistic because during most of the spring, when BDCP proposes that Delta outflow be increased, agricultural water users are not typically irrigating. This means that there is not sufficient transfer water available to meet the increased Delta outflow requirements without releasing stored water from the reservoirs. Releasing stored water to meet the increased Delta outflow requirements could potentially impact salmonids on the Sacramento and American River systems.

Simulated operation of BDCP’s dual conveyance, coordinating proposed North Delta diversion facilities with existing south Delta diversion facilities, is inconsistent with the project description.

The Draft BDCP and associated Draft EIR/EIS specify criteria for how much flow can be diverted by the new NDD facilities and specify when to preferentially use either the NDD facilities or the existing SDD facilities. However, the BDCP Model contains an artificial constraint that prevents the NDD facilities from taking water as described in the BDCP project description. In addition to affecting diversions from the NDD, this artificial constraint contains errors that affect the NAA operation. This error has been fixed by DWR and Reclamation in more recent versions of the model; however, the error remains in the BDCP Model. Additionally, the BDCP Model does not reflect the Summer operations of the SDD that are described in the Draft EIR/EIS as a feature of the BDCP project intended to prevent water quality degradation in the south Delta. The net effect of these two errors is that the BDCP Model significantly underestimates the amount of water diverted from the NDD facilities and overestimates the amount of water diverted from the SDD.

BDCP Model contains numerous coding and data issues that skew the analysis and conflict with actual real-time operational objectives and constraints

Operational logic is coded into the CalSim II model to simulate how DWR and Reclamation would operate the system under circumstances for which there are no regulatory or other definitive rules. This attempt to specify (i.e., code) the logic sequence and relative weighting so that a computer can simulate “expert judgment” of the

human operators is a critical element to the CalSim II model. In the BDCP Model, some of the operational criteria for water supply allocations and existing facilities such as the Delta Cross Channel and SLR are inconsistent with real-world conditions.

4 INDEPENDENT MODELING

The Independent Modeling effort originally stemmed from reviews of BDCP Model during which the Reviewers discovered that the BDCP Model did not provide adequate information to determine the effects of the BDCP. There are three basic reasons why the Reviewers cannot assess how the BDCP will affect water operations: 1) NAAs do not depict reasonable operations under the described climate change assumptions, 2) operating criteria used in the BDCP Alternative 4 result in unrealistic operations, and 3) updates to CalSim II since the BDCP modeling was performed almost 4 years ago will likely alter model results to a sufficient degree that conclusions based on the BDCP modeling will likely be different than those disclosed in the Draft EIR/EIS. Given that it is not possible to determine how BDCP may affect CVP and SWP operations or water system flows and conditions with the BDCP model, Independent Modeling was performed to assess potential effects due to the BDCP.

To revise the models, the Reviewers consulted with operators at DWR and Reclamation to improve the representation of operational assumptions. Additionally, the Reviewers consulted with modelers at DWR and Reclamation to share findings, to strategize on the proper way to incorporate the guidance received from the operators, and to present revised models to DWR and Reclamation for their review. This collaborative and iterative process differed considerably from a standard consulting contract where the work product is not shared beyond the client-consultant until a final version is complete. To the contrary, consultations with agency experts were conducted early and repeatedly to ensure the revisions would reflect reasonable operations and to provide an independent review.

The first phase of this Independent Modeling effort (described in Section 4.1) was development of an updated without project baseline (similar to the NAA but with current, improved assumptions). The Independent Modeling does not incorporate climate change because the climate change hydrological assumptions developed by BDCP cause unrealistic operation of the system absent commensurate changes to operating criteria.

After the baseline was complete and reviewed, the second phase of this effort (described in Section 4.2) incorporated the facilities and operations for the BDCP described as Alternative 4 H3 in the Draft EIR/EIS, and otherwise known as the Evaluated Starting Operations (ESO) scenarios in the BDCP. During this phase, the issues that were identified during the Reviewers' initial review were corrected (see Section 3.3) along with corrections made to resolve additional issues that were revealed as improvements were incorporated. Finally, results of the Independent Modeling and potential effects of the BDCP on water supply and instream flows are discussed in Section 4.3.

4.1 Improvements to CalSim II Assumptions

For this effort, the most up to date modeling tools were provided by DWR and Reclamation and further improvements were added to the CalSim II assumptions in coordination with DWR and Reclamation staff. Many of the improvements have since been incorporated into DWR and Reclamation's model and others are under review.

Revisions incorporated by DWR and Reclamation for the 2013 baseline

DWR and Reclamation provided CalSim II models used for the 2013 SWP Delivery Reliability Report (DRR) for use in this Independent Modeling effort. The 2013 SWP DRR, Technical Addendum, and associated models are now available on DWR's website⁹. Assumptions used for this Independent Modeling effort are consistent with the 2013 SWP DRR and are listed in Table 4 of the Technical Addendum.

⁹ <http://baydeltaoffice.water.ca.gov/swpreliability/>

CalSim II is continuously being improved to better represent CVP and SWP operations and fix known problems. The Technical Addendum to the 2013 SWP DRR contains a list of updates and fixes that have occurred since the last SWP DRR was released in 2011. Among these changes and fixes are key items that directly affect operation of facilities proposed in the BDCP Alternative 4; these items are listed on pages 4-6 of the 2013 SWP DRR Technical Addendum.

A key component of this package of modeling revisions was fixing an error regarding artificial minimum instream flow requirements in the Sacramento River at Hood. An “artificial” minimum instream flow requirement had been specified; the requirement is artificial in that it does not represent a regulatory requirement, but rather is a modeling technique.

Additional Revisions to CalSim II Assumptions

As part of the Independent Modeling effort, a number of changes were made to the 2013 SWP DRR version of CalSim II to better represent the existing facilities, regulatory requirements, and water user demands. These revisions are described in the Technical Appendix and summarized here:

- San Joaquin River Restoration Program (SJRRP) was not incorporated. This modification was made to be consistent with the BDCP assumptions, but also allows the identification of the separate effect of the BDCP void of the combined effect with SJRRP flows. Although inclusion of the SJRRP is necessary in the documentation of BDCP, the Independent Modeling did not include it.
- VAMP operations were not incorporated because the VAMP program has expired and is no longer being implemented.
- Tuolumne River basin was updated.
- Folsom Reservoir operations for flood control were updated.
- Additional water demands on the Feather River were incorporated to represent existing agricultural diversions used for rice decomposition.
- Diversions by East Bay Municipal Utility District (EBMUD) from the Sacramento River at Freeport were modified to better represent the EBMUD CVP water service contract.
- Minimum flow requirements for Wilkins Slough and Red Bluff were corrected for September 1933.
- CVP M&I demands are updated to reflect current assumptions used by Reclamation.
- Modifications were made to more accurately reflect refilling of New Bullards Bar Reservoir in coordination with transfers made under the Yuba Accord.
- Los Vaqueros Reservoir capacity was updated to reflect a recent expansion of the reservoir that was completed in 2012.

4.2 Improvements to BDCP Operations

After the baseline was completed and reviewed (as summarized above in Section 4.1), the facilities and operations associated with BDCP Alternative 4 H3 in the Draft EIR/EIS, otherwise known as the Evaluated Starting Operations (ESO) scenarios in the Draft Plan, were incorporated into the model. During this phase, the issues that were identified during the Reviewers’ initial review (see Section 3.3) were corrected along with correcting additional issues that were revealed as improvements were incorporated. These revisions are described in the Technical Appendix and summarized here:

- San Luis Reservoir operation
- Delta Cross Channel gate operation in October
- Delivery allocation adjustment for CVP SOD contractors

- Folsom/Shasta balance
- North Delta Diversion bypass criteria
- Wilkins Slough minimum flow requirement

In the Independent Modeling, San Luis rule-curve logic was refined for both SWP and CVP operations. San Luis rule-curve is used to maintain an appropriate balance between San Luis Reservoir (SLR) storage and North of Delta reservoirs. The key considerations in formulating rule-curve are 1) ensuring that sufficient water is available in SLR to meet contract allocations when exports alone are insufficient due to various operational constraints and 2) minimize SLR carryover storage to low point criteria (both CVP and SWP) and Article 56 carryover (only SWP). The basic premise is to maintain SLR storage no higher than necessary to satisfy south of Delta obligations to avoid excessive drawdown of upstream storage.

In the BDCP NAA and the Independent Modeling FNA, the model has a priority to release excess stored water that will likely be released for flood control purposes from Shasta and Folsom storage for export at Jones Pumping Plant to storage in SLR in the late summer and early fall months. The purpose was to get a head start on filling SLR for the coming water year if there is a high likelihood of Shasta or Folsom spilling. This was an assumed CVP/SWP adaptation to the export reductions in the winter and spring months due to the salmon and smelt biological opinions. However, with the NDD facility in Alt 4, winter and spring export restrictions impact CVP exports much less and there is no longer a reason to impose this risk on upstream storage. As such, the weights, or prioritizations, of storage in Shasta and Folsom were raised so that excess water would not be released specifically to increase CVP San Luis storage Reservoir above rule-curve. This was changed in Alt 4 and not the FNA to better reflect how the system may operate under these different conditions.

The BDCP Alt 4 results in significantly more October surplus Delta outflow as compared to the baseline. The cause of this Delta surplus at a time when the Delta is frequently in balance is a combination of proposed through-Delta export constraints (Old and Middle River (OMR) flow criteria and no through-Delta exports during the San Joaquin River October pulse period), Rio Vista flow requirements, and DCC gate operations. In DWR's BDCP studies, it was assumed that the DCC gates would be open for the entire month of October thereby requiring much higher Sacramento River flows at Hood in order to meet the Rio Vista flow requirement than if the DCC gates were closed. Whereas in the Independent Modeling of the BDCP it was assumed that the DCC gates were closed for a number of days during the month such that the 7,000 cfs NDD bypass criteria would be sufficient to meet the weekly average Rio Vista flow requirements. The intent was to minimize surplus Delta outflow while meeting Delta salinity standards and maintaining enough bypass flow to use the NDD facility for SDD. This is an approximation of what is likely to occur in real-time operations under similar circumstances. Further gate closures may be possible as salinity standards allow if operators decide to preserve upstream storage at the expense of NDD diversions. This type of operation would require additional model refinements.

CVP SOD Ag service and M&I allocations are limited by both system wide water supply (storage plus inflow forecasts) and Delta export constraints; whereas similar CVP NOD allocations are dependent solely on water supply. This frequently results in SOD water service contractors receiving a lower contract year allocation than NOD water service contractors, especially under the Biological Opinion export restrictions. However, with the NDD facility operations as proposed under Alt 4 H3, the CVP can largely bypass these Delta export restrictions and the export capacity constraint on CVP SOD allocations was determined to be overly conservative. Therefore, the export capacity component of CVP SOD allocations was removed in the BDCP Alternative and both SOD and NOD CVP allocations are equal and based only on water supply.

For the Independent Modeling, CVP operations were refined in the BDCP Alternative to provide maximum water supply benefits to CVP contractors while protecting Trinity, Shasta, and Folsom carryover storage in the drier years. As a whole, this was accomplished with refinements to allocation logic and San Luis rule-curve. However, in the initial study runs, an imbalance between Folsom and Shasta was created; while there was a total positive

impact to upstream storage in dry years, there was a negative impact to Folsom storage. This was resolved by inserting Folsom protections in the Shasta-Folsom balancing logic. With these protections, the positive carryover impacts were distributed to Trinity, Shasta, and Folsom.

The daily disaggregation method for implementing NDD bypass criteria as implemented in DWR's BDCP model was left mostly intact for the Independent Modeling. However, to properly fit the bypass criteria implementation within the latest CalSim operations formulation certain modifications were made. Modifications are as follows:

1. No NDD operations occur in cycles 6 through 9 so that Delta operations and constraints can be fully assessed without NDD interference.
2. Cycles 10 and 11 (Daily 1 and Daily 2 respectively) were added to determine NDD operations given various operational constraints including the NDD bypass criteria.
3. From July to October, bypass criteria are based on monthly average operations (no daily disaggregation). Given the controlled reservoir releases at this time and the constant bypass criteria (5,000 cfs from July to September and 7,000 cfs in October), this was determined to be a reasonable assumption. This also simplified coordination of DCC gate operations with NDD in October which will be discussed later.
4. When warranted by conditions in cycle Daily 1 (cycle 10), the bypass criteria in May and June were allowed to be modeled on a monthly average basis in cycle Daily 2 (cycle 11). This allowed a reduction in the number of cycles necessary to determine the fully allowed diversion under the bypass criteria when the Delta was in balance and additional upstream releases were made to support diversions from the North Delta.

Currently in CalSim II, relaxation of the Wilkins Slough minimum flow requirement is tied to CVP NOD Ag Service Contractor allocations. This does not reflect actual operations criteria where relaxation of the flow requirement is dependent solely on storage conditions at Shasta. From the comparative analysis perspective of our CalSim planning studies, this introduces a potential problem: changes in CVP NOD Ag Service allocations can result in unrealistic changes in required flow at Wilkins Slough, and such changes in Wilkins Slough required flow can result in unrealistic impacts to Shasta storage. To bypass this problem, we assumed that the required flow at Wilkins Slough in the alternative was equal to the baseline.

4.3 Independent Modeling output and analysis of BDCP Effects

Analysis for this effort was focused on BDCP Alt 4 with existing spring and Fall X2 requirements, which corresponds to "Alternative 4 H3" in the Decisions Tree. This modeling is performed without climate change, and includes refined operating criteria for the NDD, CVP and SWP reservoirs, DCC gate closures, and water supply allocations. This modeling includes all Project features that are included in Alt 4 in the BDCP Model. The key Project features incorporated into BDCP are displayed in Figure 1 and summarized as:

- North Delta Diversion capacity of 9,000 cfs
- NDD bypass flow requirements
- 25,000 acres of additional tidal habitat
- Notched Fremont Weir to allow more flow into Yolo Bypass
- Additional positive Old and Middle River flow requirements
- Removal of the San Joaquin River I/E ratio (NMFS 2009)
- Changed location for Emmaton water quality standard in SWRCB D-1641
- Additional Sacramento River flow requirement at Rio Vista

Sacramento San Joaquin Delta

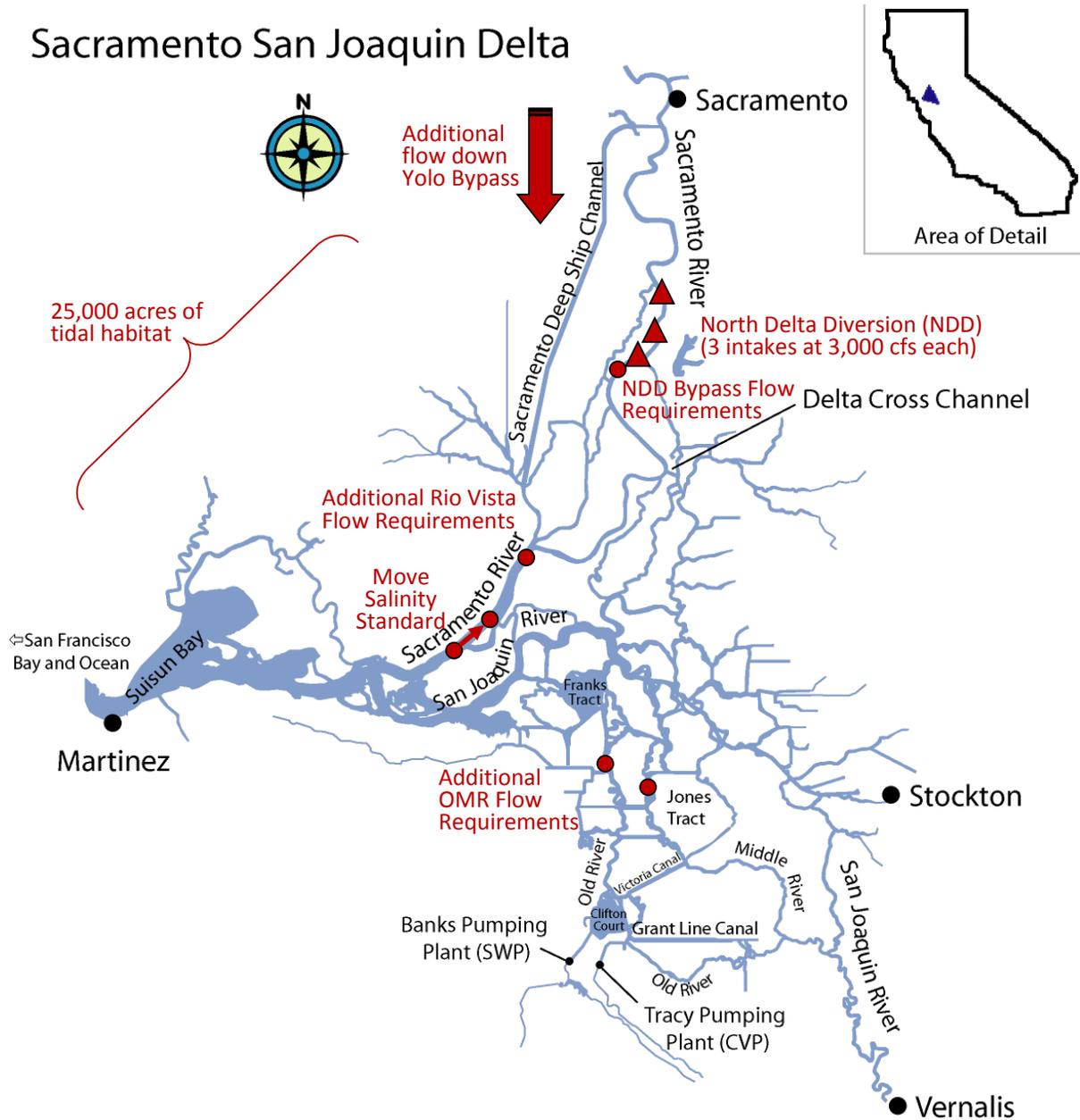


Figure 1. Map of Delta with location of key BDCP facilities and regulatory changes

Annual maximum and minimum storage in San Luis for the (a) CVP and (b) SWP under ELT conditions for the no action alternative (NAA_ELT) and BDCP Alternative 4 H3 (Alt4_ELT).

For the purpose of describing results of the Independent Modeling, the revised baseline scenario without climate change, originally termed No Action Alternative (NAA) in the BDCP Draft EIR/EIS, is referred to as the Future No Action (FNA) in this discussion. Additionally, in the Independent Modeling, Alternative 4 operational scenario H3 without climate change is simply referred to as “Alt 4”. The results for the Independent Modeling are illustrated in the Technical Attachment. Key results are presented below.

The change in conditions between FNA and Alt 4 is indicative of the effects of the BDCP on water supply and Delta flows. An effect of the BDCP is an anticipated increase in Delta export and corresponding decrease in Delta Outflow. Table 2 illustrates the estimated change in Delta Outflow by year type, amounting to an average annual 0.76 MAF. Table 3 illustrates the corresponding change in exports by year type, and also illustrates the estimated change in geographical source of export water. With the BDCP it is anticipated that exports from the South Delta (via through Delta conveyance) will decrease by 2.53 MAF. Exports derived from the North Delta (via the tunnels) will amount to 3.28 MAF.

Table 2. Change in Delta outflow due to the BDCP (Alt 4 minus FNA) (Million Acre-Feet)

Reduction in the quantity of water that leaves the Delta by flowing west into San Francisco Bay by water year type.

Water Year Type	FNA Delta Outflow	Change in Delta Outflow
Wet	28.6	-1.2
Above Normal	17.1	-1.0
Below Normal	9.9	-0.68
Dry	7.3	-0.39
Critical	5.1	-0.13
Average	15.6	-0.76

Table 3. Change in quantity of water exported due to the BDCP (Alt 4 minus FNA) (Million Acre-Feet)

Reduction in the quantity of water exported from the existing South Delta export facilities and corresponding increase in the quantity exported from the proposed facilities in the North Delta, by water year type.

Water year Type	FNA Total Delta Export	Change in South Delta Exports (through Delta)	Change in North Delta Exports (through tunnels)	Change in Total Exports
Wet	6.0	-3.8	5.0	1.2
Above Normal	5.2	-2.9	4.4	1.5
Below Normal	5.1	-2.4	3.2	0.8
Dry	4.2	-1.8	1.8	0.07
Critical	2.8	-0.7	0.7	0.02
Average	4.9	-2.53	3.28	0.75

Table 4. Change in quantity of CVP water exported by SWP facilities (Alt 4 minus FNA) (Thousand Acre-Feet)

Quantity of water exported at Banks Pumping Plant for later use by CVP contractors is increased in all water year types except the driest years (critical designation).

Water Year Type	FNA CVP water exported by SWP	Change in CVP water exported by SWP
Wet	58	229
Above Normal	44	208
Below Normal	66	117
Dry	86	7
Critical	38	-9
Average	60	123

The Independent Modeling shows that implementation of the BDCP could shift a portion of the SWP exports from summer to winter and spring because the proposed NDD facilities can export water at times when the existing SDD facilities are constrained due to fishery concerns. As a result of this shift in timing, capacity is available at the SWP facilities during the summer months. The BDCP Model assumes that CVP could utilize the SWP facilities (Table 4) at any time when the CVP facilities are fully utilized; this sharing of diversion facilities is termed “joint point of diversion” or JPOD. Additional criteria to meet specific water quality and water level objectives are defined in response plans required by the State Water Board’s water right decision D-1641. BDCP Model assumes that these additional criteria are met; the Independent Modeling continues this assumption without making any judgment as to whether the criteria would be met. An evaluation of this would require additional hydrodynamic modeling.

The Independent Modeling shows higher average annual CVP carryover (end of September) storage than the NAA by about 28 TAF. During dryer years when upstream storage is lower there is an increase in carryover and during wetter years when storage is higher there are storage decreases (Table 5). Upstream SWP storage, Table 6, behaves in a similar manner as CVP storage, there are decreases in wetter years and increased in dryer years.

CVP San Luis Reservoir fills in about 40% of years in Alt 4 compared to about 20% in the FNA. CVP San Luis reaches dead pool in about 25% of years in both the FNA and Alt 4. SWP San Luis Reservoir fills in about 43% of years in Alt 4 compared to about 18% in the FNA. SWP San Luis reaches dead pool in about 25% of years in Alt 4 and about 30% of years in the FNA.

Table 5. Change in CVP upstream carryover storage (Alt 4 minus FNA) (Thousand Acre-Feet)

CVP carryover (end of September) storage decreases in wetter years when FNA storage is highest and increases in dryer years when FNA storage is lowest

Water Year Type	FNA CVP Upstream Storage	Change in CVP Upstream Storage
Wet	5578	-8
Above Normal	5200	-150
Below Normal	4717	-1
Dry	4049	66
Critical	2285	258
Average	4558	28

Table 6. Change in SWP upstream carryover storage (Alt 4 minus FNA) (Thousand Acre-Feet)

SWP carryover (end of September) storage decreases in wetter years when FNA storage is highest and increases in dryer years when FNA storage is lowest

Water Year Type	FNA SWP Upstream Storage	Change in SWP Upstream Storage
Wet	2407	33
Above Normal	1934	-150
Below Normal	1517	14
Dry	1194	157
Critical	968	127
Average	1709	44

5 COMPARING INDEPENDENT MODELING AND BDCP MODEL

The Independent Modeling effort originally stemmed from reviews of DWR's BDCP Model where the Reviewers through their independent analysis found that BDCP Model does not provide adequate information to determine how BDCP may affect the system. Based on the premise that the Independent Modeling portrays a more accurate characterization of how the CVP/SWP system may operate under Alt 4, this comparison is meant to demonstrate the differences between results of a more accurate and realistic analysis and the BDCP Model. Differences in results between these modeling efforts are believed to provide insight regarding how effects that BDCP will have on the actual CVP/SWP system differ from modeling used to support the Draft EIR/S.

Although thorough comparisons of modeling were performed, only key differences are illustrated for the purpose of this comparison.

Conclusions regarding BDCP effects

Based on the Independent Modeling, the amount of water exported (diverted from the Delta) may be approximately 200 thousand acre-feet (TAF) per year higher than the amount disclosed in the Draft EIR/S. This total represents

- approximately 40 TAF/yr more water diverted and delivered to the SWP south of Delta contractors, and
- approximately 160 TAF/yr more water diverted and delivered to the CVP south of Delta contractors.

The BDCP Model estimates that, under the NAA ELT (without the BDCP), total average annual exports for CVP and SWP combined are estimated to be 4.73 million acre feet (MAF) and in the Independent Modeling FNA combined exports are 5.61 MAF. The BDCP Model indicates an increase in exports of approximately 540 TAF and the Independent Modeling shows an increase of approximately 750 TAF in Alt 4.

The Independent Modeling suggests that Delta outflow would decrease by approximately 200 TAF/yr compared to the amount indicated in the Draft EIR/S.

- This lesser amount of Delta outflow has the potential to cause greater water quality and supply impacts for in-Delta beneficial uses and additional adverse effects on species. To determine the potential effects of the reduced amount of outflow, additional modeling is needed using tools such as DSM2.

The BDCP Model does not accurately reflect the location of the diversions that the SWP and CVP will make from the Delta.

- When the errors in the model are corrected, it reveals that the North Delta intakes could divert approximately 680 TAF/yr more than what was disclosed in the BDCP Draft EIR/S, and
- the amount of water diverted at the existing South Delta facilities would be approximately 460 TAF/yr less than what is projected in the BDCP Draft EIR/S.

Hydrologic modeling of BDCP alternatives using CalSim II has not been refined enough to understand how BDCP may affect CVP and SWP operations and changes in Delta flow dynamics. Better defined operating criteria for project alternatives is needed along with adequate modeling rules to analyze how BDCP may affect water operations. Without a clear understanding of how BDCP may change operations, effects analysis based on this modeling may not produce reliable results and should be revised as improved modeling is developed.

6 GLOSSARY

acre-foot The volume of water (about 325,900 gallons) that would cover an area of 1 acre to a depth of 1 foot. This is enough water to meet the annual needs of one to two households.

agricultural water supplier As defined by the California Water Code, a public or private supplier that provides water to 2,000 or more irrigated acres per year for agricultural purposes or serves 2,000 or more acres of agricultural land. This can be a water district that directly supplies water to farmers or a contractor that sells water to the water district.

annual Delta exports The total amount of water transferred (“exported”) to areas south of the Delta through the Harvey O. Banks Pumping Plant (SWP) and the C. W. “Bill” Jones Pumping Plant (CVP) in 1 year.

appropriative water rights Rights allowing a user to divert surface water for beneficial use. The user must first have obtained a permit from the State Water Resources Control Board, unless the appropriative water right predates 1914.

Article 21 water Water that a contractor can receive in addition to its allocated Table A water. This water is only available if several conditions are met: (1) excess water is flowing through the Delta; (2) the contractor can use the surplus water or store it in the contractor’s own system; and (3) delivering this water will not interfere with Table A allocations, other SWP deliveries, or SWP operations.

biological opinion A determination by the U.S. Fish and Wildlife Service or National Marine Fisheries Service on whether a proposed federal action is likely to jeopardize the continued existence of a threatened or endangered species or result in the destruction or adverse modification of designated “critical habitat.” If jeopardy is determined, certain actions are required to be taken to protect the species of concern.

CalSim-II A computer model, jointly developed by DWR and the U.S. Bureau of Reclamation, that simulates existing and future operations of the SWP and CVP. The hydrology used by this model was developed by adjusting the historical flow record (1922–2003) to account for the influence of changes in land uses and regulation of upstream flows.

Central Valley Project (CVP) Operated by the U.S. Bureau of Reclamation, the CVP is a water storage and delivery system consisting of 20 dams and reservoirs (including Shasta, Folsom, and New Melones Reservoirs), 11 power plants, and 500 miles of major canals. CVP facilities reach some 400 miles from Redding to Bakersfield and deliver about 7 million acre-feet of water for agricultural, urban, and wildlife use.

cubic feet per second (cfs) A measure of the rate at which a river or stream is flowing. The flow is 1 cfs if a cubic foot (about 7.48 gallons) of water passes a specific point in 1 second. A flow of 1 cubic foot per second for a day is approximately 2 acre-feet.

Delta exports Water transferred (“exported”) to areas south of the Delta through the Harvey O. Banks Pumping Plant (SWP) and the C. W. “Bill” Jones Pumping Plant (CVP).

Delta inflow The combined total of water flowing into the Delta from the Sacramento River, San Joaquin River, and other rivers and waterways.

exceedence plot For the SWP, a curve showing SWP delivery probability (especially for Table A water)—specifically, the likelihood that SWP Contractors will receive a certain volume of water under current or future conditions.

incidental take permit A permit issued by the U.S. Fish and Wildlife Service or National Marine Fisheries Service, under Section 10 of the federal Endangered Species Act, to private nonfederal entities undertaking otherwise lawful projects that might result in the “take” of an endangered or threatened species. In California, an additional permit is required and take may be authorized under Section 2081 of the California Fish and Game Code through issuance of either an incidental take permit or a consistency determination. The California Department of Fish and Wildlife is authorized to accept a federal biological opinion as the take authorization for a State-listed species when a species is listed under both the federal and California Endangered Species Acts.

riparian water rights Water rights that apply to lands traversed by or adjacent to a natural watercourse. No permit is required to use this water, which must be used on riparian land and cannot be stored for later use. Riparian rights attach only to the “natural” flow in the water course and do not apply to abandoned flows or stored water releases.

State Water Project (SWP) Operated by DWR, a water storage and delivery system of 33 storage facilities, about 700 miles of open canals and pipelines, four pumping-generating plants, five hydroelectric power plants, and 20 pumping plants that extends for more than 600 miles in California. Its main purpose is to store and distribute water to 29 urban and agricultural water suppliers in Northern California, the San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and Southern California. The SWP provides supplemental water to 25 million Californians (almost two-thirds of California’s population) and about 750,000 acres of irrigated farmland. Water deliveries have ranged from 1.4 million acre-feet in a dry year to more than 4.0 million acre-feet in a wet year.

SWP Contractors Twenty-nine entities that receive water for agricultural or municipal and industrial uses through the SWP. Each contractor has executed a long-term water supply contract with DWR. Also sometimes referred to as “State Water Contractors.”

Table A water (Table A amounts) The maximum amount of SWP water that the State agreed to make available to an SWP Contractor for delivery during the year. Table A amounts determine the maximum water a contractor may request each year from DWR. The State and SWP Contractors also use Table A amounts to serve as a basis for allocation of some SWP costs among the contractors.

urban water supplier As defined by the California Water Code, a public or private supplier that provides water for municipal use directly or indirectly to more than 3,000 customers or supplies more than 3,000 acre-feet of water in a year. This can be a water district that provides the water to local residents for use at home or work, or a contractor that distributes or sells water to that water district.

Water Rights Decision 1641 (D-1641) A regulatory decision issued by the State Water Resources Control Board in 1999 (updated in 2000) to implement the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta. D-1641 assigned primary responsibility for meeting many of the Delta’s water quality objectives to the SWP and CVP, thus placing certain limits on SWP and CVP operations.

water year In reports on surface water supply, the period extending from October 1 through September 30 of the following calendar year. The water year refers to the September year. For example, October 1, 2010, through September 30, 2011 is the 2011 water year.

Review of Bay Delta Conservation Program Modeling

by MBK Engineers and Daniel B. Steiner, Consulting Engineer

Technical Appendix

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1 INTRODUCTION

Since December 2012, MBK Engineers and Dan Steiner (collectively “Reviewers”) have assisted various parties in evaluating the operations modeling that was performed for the Bay Delta Conservation Plan (BDCP). To assist in understanding BDCP and the potential implications, stakeholders¹ requested that the Reviewers review the CalSim II modeling studies performed as part of the BDCP (hereafter “BDCP Studies” or “BDCP Model”).

An initial review led the Reviewers to conclude that the BDCP Model, which serves as the basis for the environmental analysis contained in the BDCP Environmental Impact Report/Statement (EIR/S), provides very limited useful information to understand the effects of the BDCP. The BDCP Model contains erroneous assumptions, errors, and outdated tools, which result in impractical or unrealistic Central Valley Project (CVP) and State Water Project (SWP) operations. The unrealistic operations, in turn, do not accurately depict the effects of the BDCP.

The Reviewers revised the BDCP Model to depict a more accurate, consistent version of current and future benchmark hydrology so that the effects of the BDCP could be ascertained. The BDCP Model was also revised to depict more realistic CVP and SWP operations upon which to contrast the various BDCP alternatives. The Reviewers made significant efforts to coordinate with and inform the U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR) managers and modelers, and CVP and SWP operators of the Reviewers’ modifications, assumptions, and findings. Where appropriate, the Reviewers also used Reclamation and DWR’s guidance and direction to refine the Reviewers’ analysis.

This technical appendix summarizes: (1) the independent review of the CalSim II modeling publicly released for the BDCP’s Draft Environmental Impact Report/Statement (EIRS), (2) the corrections and revisions made to the assumptions in the CalSim II model, and (3) comparisons between the BDCP and independent modeling results. The detailed information in this appendix is summarized in our main report.

¹ The entities who funded this report are Contra Costa Water District, East Bay Municipal Utility District, Friant Water Authority, Northern California Water Association, North Delta Water Agency, San Joaquin River Exchange Contractors Water Authority, San Joaquin Tributaries Authority, and Tehama Colusa Canal Authority.

2 REVIEW OF BDCP CALSIM II MODELING

2.1 Climate Change

Implementation of Climate Change

The analysis presented in the BDCP Documents attempts to incorporate the effects of climate change at two future climate periods: the early long term (ELT) at approximately the year 2025; and the late long term (LLT) at approximately 2060. As described in the BDCP documents², other analytical tools were used to determine anticipated changes to precipitation and air temperature that is expected to occur under ELT and LLT conditions. Projected precipitation and temperature was then used to determine how much water is expected to flow into the upstream reservoirs and downstream accretions/depletions over an 82-year period of variable hydrology; these time series were then used as inputs into the CalSim II operations model. A second aspect of climate change, the anticipated amount of sea level rise, is incorporated into the CalSim II model by modifying a subroutine that determines salinity within the Delta based on flows within Delta channels. The effects of sea level rise will manifest as a need for additional outflow when water quality is controlling operations to prevent seawater intrusion.

This report does not review the analytical processes by which reservoir inflows and runoff were developed, nor does it evaluate the modified flow-salinity relationships that are assumed due to sea level rise; those items could be the focus of another independent review. This review is limited to evaluating how the modified flows were incorporated into CalSim II and whether the operation of the CVP and SWP water system in response to the modified flows and the modified flow-salinity relationship is reasonable for the ELT and LLT conditions. This work reviews the assumed underlying hydrology and simulated operation of the CVP/SWP, assumed regulatory requirements, and the resultant water delivery reliability.

CalSim II Assumptions

To assess climate change, the three without Project (or “baseline” or “no action”) modeling scenarios were reviewed: No Action Alternative (NAA)³, No Action Alternative at the Early Long Term (NAA – ELT), and No Action Alternative at the Late Long Term (NAA –LLT). Assumptions for NAA, NAA-ELT, and NAA-LLT are provided in the Draft EIR⁴. The only difference between these scenarios is the climate-related changes made for the ELT and LLT conditions (Table 1).

Table 1. Scenarios used to evaluate climate change

Scenario	Climate Change Assumptions	
	Hydrology	Sea Level Rise
No Action Alternative (NAA)	None	None
No Action Alternative at Early Long Term (NAA-ELT)	Modified reservoir inflows and runoff for expected conditions at 2025	15 cm
No Action Alternative at Early Long Term (NAA-LLT)	Modified reservoir inflows and runoff for expected conditions at 2060	45 cm

² BDCP EIR/EIS Appendix 5A, Section A and BDCP HCP/NCCP Appendix 5.A.2

³ NAA is also called the Existing Biological Conditions number 2 (EBC-2) in the Draft Plan.

⁴ BDCP EIR/EIS Appendix 5A, Section B, Table B-8

The differences between the NAA and NAA-ELT reveal the effects of the climate change assumptions under ELT conditions; similarly, the differences between the NAA and NAA-LLT reveal the effects of the climate change assumptions under LLT conditions.

Regulatory requirements

Each of the no action alternatives assumes the same regulatory requirements, generally representing the existing regulatory environment at the time of study formulation (February 2009), including Stanislaus ROP NMFS BO (June 2009) Actions III.1.2 and III.1.3, Trinity Preferred EIS Alternative, NMFS 2004 Winter-run BO, NMFS BO (June 2009) Action I.2.1, SWRCB WR90-5, CVPIA (b)(2) flows, NMFS BO (June 2009) Action I.2.2, ARFM NMFS BO (June 2009) Action II.1, no SJRRP flow modeled, Vernalis SWRCB D1641 Vernalis flow and WQ and NMFS BO (June 2009) Action IV.2.1, Delta D1641 and NMFS Delta Actions including Fall X2 FWS BO (December 2008) Action 4, Export restrictions including NMFS BO (June 2009) Action IV.11.2v Phase II, OMR FWS BO (December 2008) Actions 1-3 and NMFS BO (June 2009) Action IV.2.3v.

The modeling protocols for the recent USFWS BO (2008) and NMFS BO (2009) have been cited as being cooperatively developed by Reclamation, NMFS, U.S. Fish and Wildlife Service (USF&WS), California Department of Fish and Wildlife (CDF&W), and DWR.

Each of the BDCP no action alternatives (NAA, NAA-ELT, and NAA-LLT) uses the same New Melones Reservoir and other San Joaquin River operations. At the time of these studies' formulation, the National Marine Fisheries Services (NMFS) Biological Opinion (BO) (June 2009) had been recently released. Also, the San Joaquin River Agreement (SJRA, including the Vernalis Adaptive Management Program [VAMP]) and its incorporation into D1641 for Vernalis flow requirements were either still in force or being discussed for extension. As a component of study assumptions, the protocols of the SJRA and an implementation of the NMFS BO for San Joaquin River operations (including New Melones Reservoir operations) is included in the studies. These protocols, in particular the inclusion of VAMP which has now expired, is not appropriate as an assumption within either the No Action or Alternative Scenarios. Although appropriate within the identification of actions, programs and protocols present at the time of the NOI/NOP, they are not representative of current or reasonably foreseeable operations. Also, modeling of the future operation of the Friant Division of the CVP assumes no San Joaquin River Restoration Program releases. While assuming no difference in the current and future operation of the Friant Division avoids another difference in existing and projected future hydrology of the San Joaquin River, the assumption does not recognize the existence of the San Joaquin River Restoration Program. Results of CVP and SWP operations, in particular as affected by export constraints dependent on San Joaquin River flows and their effect on OMR, E/I and I/E diversion constraints, would be different with a different set of assumptions for San Joaquin River operations.

Finally, the habitat restoration requirements in the 2008 FWS BO and the 2009 NMFS BO are not included in the No Action Alternative baselines. Although the restoration is required to be completed either with or without completion of the BDCP, the restoration was only analyzed as part of the with project scenarios.

Model Results

Inflow and Reservoir Storage in the Sacramento River Basin

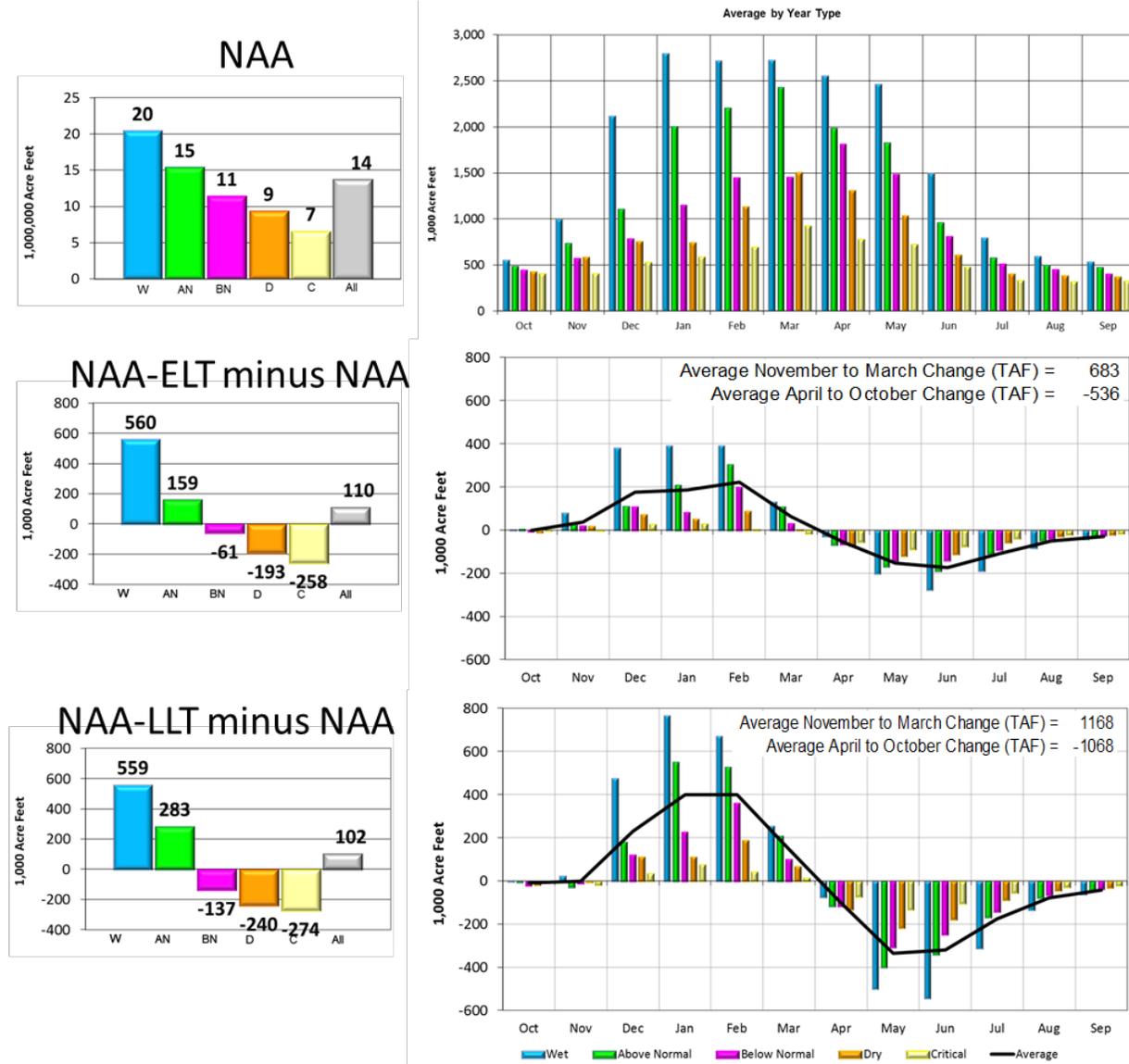
The significance of changed hydrology between the three without project baselines is illustrated in Figure 1 below. The figure illustrates the projected combined inflow of Trinity, Shasta, Oroville, and Folsom Reservoirs under the three NAA baselines. Numerous modeling projections for climate change have been developed, and in this BDCP group of Scenarios Trinity, Shasta, and Oroville inflow are projected to increase overall, but with a

significant shift from spring runoff to winter runoff and increases in wetter years with decreases in dryer years. Folsom Reservoir inflow is projected to remain about the same at the time of the NAA-ELT Scenario but decreases by the time of the NAA-LLT Scenario. The spring to winter shift in runoff is also projected for Folsom Reservoir inflow.

If climate change resulted in such drastic inflow changes, there is argument that certain underlying operating criteria such as instream flow requirements and flood control diagrams would require change in recognition of the changed hydrology. Regarding current environmental flow requirements carried into the NAA Scenarios, we question an assumed operation that continues to attempt to meet temperature targets when flow releases are unlikely to meet the target and thus a sustainable operation plan is not possible. For example, the CVP and SWP are unlikely to draw reservoirs to dead pool as often as the models depict. The NAA-ELT and NAA-LLT model Scenarios show project reservoirs going to dead pool in 10% of years; such operation would result in cutting upstream urban area deliveries below what is needed for public health and safety in 10% of years and would lead to water temperature conditions that would likely not achieve the assumed objectives. Again in short, the Scenarios that include climate change do not provide a reasonable underlying CVP/SWP operation with a changed hydrology from which to impose a Project upon to understand how BDCP Alternatives will affect the water system and water users.

In our opinion, the CalSim II depicted operations that incorporate climate change are not reasonably foreseeable and do not represent a likely future operation of the CVP/SWP. Although an argument is typically made that these study baselines will be used in a comparison analysis with Project Alternatives tiering from these baselines, we believe that the depicted operations do not represent credible CVP/SWP operations and we have no confidence in the results and they are inappropriate as the foundation of a Project Alternative. As such, although the modeling approach may provide a relative comparison between equal foundational operations, we are apprehensive to place much confidence in the computed differences shown between the NAA and Project Alternative Scenarios.

Figure 1. Projected Inflow to Trinity, Shasta, Oroville, and Folsom Reservoirs – NAA, NAA-ELT and NAA-LLT

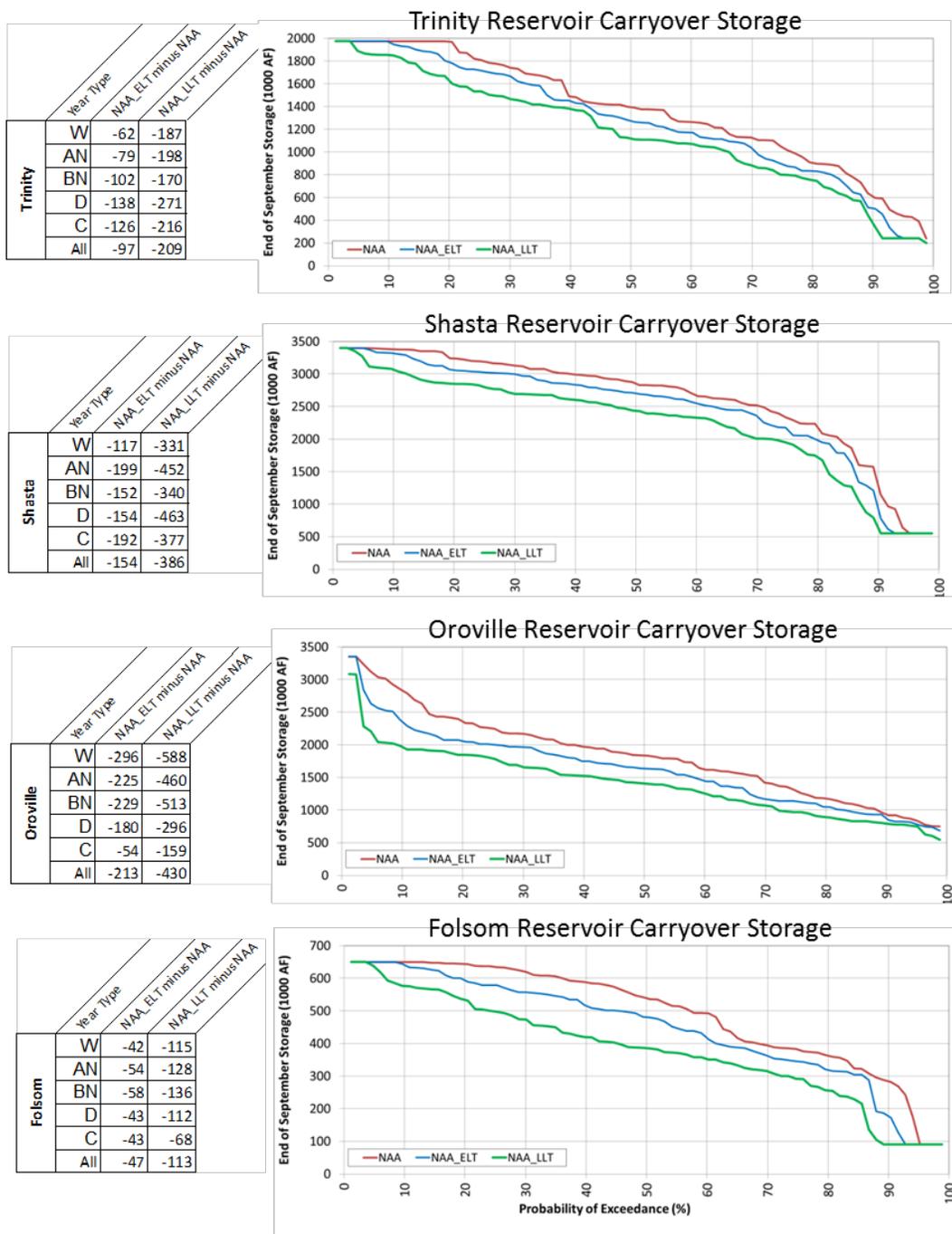


Carryover Storage in the Sacramento River Basin

For upstream CVP and SWP reservoirs the assumed shift of inflows due to climate change (Figure 1) along with a continuing need to satisfy exports demands significantly affects carryover storage. The CVP and SWP simply cannot satisfy water demands and regulatory criteria imposed on them in the NAA-ELT and NAA-LLT modeling scenarios.

Figure 2 illustrates the typical change in carryover storage as shown for Trinity, Shasta, Oroville, and Folsom Reservoirs. The relatively high frequency (approximately 10% of time) of minimum storage occurring at CVP reservoirs illustrates our questioning of credible operations in the studies.

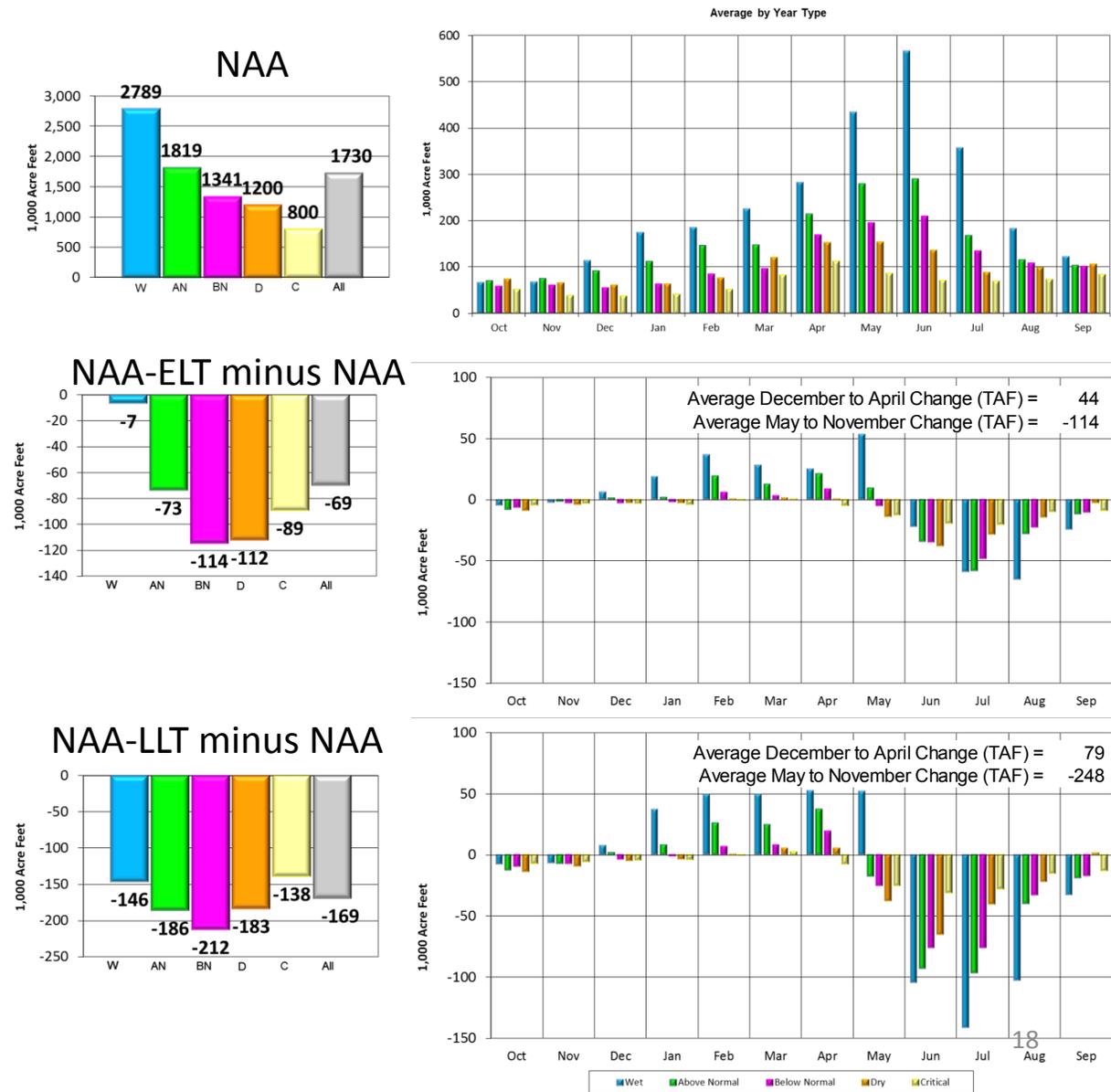
Figure 2. Projected Shasta Reservoir Carryover Storage, NAA, NAA-ELT and NAA-LLT



Inflow and Carryover Storage in the San Joaquin River Basin

San Joaquin Valley reservoirs are depicted with an overall decrease in annual runoff with some shifting of runoff from spring to winter, but mostly just decreases in spring runoff due to a decline in snowmelt runoff during late spring⁵. Figure 3 illustrates the assumed effects of climate change upon inflow to Millerton Lake.

Figure 3. Projected Inflow to Millerton Lake –NAA, NAA-ELT and NAA-LLT



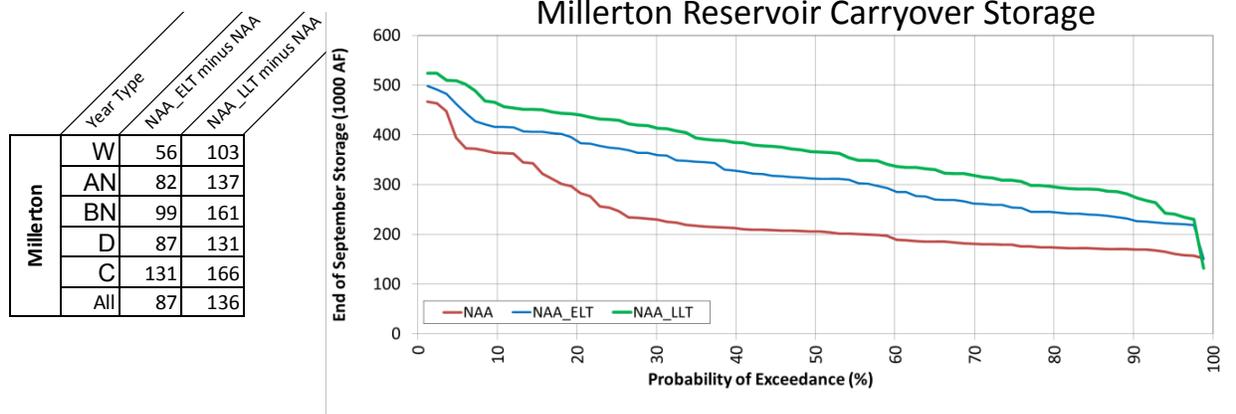
The hydrology differences imposed in the NAA Scenarios of the Friant Division are described above, and its appropriateness may be subject to additional debate and Alternative assumptions. However, our review found that implementation of Millerton Reservoir inflow as affected by climate change was improperly performed.

⁵ BDCP Appendix 5A.2

Inflow to Millerton Reservoir in this version of CalSim is input in three separate time series for purposes of depicting the hydrology of potential upper basin reservoirs. Climate change hydrology was inconsistently incorporated at Millerton Reservoir and misapplied to the water supply and flood control operations. The result is an unrealistic operation for river releases and canal diversions. Figure 3 illustrates the projected ELT and LLT changes in Millerton Reservoir inflow incorporated in these studies. On face value of the input data, regardless of Friant Dam river release assumptions the effect of climate change at Millerton Lake will affect water deliveries.

Evidence of the inconsistent inflow problem is shown in the result for the comparison of carryover storage of Millerton Reservoir under the NAA, NAA-ELT, and NAA-LLT Scenarios (Figure 4). Carryover storage is higher in the ELT and LLT Scenarios due to climate change effects to inflow incorporated in reservoir operations but not in the computation of water supply deliveries. Thus, water deliveries are suppressed and the reservoir ends the year with greater storage.

Figure 4. Millerton Reservoir Carryover Storage, NAA, NAA-ELT and NAA-LLT Scenarios



CVP Water Service Contractor’s water allocations are based on available CVP supplies, Figure 5 contains exceedance probability plots of deliveries and allocation percentages to these contractors. Table 2 contains average annual allocation to these CVP Water Service Contractors. Water supplies to these contractors decrease in the ELT and LLT relative to NAA Conditions.

Table 2. CVP Water Service Contractor Allocation Summary

	NAA	NAA-ELT	NAA-LLT
North of Delta Agricultural Service Contractors	61%	53%	46%
South of Delta Agricultural Service Contractors	48%	44%	39%
North of Delta M&I Contractors	85%	81%	77%
South of Delta M&I Contractors	79%	77%	74%

CVP Sacramento River Settlement, San Joaquin River Exchange, and Refuge deliveries are based on Shasta Criteria and are 100% in most years and 75% in “Shasta critical” years⁶. Figure 6 contains exceedance probability charts for annual water deliveries to CVP contractors whose allocations are based on Shasta Criteria. In the NAA-ELT and NAA-LLT modeling scenarios, the Sacramento River Settlement and Refuge deliveries are reduced due to water shortages that occur more often under the climate change assumptions.

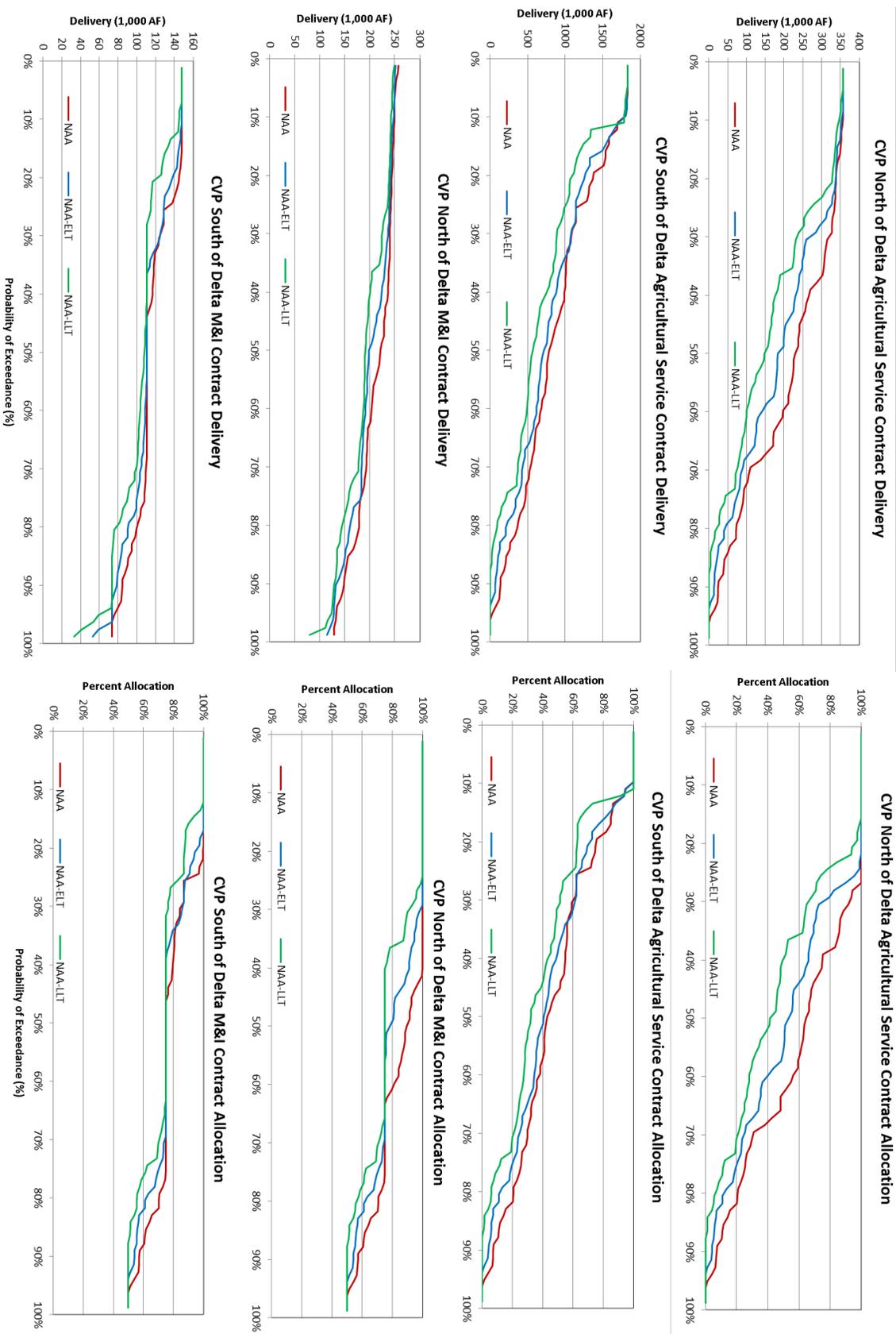
SWP Water Supply

Corresponding with the CVP operation is the projected operation of the SWP under No Action Conditions. These illustrations are shown to provide a comparison to SWP storage and exports, particularly during drought. A comparison of SWP exports to CVP SOD deliveries shows that each project exports about the same amount of water during drought.

Average annual SWP Table A water supply allocations are 62% for NAA, 61% for NAA-ELT, and 57% for NAA-LLT. Figure 7 contains an exceedance probability plot summary of SWP deliveries. SWP North of Delta deliveries to the Feather River Service Area in both the ELT and LLT are less than NAA during about 10% of the time.

⁶ A “Shasta critical” year is determined when the forecasted full natural inflow into Shasta Lake is equal to or less than 3.2 million acre-feet.

Figure 5. CVP Water Service Contractor Delivery Summary



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Figure 6. CVP Contractor Delivery Summary for Contractors with Shasta Criteria Allocations

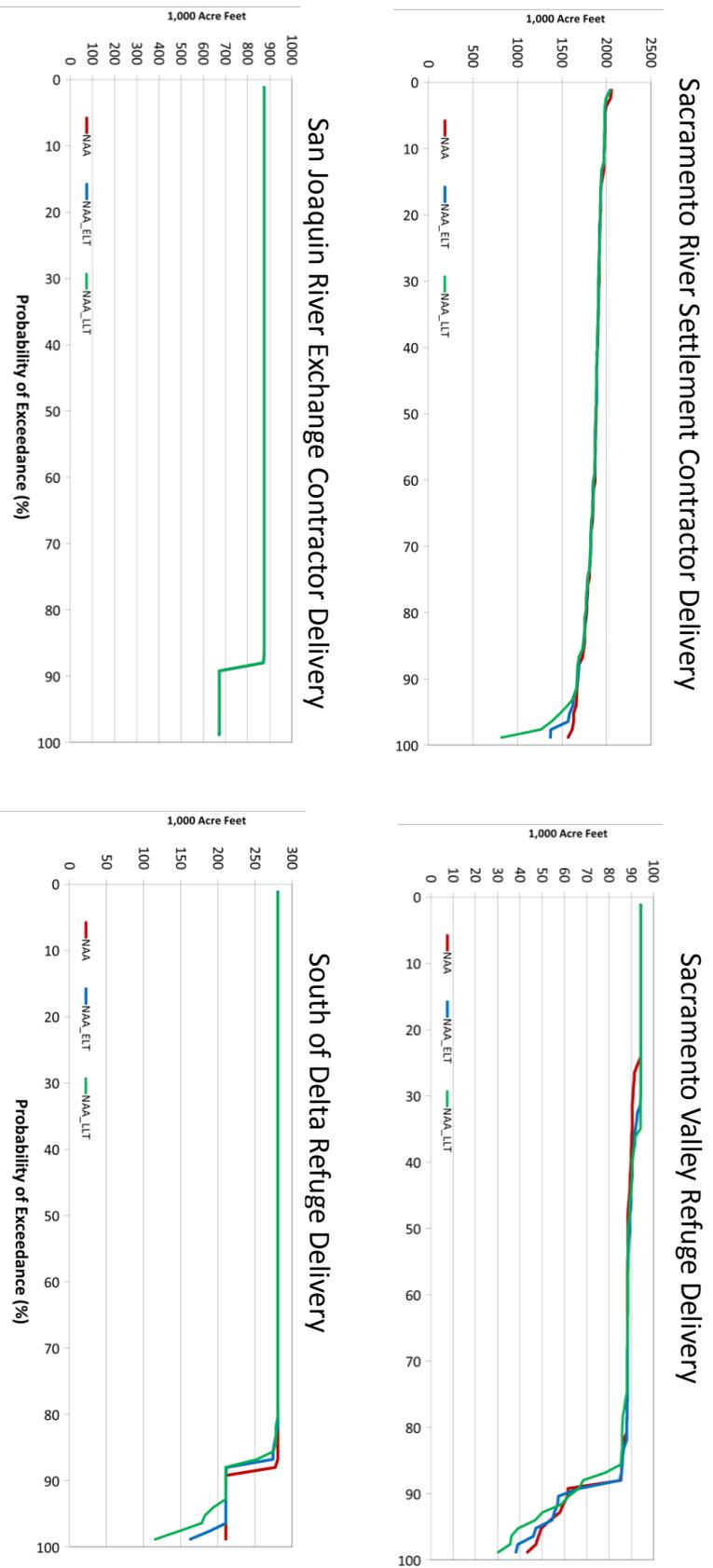
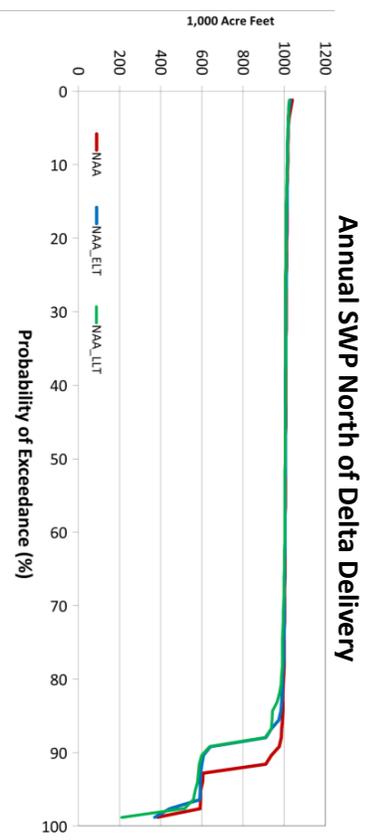
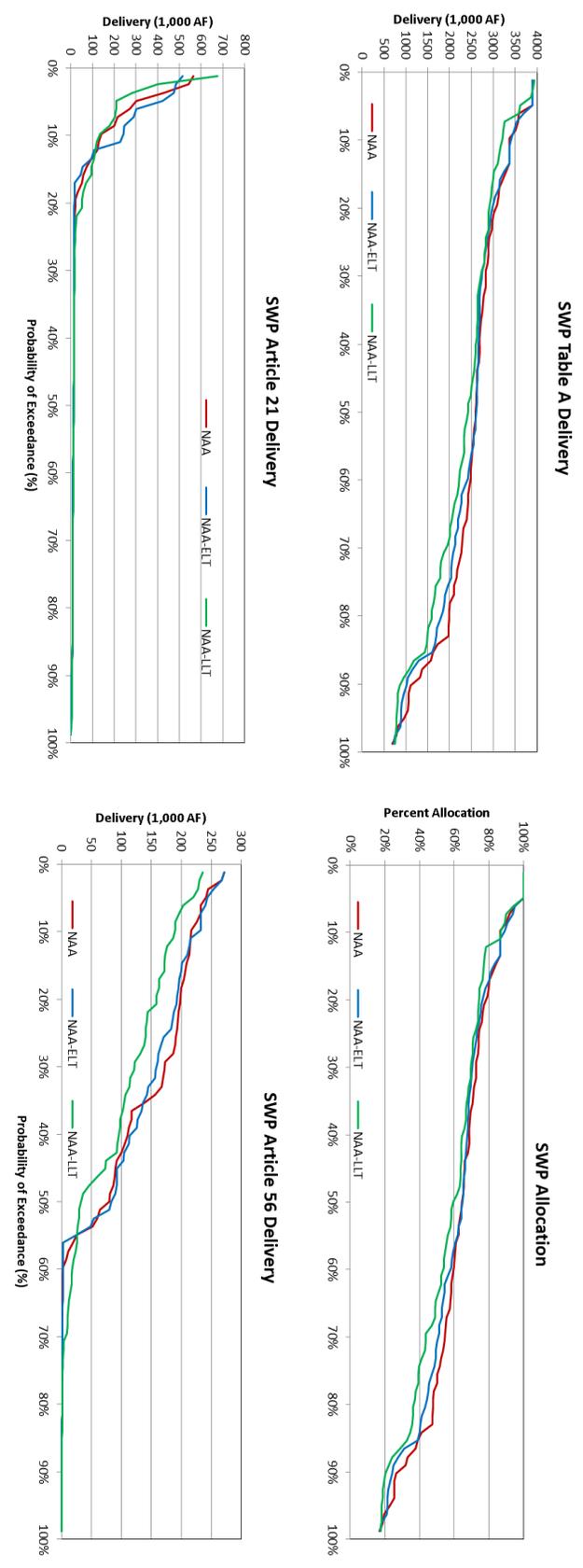


Figure 7. SWP Delta Delivery Summary



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CVP/SWP Exports

Exports of the CVP and SWP have been projected to change due to a combination of climate change effects on water availability (primary effect), flow requirements for salinity control (sea level rise), additional in-basin water demands, and to a small extent greater export potential (DMC-CA intertie). Figure 8 illustrates the simulation of CVP exports and combined CVP/SWP exports under NAA, NAA-ELT, and NAA-LLT Scenarios. Under NAA average annual CVP exports are about 2.24 MAF (2.18 at Jones PP) and are about 100 TAF less in the NAA-ELT Scenario and 230 TAF less in the NAA-LLT. Annual average SWP exports are about 2.61 MAF in the NAA and are 68 TAF less in the NAA-ELT and 212 TAF less in the NAA-LLT. Annual average combined CVP/SWP exports are about 4.9 MAF in the NAA modeling (Figure 9) and about 170 TAF and 460 TAF less in the NAA-ELT and NAA-LLT respectively.

Figure 8. CVP Exports at Jones PP, NAA, NAA-ELT and NAA-LLT

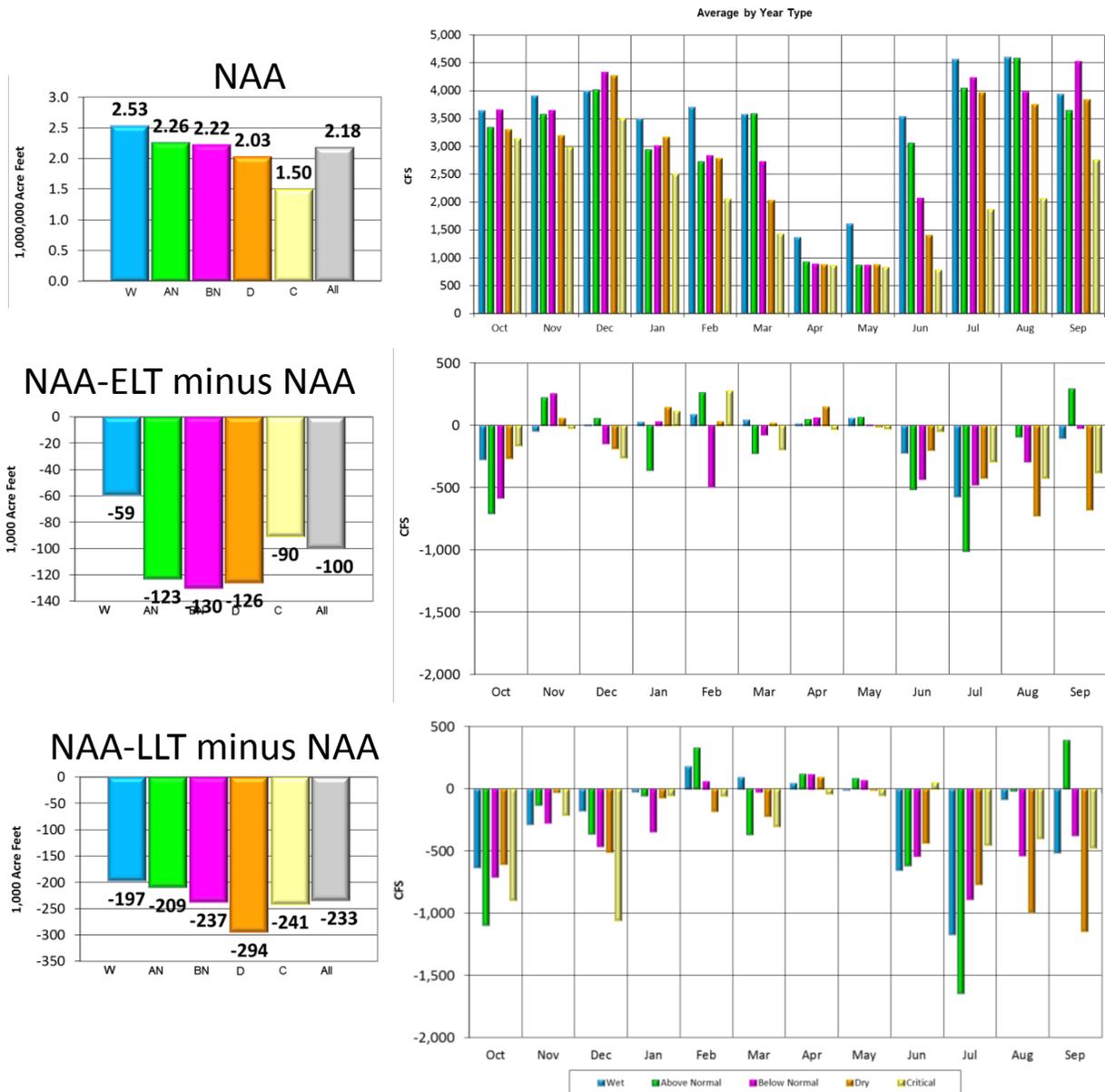
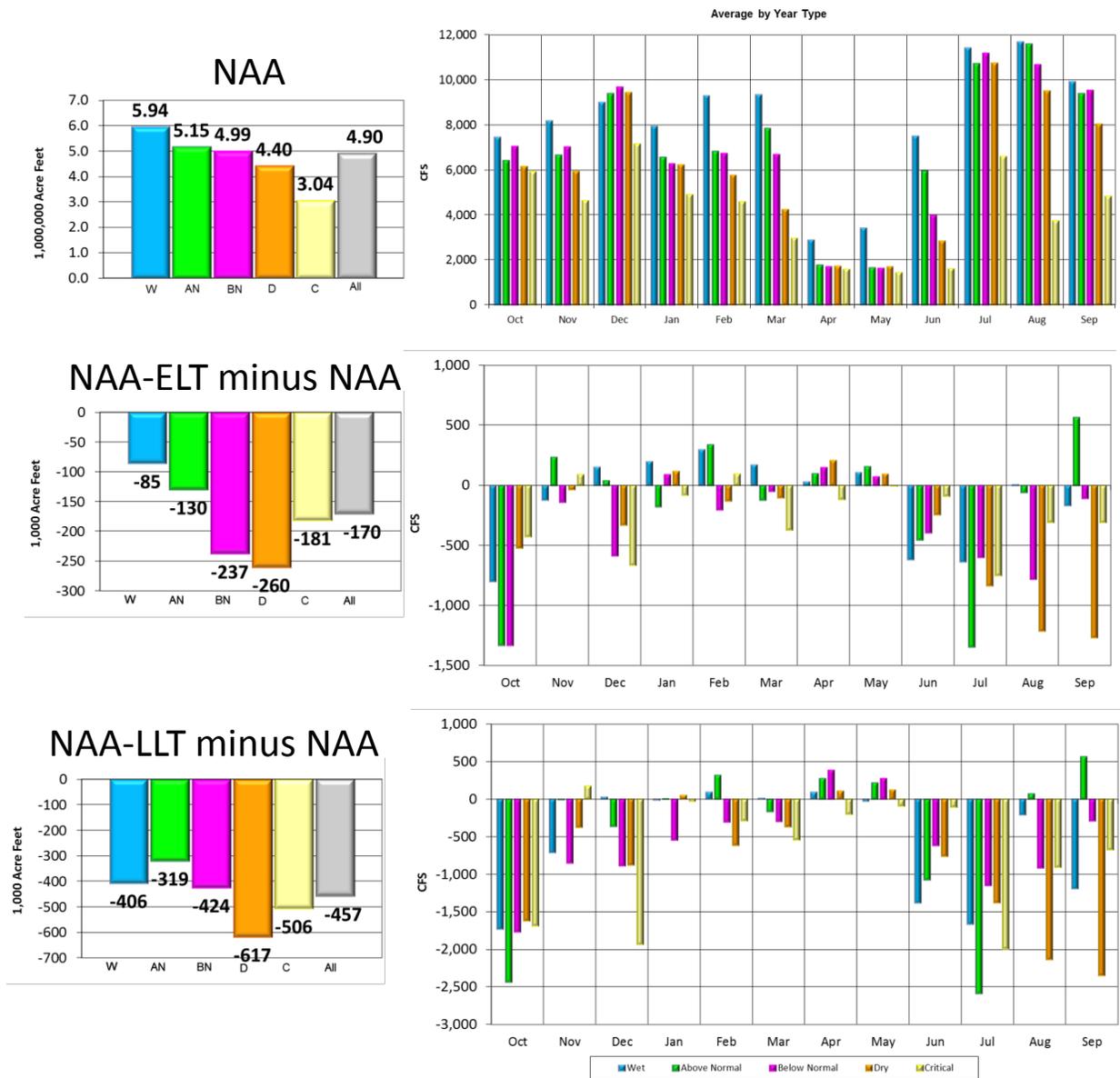


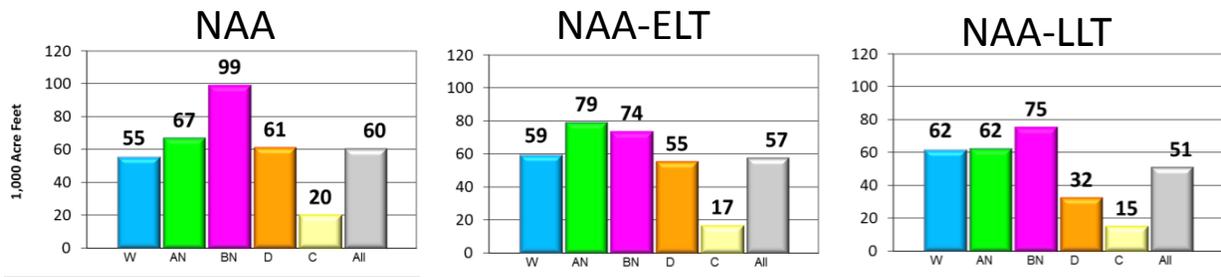
Figure 9. Total CVP/SWP Exports, NAA, NAA-ELT and NAA-LLT



Joint Point of Diversion

The NAA Alternatives do not make use of Joint Point of Diversion (JPOD), however CVP water is pumped at Banks to satisfy the Cross Valley Canal (CVC) contracts. **Figure 10** shows annual Banks wheeling for CVC for the NAA, NAA-ELT and NAA-LLT.

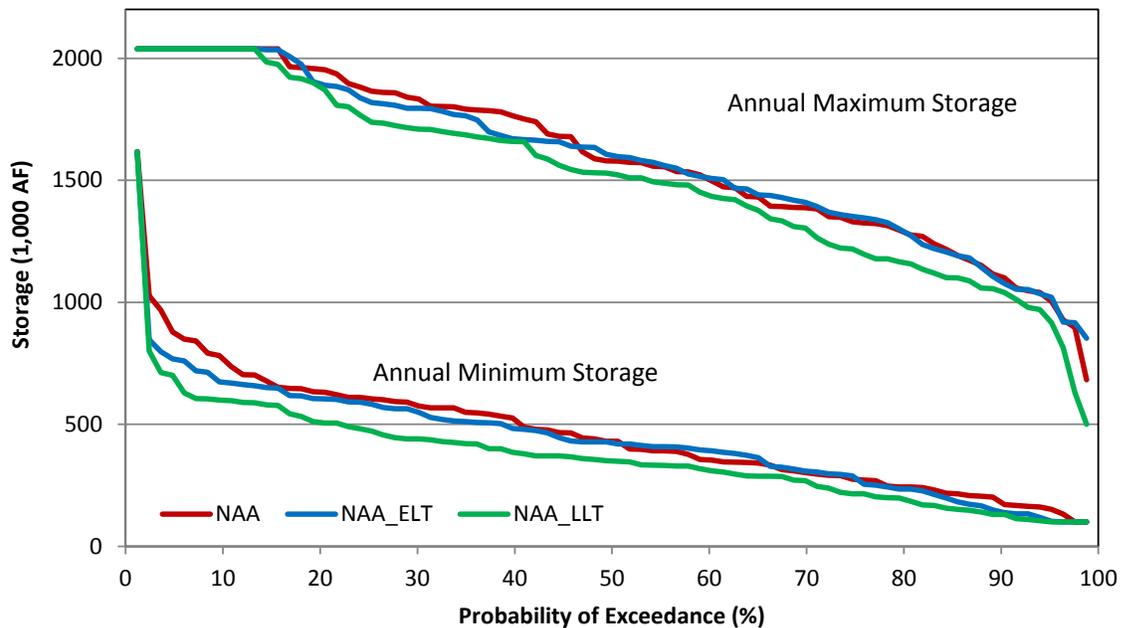
Figure 10. Cross Valley Canal Wheeling at Banks



San Luis Reservoir Operations

Modeling protocols will use San Luis Reservoir to store water when available and provide supply as exports are constrained by hydrology or regulatory constraints. Figure 11 illustrates the projected operation of San Luis Reservoir under the NAA, NAA-ELT, and NAA-LLT Scenarios. The annual maximum storage shows that the ability to fill San Luis Reservoir is somewhat similar for NAA and NAA-ELT but with less ability to fill in the NAA-LLT. The frequency of a low annual low point of San Luis Reservoir is exacerbated in the NAA-LLT Scenario. In all the Scenarios, San Luis Reservoir is heavily exercised. As currently projected, San Luis Reservoir will only fill as the result of very favorable hydrologic conditions including the availability of spill water from Friant or the Kings River system that offsets DMC water demands at the Mendota Pool.

Figure 11. San Luis Reservoir Storage – NAA, NAA-ELT and NAA-LLT



Sacramento River Temperature

CalSim II results, along with meteorological data, are used in temperature models that simulate reservoir temperature and river temperature. The BDCP modeling provided by DWR for review included the Sacramento

River temperature model and results for the No Action and Alternatives. Each BDCP Alternative used temperature target criteria for the upper Sacramento River as is used for the Existing Conditions modeling scenario. Equilibrium temperatures, a calculated model input that approximately depicts the effective air temperature for interaction with water temperature in the model, between Shasta and Gerber are increased by an annual average of 1.6°F for the ELT Scenarios and by 3.3°F for LLT Scenarios. Figure 12 contains monthly exceedance probability charts of temperature at Bend Bridge in the Sacramento River for April through October for the Existing Conditions and NAA-ELT Scenarios. There is about a 1 degree increase in average monthly temperature for the April through October period. Figure 13 contains similar information as Figure 12, but compares modeling results for the NAA-LLT and Existing Conditions Scenarios, there is often a 2°F increase in the NAA-LLT relative to Existing Conditions.

The increase in equilibrium temperatures combined with decreases in storage would lead to water temperature conditions that would likely not achieve the assumed objectives. Figure 12 and Figure 13 illustrate an increase in the probability that a water temperature target of 56°F would be exceeded at Bend Bridge under both the NAA-ELT and NAA-LLT Scenarios. The probability of exceedance increases approximately 5% to 20% depending on the month for the NAA-ELT Scenario and approximately 10% to 40% for the NAA-LLT Scenario.

Figure 12. Temperature Exceedance Sacramento River at Bend Bridge Existing, No Action Alternative, ELT

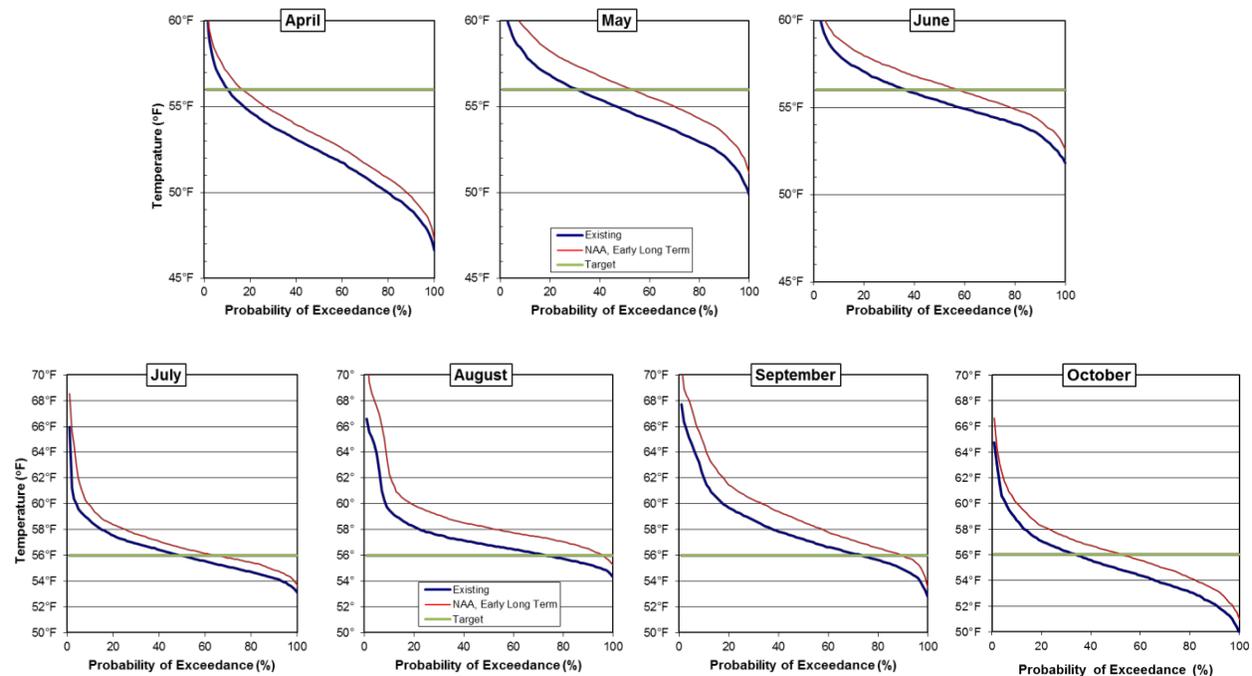
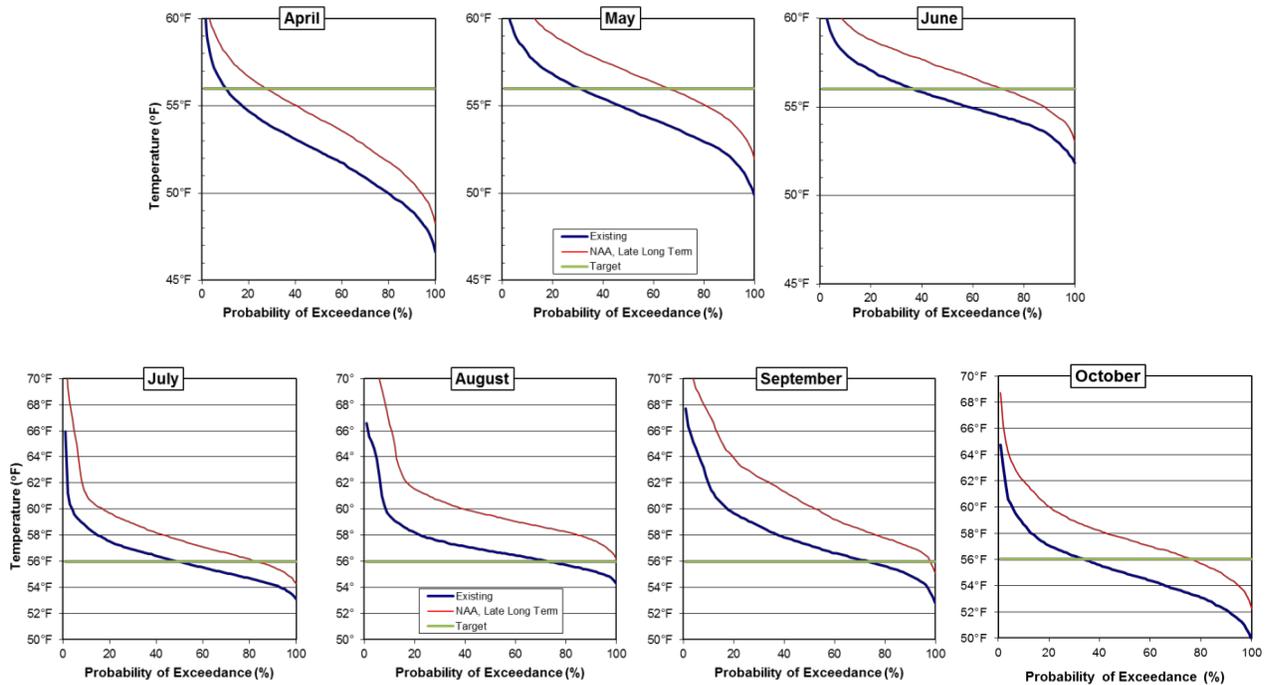


Figure 13. Temperature Exceedance Sacramento River at Bend Bridge Existing, No Action Alternative, LLT



Conclusions regarding Climate Change Assumptions and Implementation

In examining the possible effects of climate change, it is not appropriate to assume that current project operations will remain static and not respond to climate change. The BDCP’s simplistic approach of assuming a linear operation of the CVP and SWP produces results that are not useful for dealing with the complex problem of climate change because it does not reflect the way in which the CVP and the SWP would actually operate whether or not the BDCP is implemented. Reviewers recommend a sensitivity analysis be conducted to develop a better understanding of the range of possible responses to climate change by the CVP and SWP, and the regulatory structures that dictate certain project operations.

Including climate change, without adaptation measures, results in insufficient water needed to meet all regulatory objectives and user demands. For example, the BDCP Model results that include climate change indicate that during droughts, water in reservoirs is reduced to the minimum capacity possible. Reservoirs have not been operated like this in the past during extreme droughts and the current drought also provides evidence that adaptation measures are called for long in advanced to avoid draining the reservoirs. In this aspect, the BDCP Model simply does not reflect a real future condition. Foreseeable adaptations that the CVP and SWP could make in response to climate change include: (1) updating operational rules regarding water releases for flood protection; (2) during severe droughts, emergency drought declarations could call for mandatory conservation; and (3) if droughts become more frequent, the CVP and SWP would likely revisit the rules by which they allocate water during shortages and operate more conservatively in wetter years. The modifications to CVP and SWP operations made during the winter and spring of 2014 in response to the drought supports the likelihood of future adaptations. The BDCP Model is, however, useful in that it reveals that difficult decisions must be made in response to climate change. But, in the absence of making those decisions, the BDCP Model results themselves are not informative, particularly during drought conditions. With future conditions projected to be so dire without the BDCP, the effects of the BDCP appear positive simply because it appears that conditions cannot get any worse (i.e., storage cannot be reduced below its minimum level). However, in reality, the future condition will

not be as depicted in the BDCP Model. The Reviewers recommend that Reclamation and DWR develop more realistic operating rules for the hydrologic conditions expected over the next half-century and incorporate those operating rules into the any CalSim II Model that includes climate change.

2.2 BDCP Operation

The next step of our analysis centered on reviewing BDCP modeling of the with project scenarios as described in the December 2013 Draft BDCP and described as Alternative 4 in the Draft EISR.

Description of the BDCP Project

At the time of review, this Alternative was coined Alt 4 and represented a dual conveyance facility. The two DWR analyses reviewed were identified as:

- Alt 4 (dual conveyance) – ELT
The same system demands and facilities as described in the NAA-ELT with the following primary changes: three proposed North Delta Diversion (NDD) intakes of 3,000 cfs each; NDD bypass flow requirements; additional positive OMR flow requirements and elimination of the San Joaquin River I/E ratio and the export restrictions during VAMP; modification to the Freemont Weir to allow additional seasonal inundation and fish passage; modified Delta outflow requirements in the spring and/or fall (defined in the Decision Tree discussed below); movement of the Emmaton salinity standard; redefinition of the EI ratio; and removal of current permit limitations for the south Delta export facilities. Set within the ELT environment.
- Alt 4 (dual conveyance) – LLT
The same as the previous Scenario except established in the LLT environment.

The BDCP contemplates a dual conveyance system that would move water through the Delta’s interior or around the Delta through an isolated conveyance facility. The BDCP CalSim II files contained a set of studies evaluating the projected operation of a specific version of such a facility. The Alternative was imposed on two baselines: the NAA-ELT scenario and the NAA-LLT scenario.

The changes (benefits or impacts) of the operation due to Alt 4 are highly dependent upon the assumed operation of not only the BDCP facilities and the changed regulatory requirements associated with those facilities, but also by the assumed integrated operation of the CVP and SWP facilities. The modeling of the NAA Scenarios introduced a significant change in operating protocols suggested primarily for reaction to climate change. We consider the extent of the reaction not necessarily representing a likely outcome, and thus have little confidence that the NAA baselines are a “best” (or even valid) representation of a baseline from which to compare an action Alternative. However, a comparison review of the Alternative to the NAA baselines illuminates operational issues in the BDCP modeling and provides insight as to where benefits or impacts may occur as additional studies are provided.

Since the effects of climate changes are more severe in the LLT than in the ELT, this review focuses on the ELT modeling because the results are less skewed by the climate change assumptions and problems.

BDCP’s Alternative 4 has four possible sets of operational criteria, termed the Decision Tree, that differ based on the “X2” standards⁷ that they contemplate:

- Low Outflow Scenario (LOS), otherwise known as operational scenario H1, assumes existing spring X2 standard and the removal of the existing fall X2 standard;

⁷ X2 is a salinity standard that requires outflows sufficient to attain a certain level of salinity at designated locations in the Delta at certain times of year.

- High Outflow Scenario (HOS), otherwise known as H4, contemplates the existing fall X2 standard and providing additional outflow during the spring;
- Evaluated Starting Operations (ESO), otherwise known as H3, assumes continuation of the existing X2 spring and fall standards;
- Enhanced spring outflow only (not evaluated in the December 2013 Draft BDCP), scenario H2, assumes additional spring outflow and no fall X2 standards.

While it is not entirely clear how the Decision Tree would work in practice, the general concept is that the prior to operation of the new facility, implementing authorities would select the appropriate Scenario (from amongst the four choices) based on their evaluation of targeted research and studies to be conducted during planning and construction of the facility.

For our analysis, we reviewed the HOS (or H4) scenario because the BDCP⁸ indicates that the initial permit will include HOS operations that may be later modified at the conclusion of the targeted research studies. The HOS includes the existing fall X2 requirements but adds additional outflow requirements in the spring. We reviewed the model code and discussed the operations with DWR and Reclamation, who acknowledged that although the SWP was bearing the majority of the responsibility for meeting the additional spring outflow in the modeling, the responsibility would need to be shared with the CVP⁹. In subsequent discussions, DWR and Reclamation have suggested that the additional water may be purchased from other water users. However, the actual source of water for the additional outflow has not been defined. Since the BDCP modeling assumes that SWP bears the majority of the responsibility for meeting the additional outflow, yet this is not how the project will be operated in reality, our review of the BDCP modeling results for HOS is limited to the evaluation of how the SWP reservoir releases on the Feather River translate into changes in Delta outflow and exports.

Our remaining analysis examines the ESO (or H3) scenario (labeled Alt 4-ELT or Alt 4-LLT in this section) because it employs the same X2 standards as are implemented in the No Action Alternatives NAA-ELT and NAA-LLT. This allows us to focus our analysis on the effects of the BDCP operations independent of the possible change in the X2 standard.

High Outflow Scenario (HOS or H4) Results

In Alt 4-ELT H4 Feather River flows during wetter years are increased more than 3,000 cfs in April and May and then decreased in most year types during July and August, while September flow is only decreased in wetter years. Figure 14 shows average monthly change in Feather River flow by water year type. Accompanying the changes in Feather River flow are changes in Oroville Reservoir storage levels, Figure 15 contains average monthly changes in Oroville storage. Alt4-ELT H4 end of June storage in Oroville during wetter years is about 480 TAF lower than the NAA-ELT while critical year storage is about 400 TAF higher. Counter to the reduction in Oroville storage, CVP average upstream carryover storage increases about 80 TAF and critical year increases by 380 TAF. Figure 16 contains average monthly changes in Delta outflow, increases in Feather River spring time flows are generally not used to increase Delta outflow, but are allowed to support increases in Delta exports.

Figure 17 displays changes in average monthly Delta exports, there are increases when diverting higher upstream spring releases in wetter years, while there are decreases during summer months in most years. Figure 18

⁸ Draft BDCP, Chapter 3, Section 3.4.1.4.4

⁹ August 7, 2013 meeting with DWR, Reclamation, and CH2M HILL

contains an average annual summary of project deliveries, total CVP deliveries increase by about 70 TAF while SWP deliveries decrease by about 100 TAF. Drier year SWP deliveries decrease by 250 to 400 TAF, while wet year deliveries increase by 200 TAF. Total CVP deliveries increase in wetter years by exporting increased releases from Oroville.

The overall effect of the HOS appears to be increases in Oroville releases that support both CVP and SWP exports in wetter years, with modest increases in Delta outflow. There is also a decrease in SWP reliability through large delivery reductions in dryer years accompanied by Oroville storage increases. In addition to increases in dry and critical year storage in Oroville, total CVP dry and critical year carryover increases by 100 TAF and 380 TAF respectively with negligible reductions in wetter years types.

CVP and SWP obligation for providing flow to satisfy Delta outflow requirements is described in the Coordinated Operations Agreement (COA). Because the CVP and SWP share responsibility for meeting required Delta outflow based on specific sharing agreement, it doesn't seem reasonable that CVP water supplies would increase while SWP water supplies decrease under this Alternative. The manner in which this alternative is modeled is inconsistent with existing agreements and operating criteria. If the increases in outflow were met based on COA, there would likely be reductions in Shasta and Folsom storage that may cause adverse environmental impacts.

Figure 14. Changes in Feather River Flow, Alt 4 H4 ELT minus NAA-ELT

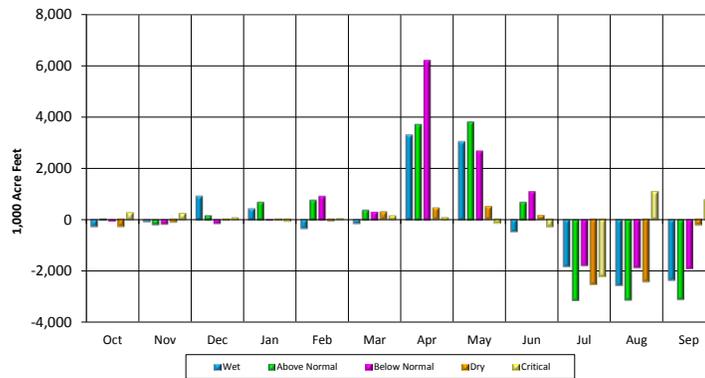


Figure 15. Changes in Oroville Storage, Alt 4 H4 ELT minus NAA-ELT

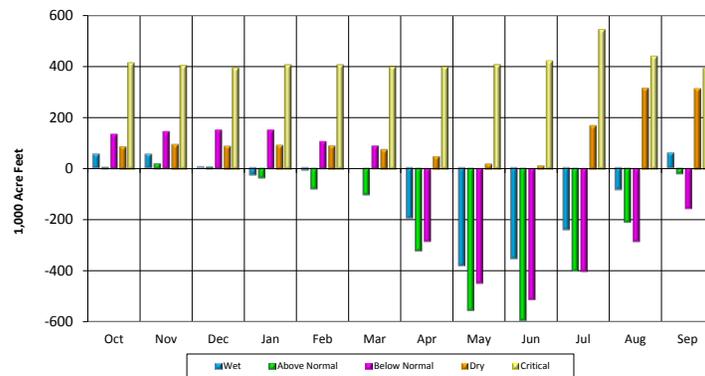


Figure 16. Changes in Delta Outflow, Alt 4 H4 ELT minus NAA-ELT

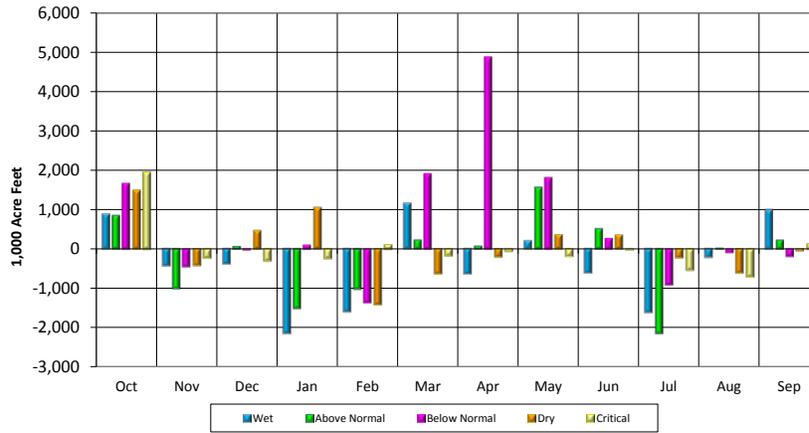


Figure 17. Changes in Delta Export, Alt 4 H4 ELT minus NAA-ELT

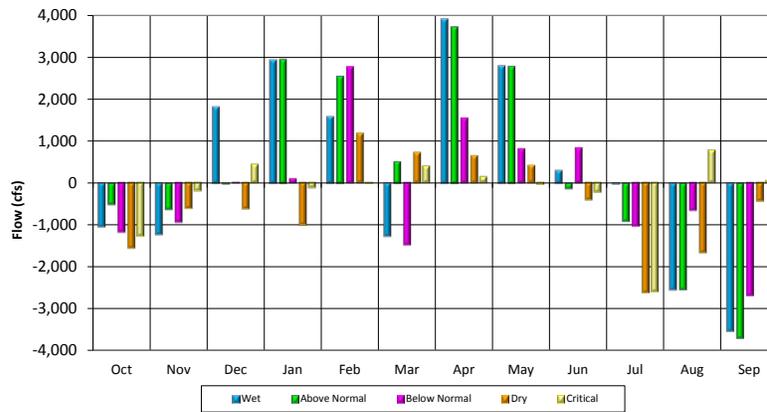
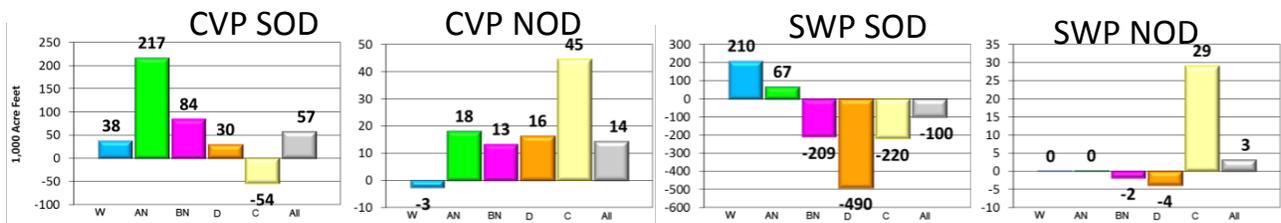


Figure 18. Changes in CVP and SWP Deliveries, Alt 4 H4 ELT minus NAA-ELT

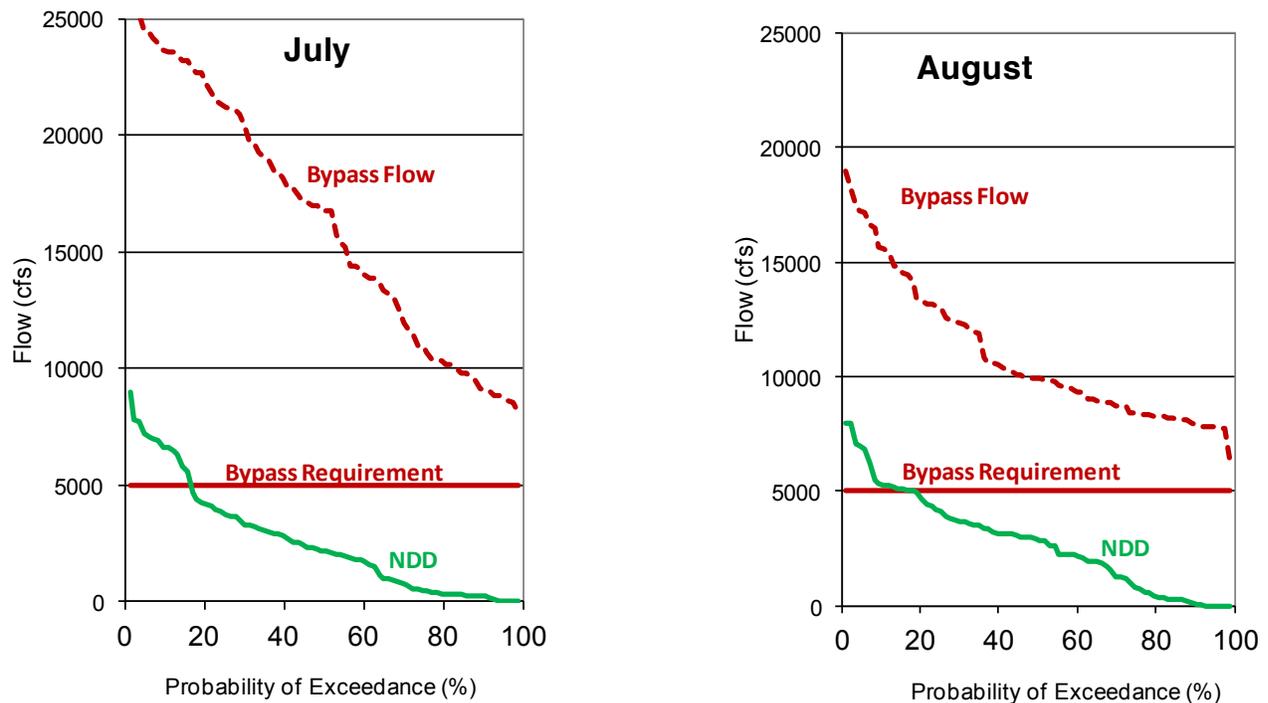


Evaluated Starting Operations (ESO or H3) Results

North Delta Diversion Intakes

Sacramento River flow below the North Delta Diversion (NDD) must be maintained above the specified bypass flow requirement, therefore the NDD rates are limited to the Sacramento River flow above the bypass requirement. Due to an error in CalSim II that specifies an unintended additional bypass requirement, modeling performed for the BDCP EIRS often bypasses more Sacramento River flow than is specified in the BDCP project description. This error has been fixed in the most recent public releases of CalSim II, but BDCP modeling has not been updated to reflect these fixes. Figure 19 contains exceedance probability plots showing the Sacramento River required bypass, Sacramento River bypass flow, NDD, and excess Sacramento River flow to the Delta as modeling for BDCP. As can be seen in Figure 19, the bypass flow is always above the bypass requirement in July and August. The BDCP version of CalSim sets a requirement for Sacramento River inflow to the Delta needed to satisfy all Delta flow, quality, and export requirements, this requirement should be removed when modeling the NDD.

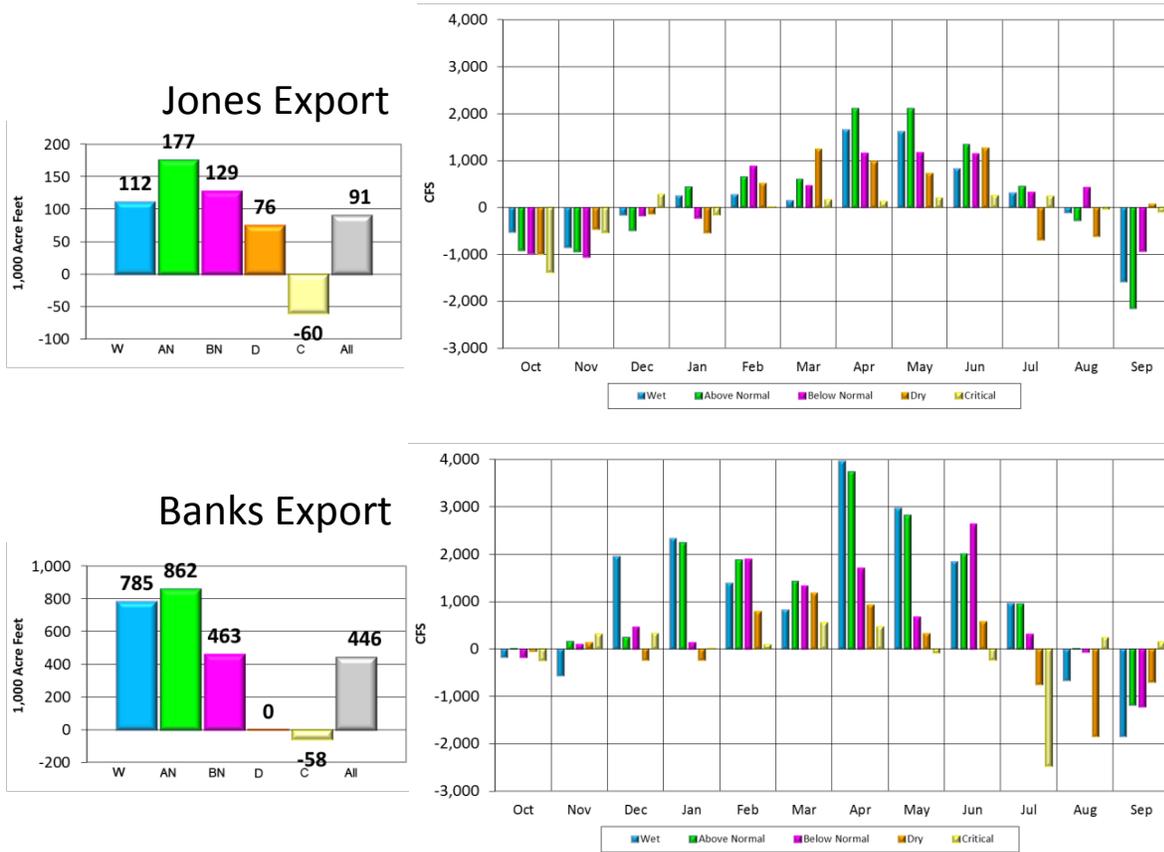
Figure 19. NDD, Bypass Requirement, Bypass Flow, and Excess Sacramento R. flow for Alt 4-ELT



CVP/SWP Exports

Overall the Alt 4 will increase exports compared to the NAA-ELT, with the majority of the increased exports realized by the SWP. Figure 20 illustrates a comparison between the NAA-ELT and Alt 4-ELT of CVP and SWP exports. On average, total combined exports under Alt 4-ELT are projected to increase by 537 TAF from 4.73 MAF to 5.26 MAF compared to the NAA-ELT.

Figure 20. Change in CVP (Jones) and SWP (Banks) Exports (Alt 4-ELT minus NAA-ELT)



With the addition of the North Delta Diversion facility, the water exported dramatically shifts from South Delta diversions to North Delta diversions. Figure 21 illustrates the change in routing of South of Delta exports under Alt 4 compared to the NAA-ELT. On average, export through the South Delta facility are projected to decrease by 2.1 MAF and the North Delta diversions will export 2.6 MAF which includes the 2.1 MAF shifted from the South Delta facility plus the additional 537 TAF of increased exports.

Figure 21. Change in Conveyance Source of Exports (Alt 4-ELT minus NAA-ELT)

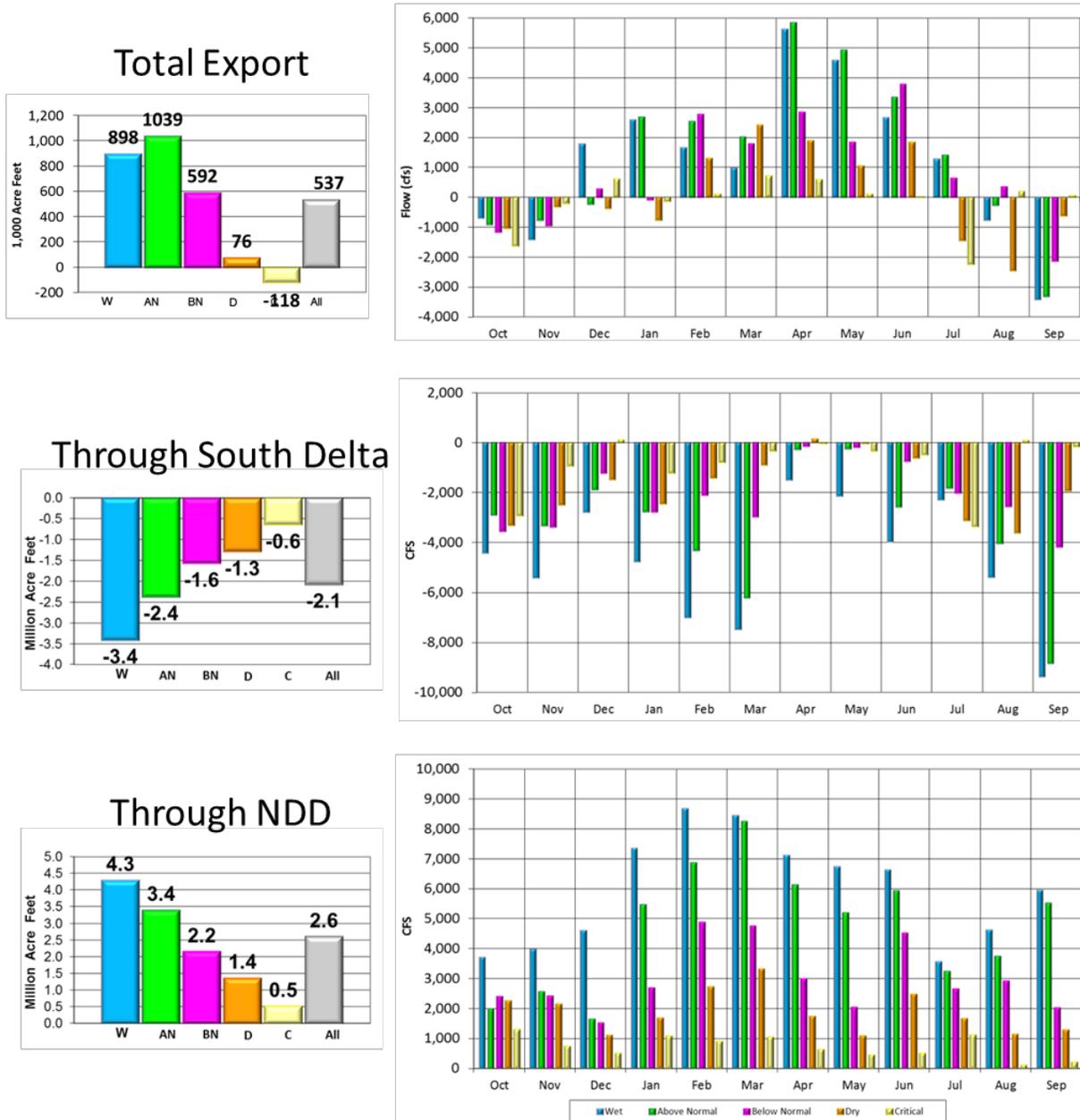
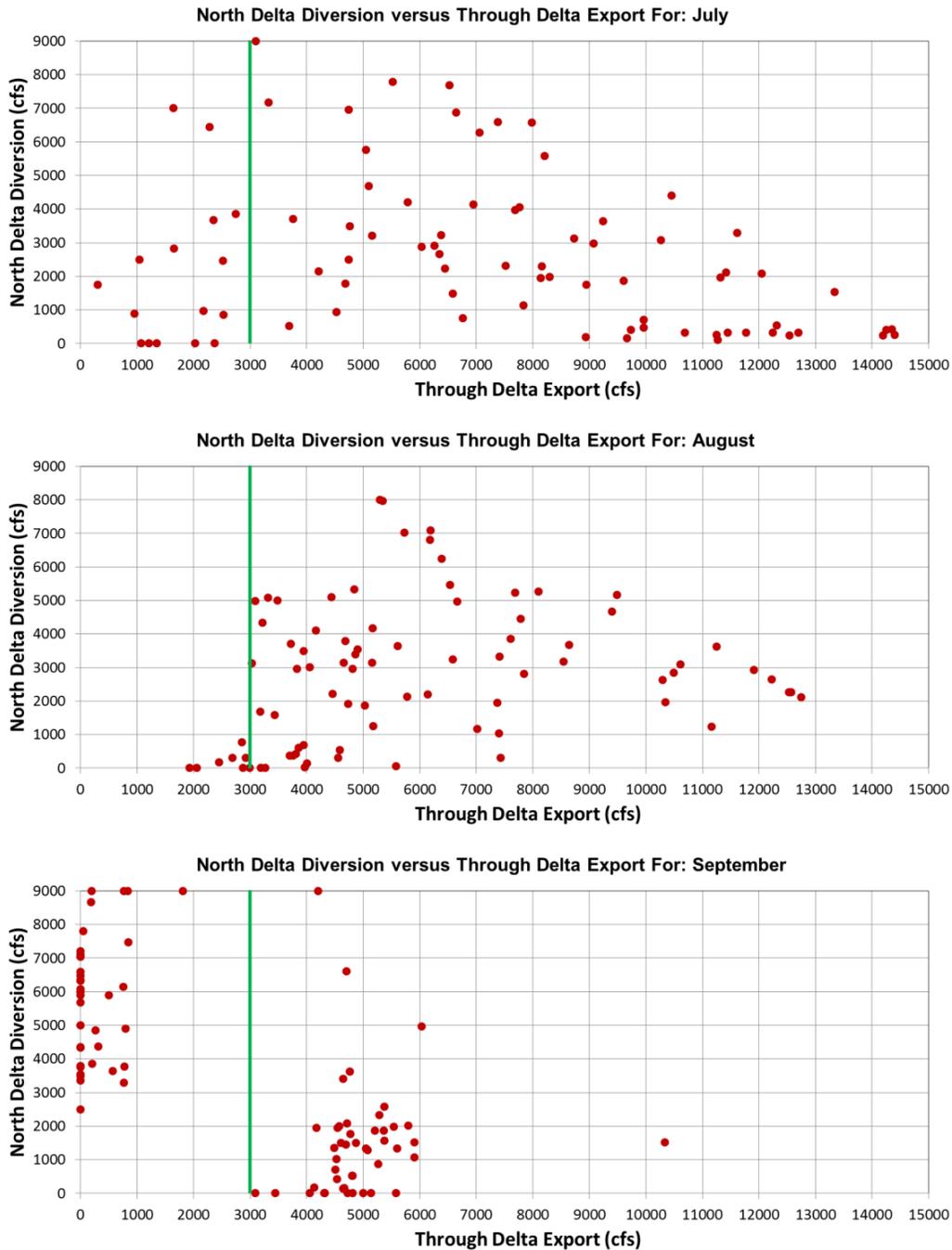


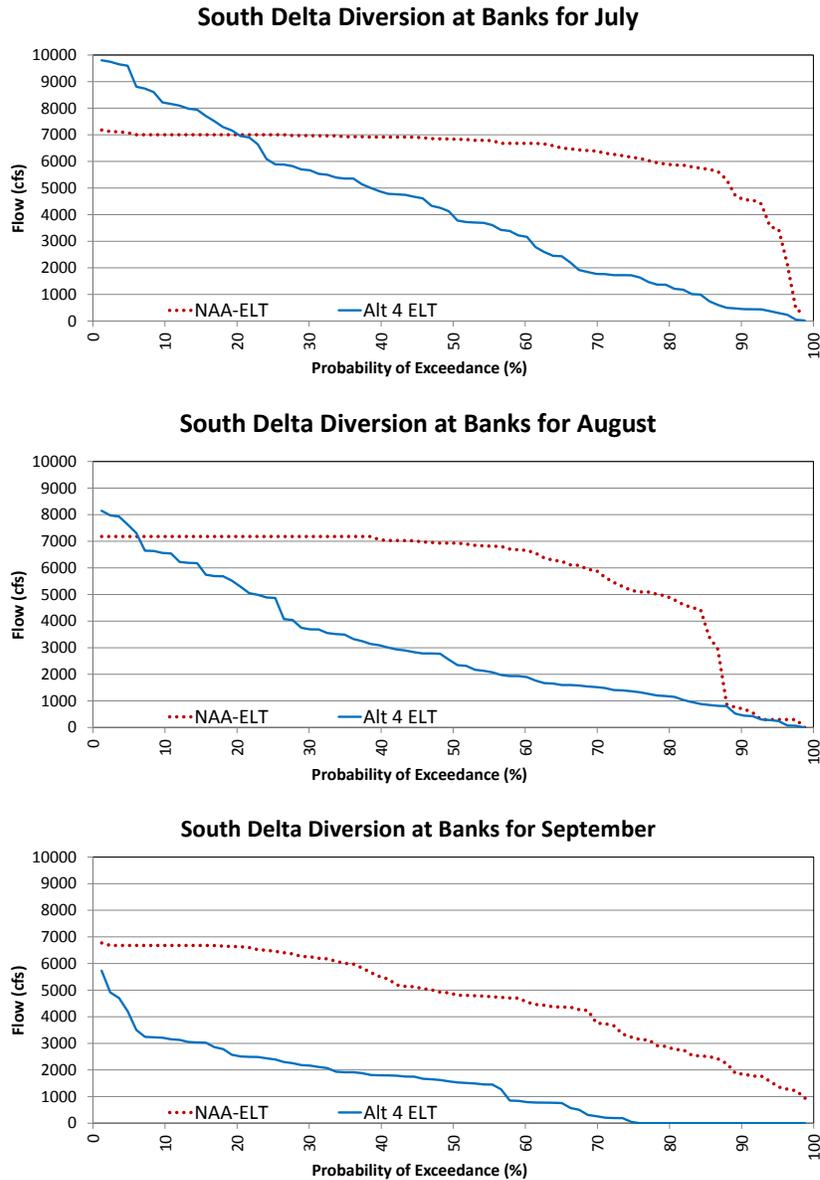
Figure 22 contains figures for July, August, and September for Alt 4-ELT that plot NDD against SDD. In the months of July to September SDD are occasionally very high, exceeding 14,000 cfs in July, with minimal NDD. This occurs due to outdated model code that imposes an instream flow requirement in Sacramento River flow below Hood in excess of the bypass criteria prescribed in the BDCP. There are numerous occurrences when bypass flows prescribed in the BDCP are exceeded and SDD are higher than expected. On the other hand, there are also many times when NDD are above minimum pumping levels and SDD are below the BDCP prescribed 3,000 cfs threshold indicated by the green line in Figure 22. For unknown reasons, the model code requiring SDD to be greater than 3,000 cfs before NDDs occur from July through September is deactivated in the BDCP modeling of this Alternative.

Figure 22. Alt 4-ELT North Delta Diversion Versus South Delta Diversion for July, August, and September



South Delta Diversion at Banks is not limited to existing permit capacity of 6,680 cfs and pumping may reach full capacity of 10,300 cfs in July, August, and September. Figure 23 contains exceedance probability charts of South Delta Diversion at Banks for July, August, and September. The chart for July shows SDD at Banks exceeding existing permit capacity 20% of years, in August this occurs in about 7% of years. There are South Delta diversions at Banks 25% of the time in September while diversions from the Sacramento River may range from 2,500 cfs to 7,500 cfs.

Figure 23. South Delta Diversion at Banks



Generally exports increase during winter and spring months due to the ability to avoid fishery concerns by diverting at the North Delta rather than South Delta.

Delta Outflow

Figure 24 illustrates a comparison of Delta outflow between the NAA-ELT and Alt 4-ELT. Decreases in Delta outflow are the result of the CVP and SWP ability to increase Delta exports in Alt 4-ELT. The apparent increase in Delta outflow in October is partially due to additional export restrictions though Old and Middle River flow requirements. However, the increase in October Delta outflow is also due to an unrealistic operation of the Delta Cross Channel. The additional export restrictions cause the flow standards imposed at Rio Vista to be the controlling point in CVP and SWP operations; the water quality standards are all being met and do not require

flows above the amount needed to satisfy the Rio Vista standard. Meeting the Rio Vista flow standards without closing the Delta Cross Channel gate results in releasing more water from upstream reservoirs than would otherwise be necessary. This occurs because a certain amount of the water released to meet the Rio Vista flow standards would flow into the Central Delta at location of the Delta Cross Channel gate. This water would not make it to Rio Vista and therefore would not be counted towards meeting the Rio Vista flow standards. However, due to the BDCP model’s assumed restrictions on exports at this time, this water could not be pumped from the South Delta facilities and thus ends up as “extra” Delta outflow. By closing the Delta Cross Channel gate, the operators would assure that all of the water released to meet the Rio Vista flow standards would be counted towards those standards. The BDCP model’s assumptions that the Delta Cross Channel gate would not be closed are not practical or a sensible operation as the operators confirmed they would close the gate during these conditions to avoid the unnecessary loss of water supplies (as was done in October and November 2013). The assumption in the BDCP model to maintain the gate in the open position causes it to overstate the amount of Delta outflow.

Figure 24. Delta Outflow Change (Alt 4-ELT minus NAA-ELT)



CVP/SWP Reservoir Carryover Storage

CVP/SWP reservoir operating criteria in the Alt4-ELT scenario differs from the NAA-ELT scenario. This difference is primarily driven by changes in both CVP and SWP San Luis Reservoir target storage. CalSim II balances upstream Sacramento Basin CVP and SWP reservoirs with storage in San Luis Reservoir by setting target storage levels in San Luis Reservoir. CalSim II will release water from upstream reservoirs to meet target levels in San Luis Reservoir and the target storage will be met as long as there is capacity to convey water and water is available in upstream reservoirs. In Alt 4 the San Luis Reservoir target storage is set very high in the spring and early summer months, and then reduced in August and set to San Luis Reservoir dead pool from September through December. This change in San Luis target storage relative to the NAA causes upstream reservoirs to be drawn down from June through August and then recuperate storage relative to the NAA by cutting releases in September; Alt 4 upstream storage then remains close to the NAA during fall months. These operational criteria cause changes in upstream cold water pool management and affect several resource areas. Figure 25, Figure 26, Figure 27, and Figure 28 contain exceedance charts for carryover storage and average monthly changes in storage by Sacramento Valley Water Year Type for North of Delta CVP and SWP reservoirs.

San Luis Reservoir Operations

In addition to changes in upstream storage conditions, changes in San Luis Reservoir target storage cause San Luis Reservoir storage to reach dead pool in many years with subsequent SOD delivery shortages. Although some

delivery shortages are due to California Aqueduct capacity constraints, the largest annual delivery shortages are a result of inappropriately low target storage levels. Average annual Table A shortages due to artificially low San Luis reservoir storage levels increased from 3 TAF in the NAA-ELT scenario to 35 TAF in the Alt4-ELT scenario. (Shortages due only to a lack of South of Delta conveyance capacity were not included in these averages.) Such shortages occurred in 2% of simulated years in the NAA-ELT scenario and 23% of years in the Alt4-ELT scenario. In addition to the inability to satisfy Table A allocations, low storage levels cause loss of SWP contractors' Article 56 water stored in San Luis Reservoir. Average annual Article 56 shortages were 43 TAF in the Alt4-ELT scenario because of low San Luis storage and 5 TAF in the NAA-ELT scenario. Low San Luis storage causes Article 56 shortages in 27% of simulated years in the Alt4-ELT scenario as compared to 5% of simulated years in the NAA-ELT. Another consequence of low storage levels in San Luis Reservoir is a shift in water supply benefits from Article 21 to Table A. As seen in Figure 29 and Figure 30 San Luis Reservoir storage fills more regularly in the Alt 4-ELT scenario, but is exercised to a lower point more often.

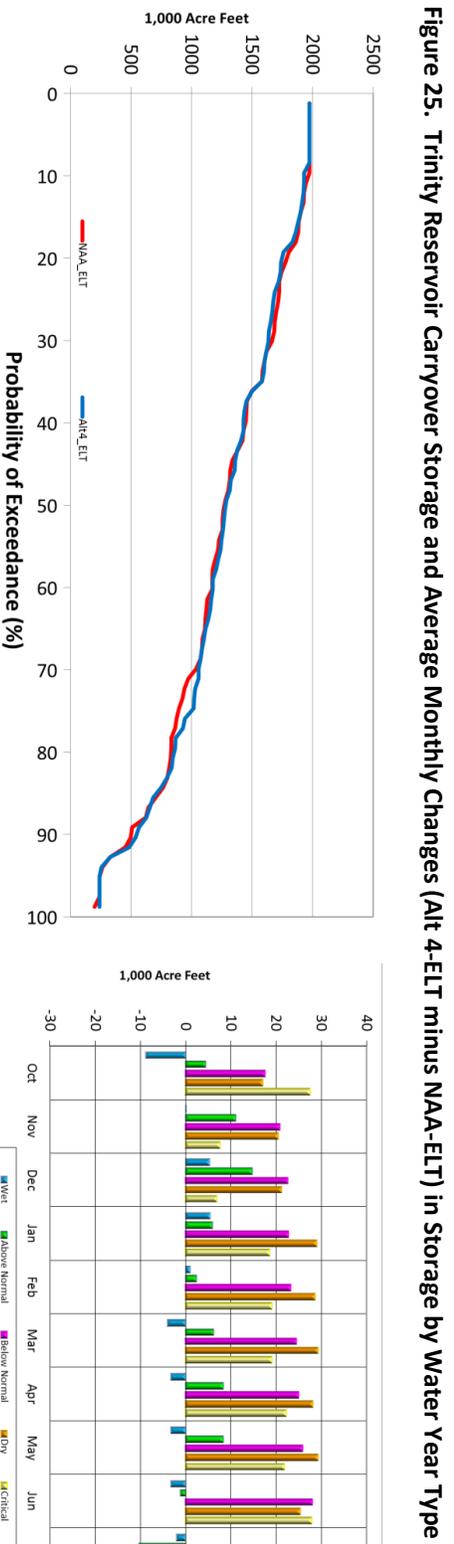


Figure 25. Trinity Reservoir Carryover Storage and Average Monthly Changes (Alt 4-ELT minus NAA-ELT) in Storage by Water Year Type

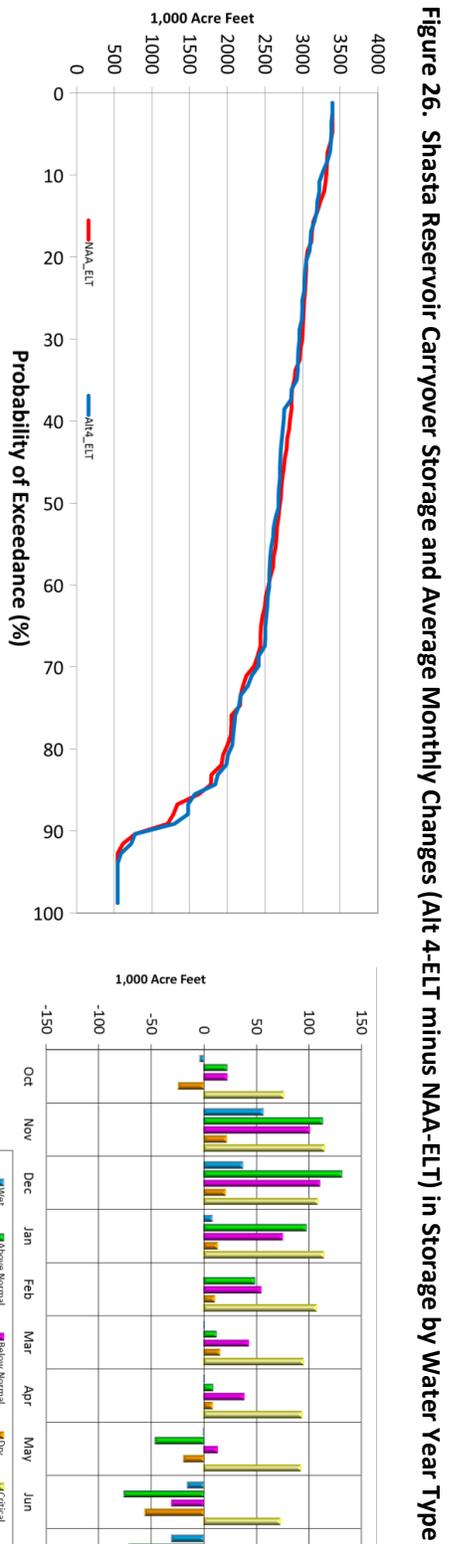


Figure 26. Shasta Reservoir Carryover Storage and Average Monthly Changes (Alt 4-ELT minus NAA-ELT) in Storage by Water Year Type

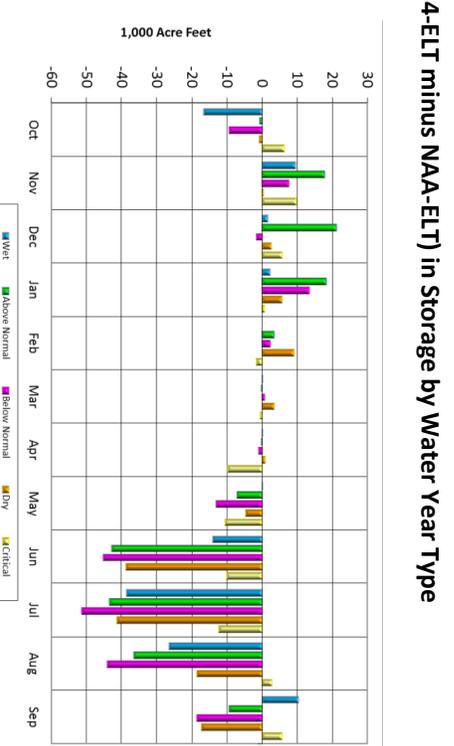
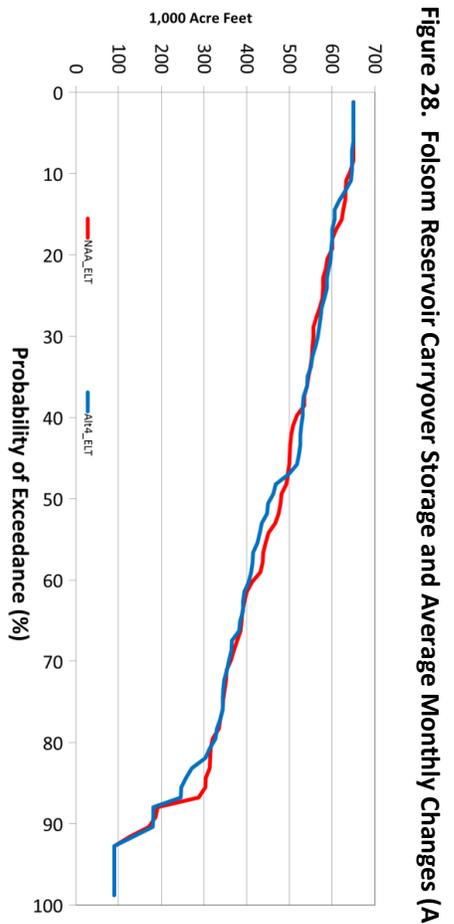
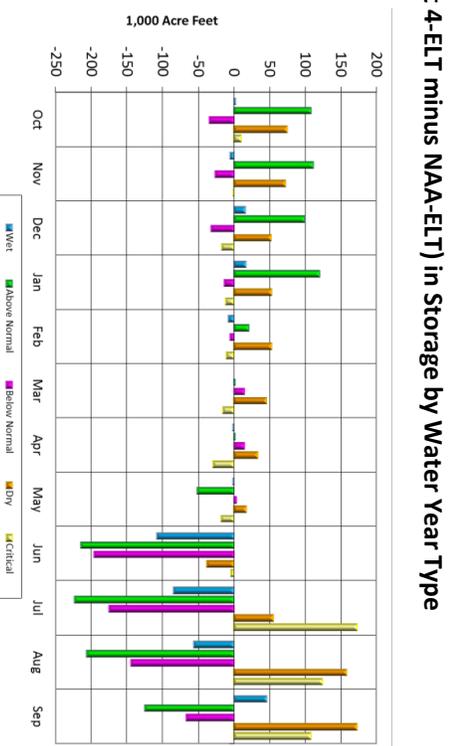
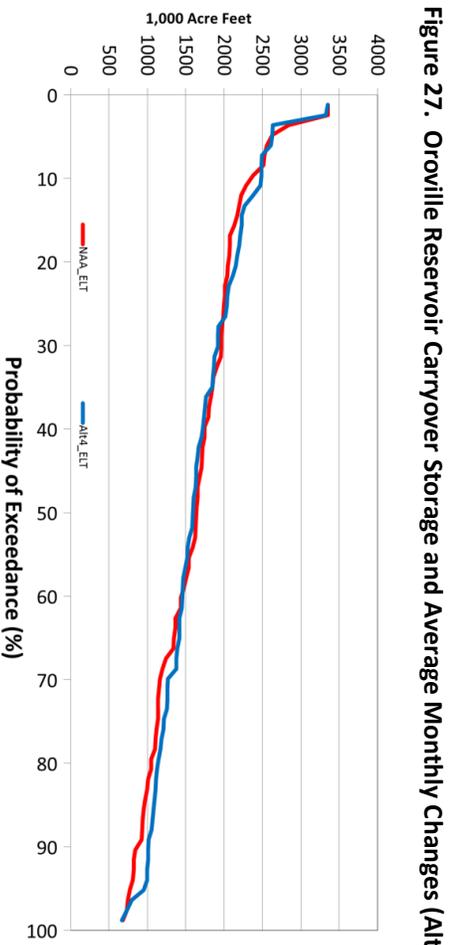


Figure 27. Oroville Reservoir Carryover Storage and Average Monthly Changes (Alt 4-ELT minus NAA-ELT) in Storage by Water Year Type

Figure 28. Folsom Reservoir Carryover Storage and Average Monthly Changes (Alt 4-ELT minus NAA-ELT) in Storage by Water Year Type

Figure 29. Federal Share of San Luis Reservoir (Alt 4-ELT and NAA-ELT)

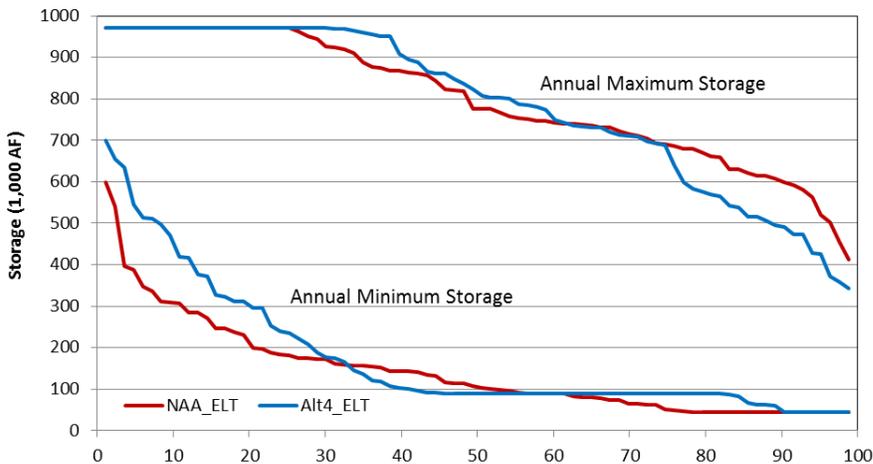
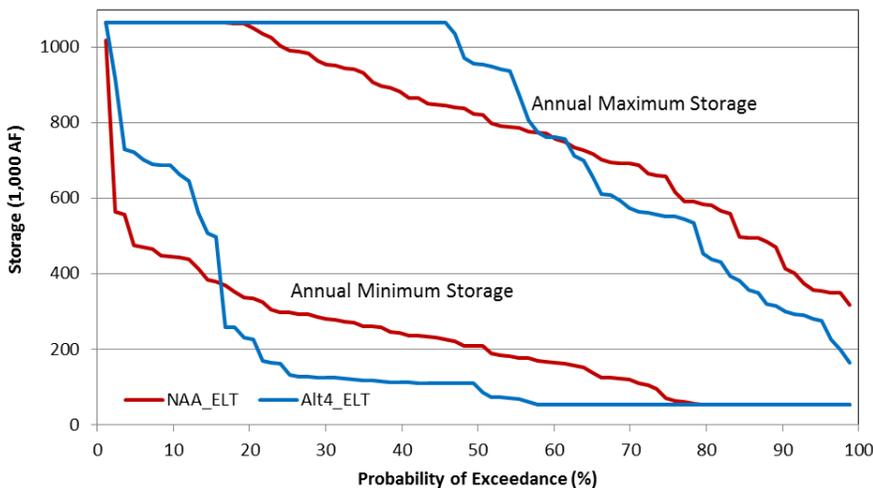


Figure 30. State Share of San Luis Reservoir (Alt 4-ELT and NAA-ELT)



CVP Water Supply

The changes in water supply to CVP customers, based on customer type and water year type is shown in Table 3. Alt 4-ELT shows an average increase of approximately 109,000 AF of delivery accruing to CVP customers with CVP SOD agricultural contractors receiving most of the benefit. Changes in Sacramento River Settlement contract deliveries are not an anticipated benefit of the BDCP, increases in these deliveries in Alt 4-ELT relative to the NAA-ELT are due to the shortages in the NAA-ELT from climate change that are reduced in Alt 4-ELT. Although the BDCP modeling demonstrates minor benefits to NOD CVP service contractors, this increase is not an anticipated benefit of the BDCP.

Consistent with modeling for the NAA-ELT Scenario, San Joaquin River Exchange Contractors receive full deliveries in accordance with contract provisions. Figure 31 compares CVP Service Contract delivery of Alt 4-ELT to the NAA-ELT Scenario. Increases in delivery generally occur in below and above normal years.

Table 3. CVP Delivery Summary (Alt 4-ELT and NAA-ELT)

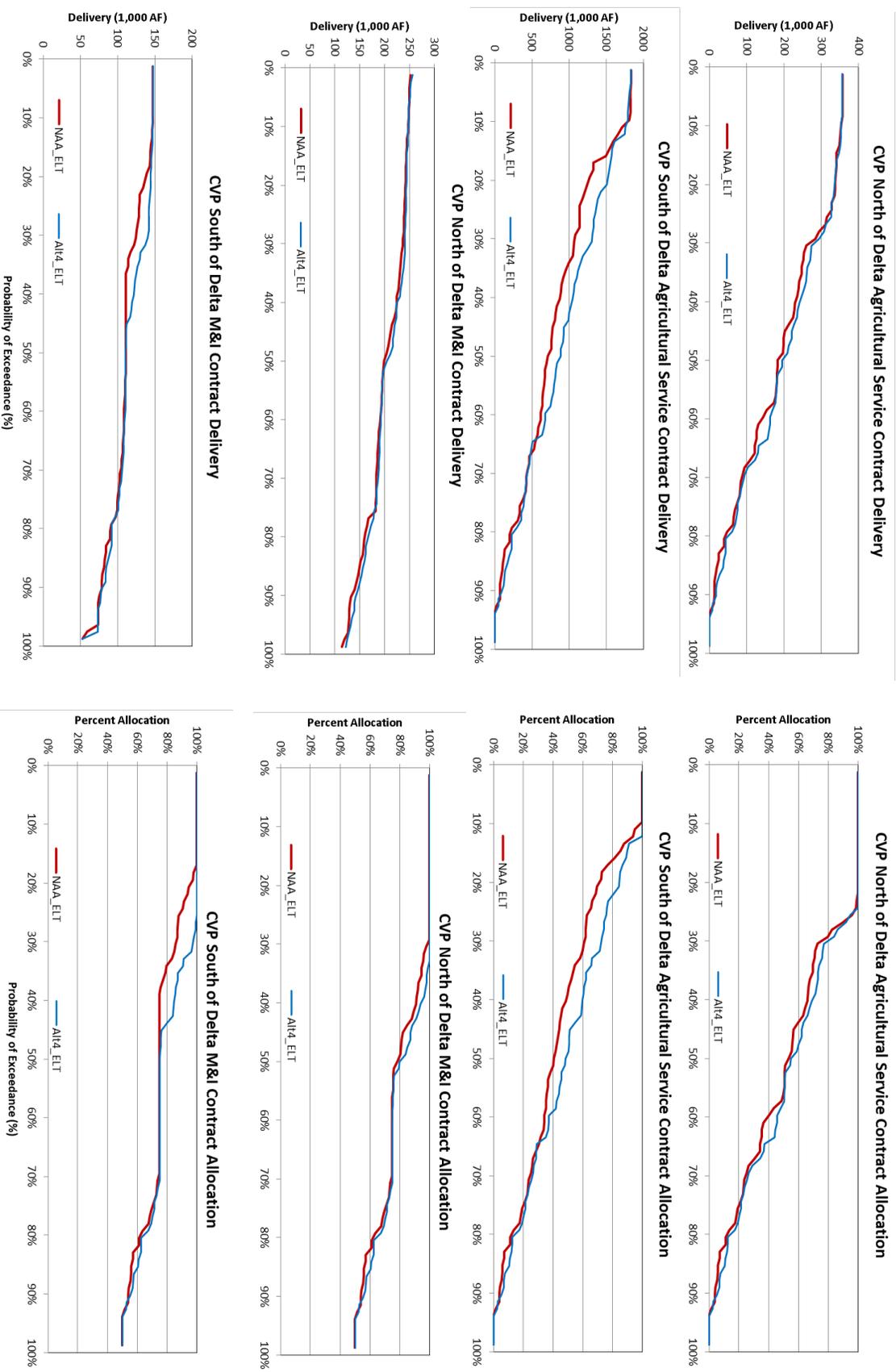
NAA-ELT (1,000 AF)

	AG NOD	AG SOD	Exchange	M&I NOD	M&I SOD	Refuge NOD	Refuge SOD	Sac. Setlmt	CVP NOD Total	CVP SOD Total
All Years	187	796	852	201	112	86	271	1846	2321	2215
W	309	1364	875	236	134	90	281	1856	2491	2837
AN	246	908	802	214	110	83	257	1716	2258	2246
BN	146	596	875	198	108	92	281	1899	2335	2044
D	95	440	864	175	100	90	277	1890	2250	1864
C	29	152	741	140	79	64	223	1674	1908	1376

Difference: Alt4-ELT minus NAA-ELT (1,000 AF)

	AG NOD	AG SOD	Exchange	M&I NOD	M&I SOD	Refuge NOD	Refuge SOD	Sac. Setlmt	CVP NOD Total	CVP SOD Total
All Years	8	90	0	4	4	1	0	3	15	94
W	1	68	0	1	3	2	1	-2	1	72
AN	14	199	0	3	12	1	0	-1	17	211
BN	17	153	0	5	4	0	0	0	22	158
D	10	48	0	5	2	1	-1	-1	15	49
C	3	6	0	5	2	-1	2	26	33	12

Figure 31. CVP Service Contract Deliveries (Alt 4-ELT and NAA-ELT)



SWP Water Supply

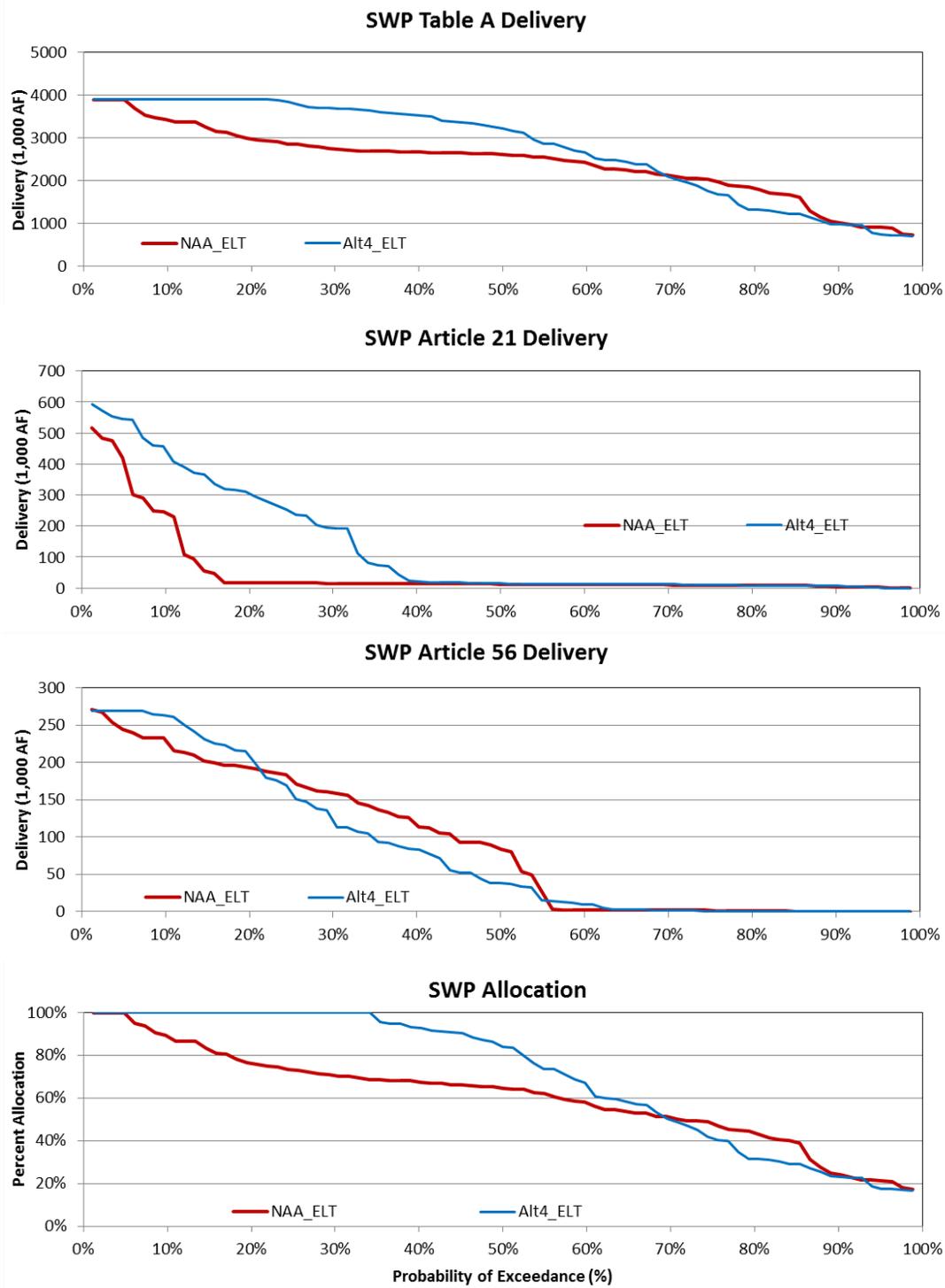
Similar in nature, but larger in magnitude are changes in SWP deliveries. Figure 32 and Table 4 illustrate the benefits of Alt 4-ELT in comparison to the NAA-ELT Scenario. These studies show an increase in average annual SWP SOD deliveries of approximately 408,000 AF, but a reduction in critical year deliveries of approximately 177,000 AF. There is an overall reduction in Article 56 deliveries. Typically in modeling and in actual SWP operations, increases in Table A correspond with increases in Article 56. The reason that Article 56 deliveries decrease overall is that insufficient quantities of water are carried over in San Luis and Article 56 contractors are subsequently shorted. SWP delivery increase is slightly less than increases in Banks export because there is increased wheeling for the Cross Valley Canal contractors with BDCP.

Table 4. SWP Delivery Summary (Alt 4-ELT and NAA-ELT)

NAA-ELT (1,000 AF)				
	Table A	Art. 21	Art. 56	Total
All Years	2425	52	90	2567
W	3112	79	112	3303
AN	2467	34	57	2559
BN	2515	48	109	2673
D	2033	43	88	2165
C	1172	28	47	1246

Difference: Alt4-ELT minus NAA ELT (1,000 AF)				
	Table A	Art. 21	Art. 56	Total
All Years	339	75	-6	408
W	587	159	5	751
AN	728	99	-24	803
BN	525	44	2	571
D	-120	19	-10	-111
C	-146	-19	-12	-177

Figure 32. SWP Contract Deliveries (Alt 4-ELT and NAA-ELT)



Freemont Weir Modifications and Yolo Bypass Inundation

A component of the BDCP Alternative 4 is a modification to the Freemont Weir to allow water to flow into the Yolo Bypass when the Sacramento River is at lower flow than is currently needed. Currently, the Sacramento River does not flow over the Freemont Weir until flow reaches about 56,000 cfs. With the proposed modification Sacramento River flow may enter the Yolo Bypass at much lower flow levels. Figure 33 and Figure 34 contains charts that compare Freemont Weir flow into the Yolo Bypass to Sacramento River flow at the weir, Figure 33 show this relationship for the NAA-ELT and Figure 34 shows this same relationship for Alt 4-ELT.

Although CalSim II is a monthly time-step model, it contains an algorithm that estimates daily flow. Therefore, average monthly flows displayed in Figure 33 shows Sacramento River entering the Yolo Bypass at flow levels less than 56,000 cfs, when this occurs water is flowing over the Freemont Weir for a portion of the month. There is a 100 cfs minimum flow diversion from the Sacramento River diversion to the Yolo Bypass from September through June in Alt 4-ELT.

Figure 35 and Figure 36 contains average monthly flow from the Sacramento River over the Freemont Weir to the Yolo Bypass for the NAA-ELT (Figure 35), average monthly difference between Alt 4-ELT and NAA-ELT (Figure 36), and the annual average difference between Alt 4-ELT and NAA-ELT (Figure 37). In the NAA-ELT scenario flow over the Freemont Weir generally occurs in wet years, this flow is extended to all year types and all months except July and August in Alt 4-ELT. The average annual increase in flow is about 430 TAF.

Figure 33. Fremont Weir vs. Sacramento River NAA-ELT

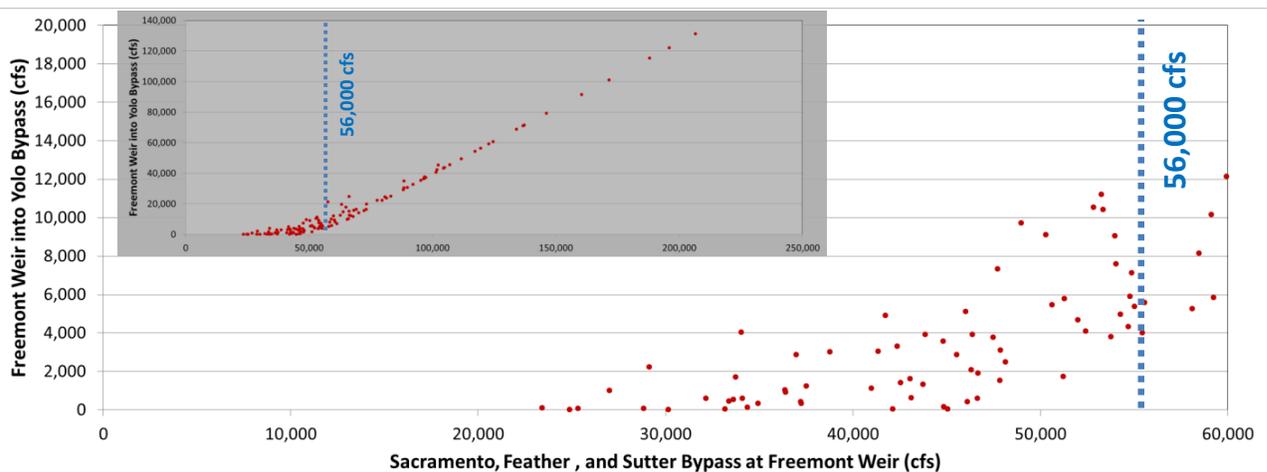


Figure 34. Fremont Weir vs. Sacramento River Alt 4-ELT

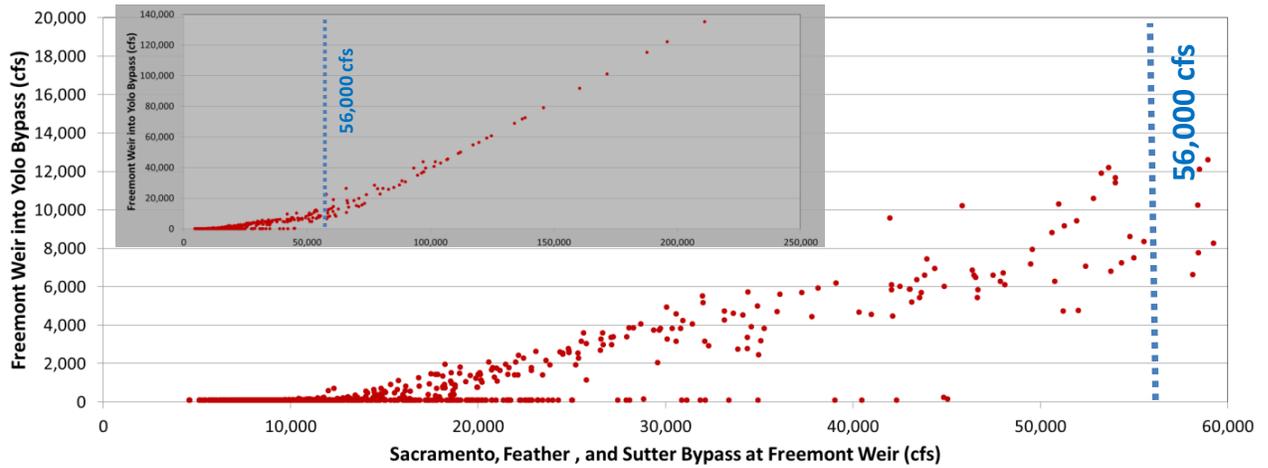


Figure 35. Average Fremont Weir Flow to Bypass by Water Year Type NAA-ELT

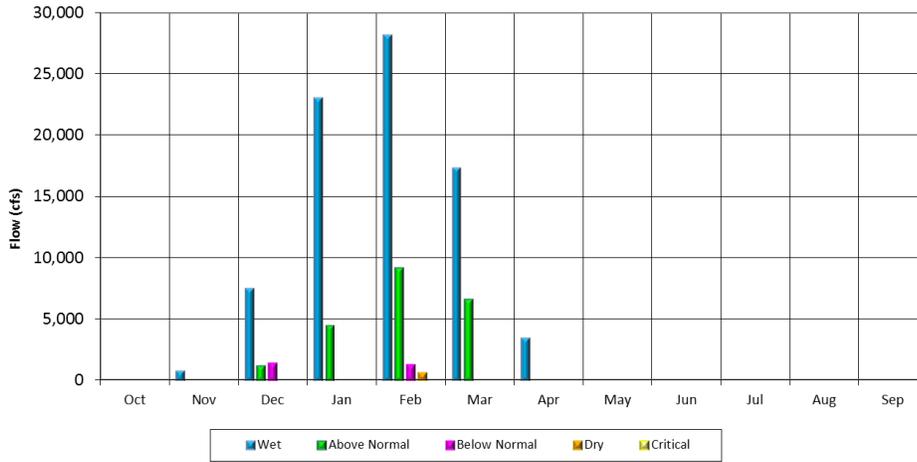


Figure 36. Average Fremont Weir Flow to Bypass by Water Year Alt 4 ELT minus NAA-ELT

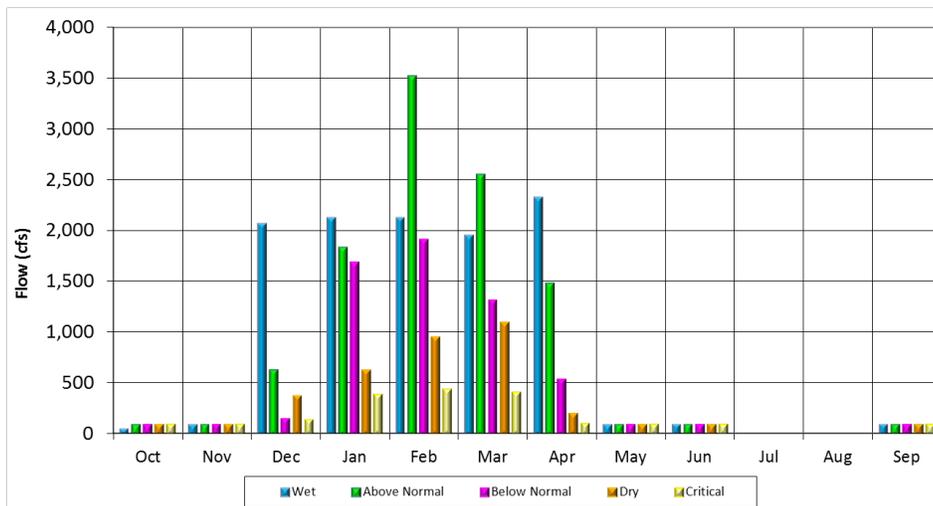
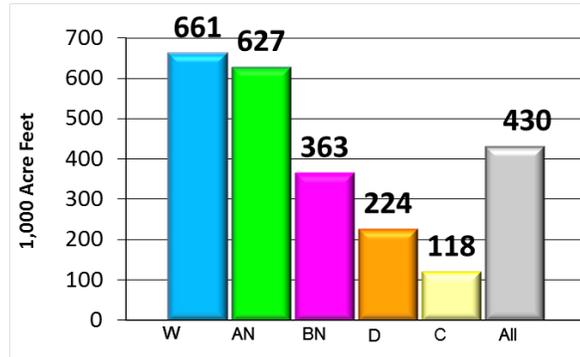


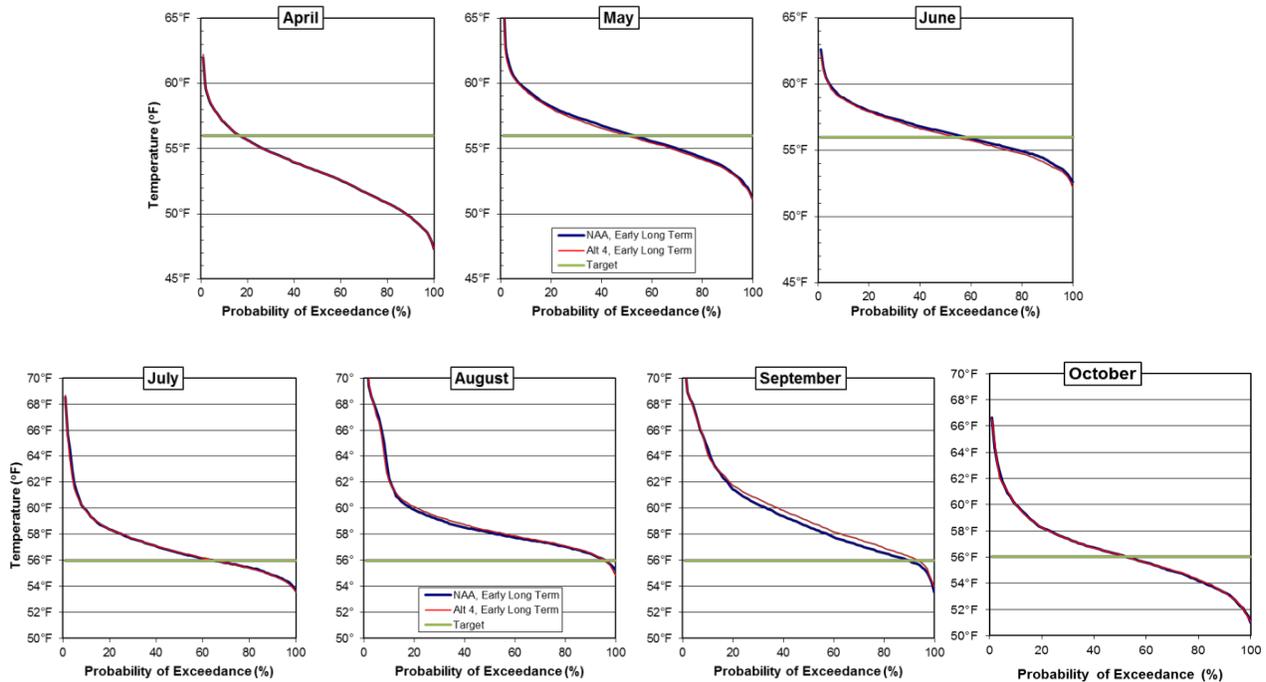
Figure 37. Annual Change in Fremont Weir Flow to Bypass Alt 4-ELT minus NAA-ELT



Sacramento River Temperature

Figure 38 contains exceedance probability plots of Sacramento River temperature at Bend Bridge for the NAA-ELT and Alt 4-ELT. For the months of April through July modeling shows few changes in upper Sacramento River water temperature. The Alt 4-ELT scenario shows temperature increases in August relative to the NAA-ELT. In about 75% of years modeling shows about 0.5°F increase in Alt 4-ELT relative to the NAA-ELT. The temperature models will meet inputted target temperatures until Shasta Lake cold water is depleted, this typically occurs in September. This is the likely reason temperature increases in modeling tend to occur in September.

Figure 38. Sacramento River Temperature at Bend Bridge NAA-ELT and Alt 4-ELT



Conclusions regarding CalSim II modeling of BDCP Alternative 4

BDCP’s “High Outflow Scenario” is not sufficiently defined for analysis.

The High Outflow Scenario (HOS) requires additional water (Delta outflow) during certain periods in the spring. The BDCP Model places most of the responsibility for meeting this new additional outflow requirement on the SWP. However, the SWP may not actually be responsible for meeting this new additional outflow requirement. This is because the COA, as it is currently being implemented, would require a water allocation adjustment that would keep the SWP whole. Where one project (CVP or SWP) releases water to meet a regulatory requirement, the COA requires a water balancing to ensure the burden does not fall inappropriately among the projects. The BDCP Model is misleading because it fails to adjust project operations, as required by the COA, to “pay back” the water “debt” to the SWP due to these additional Delta outflow requirements. Unless there is a significant revision to COA, the BDCP Model overstates the impacts of increased Delta outflow on the SWP and understates the effects on the CVP.

Furthermore, after consulting with DWR and Reclamation project operators and managers, the Reviewers conclude that there is no apparent source of CVP or SWP water to satisfy both the increased Delta outflow requirements and pay back the COA “debt” to the SWP without substantially depleting upstream water storage. It appears, through recent public discussions regarding the HOS, that BDCP anticipates additional water to satisfy the increased Delta outflow requirement and to prevent the depletion of cold water pools will be acquired through water transfers from upstream water users. However, this approach is unrealistic because during most of the spring, when BDCP proposes that Delta outflow be increased, agricultural water users are not typically irrigating. This means that there is not sufficient transfer water available to meet the increased Delta outflow requirements without releasing stored water from the reservoirs. Releasing stored water to meet the increased Delta outflow requirements could potentially impact salmonids on the Sacramento and American River systems

Simulated operation of BDCP’s dual conveyance, coordinating proposed North Delta diversion facilities with existing south Delta diversion facilities, is inconsistent with the project description.

The Draft BDCP and associated Draft EIR/EIS specify criteria for how much flow can be diverted by the new North Delta Diversion (NDD) facilities and specify when to preferentially use either the NDD facilities or the existing South Delta Diversion (SDD) facilities. However, the BDCP Model contains an artificial constraint that prevents the NDD facilities from taking water as described in the BDCP project description. In addition to affecting diversions from the NDD, this artificial constraint contains errors that affect the NAA operation. This error has been fixed by DWR and Reclamation in more recent versions of the model; however, the error remains in the BDCP Model. Additionally, the BDCP Model does not reflect the Summer operations of the SDD that are described in the Draft EIR/EIS as a feature of the BDCP project intended to prevent water quality degradation in the south Delta. The net effect of these two errors is that the BDCP Model significantly underestimates the amount of water diverted from the NDD facilities and overestimates the amount of water diverted from the SDD.

BDCP modeling contains numerous coding and data issues that skew the analysis and conflict with actual real-time operational objectives and constraints

logic is coded into the CalSim II model to simulate how DWR and Reclamation would operate the system under circumstances for which there are no regulatory or other definitive rules. This attempt to specify (i.e., code) the logic sequence and relative weighting so that a computer can simulate “expert judgment” of the human operators is a critical element to the CalSim II model. In the BDCP Model, some of the operational criteria for water supply allocations and existing facilities such as the Delta Cross Channel and San Luis Reservoir are inconsistent with real-world conditions.

3 INDEPENDENT MODELING

The Independent Modeling effort originally stemmed from reviews of BDCP Model during which the Reviewers discovered that the BDCP Model did not provide adequate information to determine the effects of the BDCP. There are three basic reasons why the Reviewers cannot assess how the BDCP will affect water operations: 1) NAAs do not depict reasonable operations under the described climate change assumptions, 2) operating criteria used in the BDCP Alternative 4 result in unrealistic operations, and 3) updates to CalSim II since the BDCP modeling was performed almost 4 years ago will likely alter model results to a sufficient degree that conclusions based on the BDCP modeling will likely be different than those disclosed in the Draft EIR/EIS. Given that it is not possible to determine how BDCP may affect CVP and SWP operations or water system flows and conditions with the BDCP model, Independent Modeling was performed to assess potential effects due to the BDCP.

To revise the models, the Reviewers consulted with operators at DWR and Reclamation to improve the representation of operational assumptions. Additionally, the Reviewers consulted with modelers at DWR and Reclamation to share findings, to strategize on the proper way to incorporate the guidance received from the operators, and to present revised models to DWR and Reclamation for their review. This collaborative and iterative process differed considerably from a standard consulting contract where the work product is not shared beyond the client-consultant until a final version is complete. To the contrary, consultations with agency experts were conducted early and repeatedly to ensure the revisions would reflect reasonable operations and to provide an independent review.

The first phase of this Independent Modeling effort was development of an updated without project baseline (similar to the NAA but with current, improved assumptions). The Independent Modeling does not incorporate climate change because the climate change hydrological assumptions developed by BDCP cause unrealistic operation of the system absent commensurate changes to operating criteria.

After the baseline was complete and reviewed, the second phase of this effort incorporated the facilities and operations for the BDCP described as Alternative 4 H3 in the Draft EIR/EIS, and otherwise known as the Evaluated Starting Operations (ESO) scenarios in the BDCP. During this phase, the issues that were identified during the Reviewers' initial review were corrected along with corrections made to resolve additional issues that were revealed as improvements were incorporated. Finally, results of the Independent Modeling and potential effects of the BDCP on water supply and instream flows are discussed.

3.1 Changes to CalSim II Assumptions

Revisions approved by DWR and Reclamation for the 2013 baseline

DWR and Reclamation provided CalSim II models used for the 2013 SWP Delivery Reliability Report (DRR) for use in this independent modeling effort. Changes to these models were made for this effort and provided to DWR and Reclamation, many of these changes have since been incorporated into DWR and Reclamation's model and others are under review.

The CalSim II model used for the 2013 SWP DRR is located on DWR's web site at: <http://baydeltaoffice.water.ca.gov/modeling/hydrology/CalSim/Downloads/CalSimDownloads/CalSim-IIStudies/SWPReliability2013/index.cfm>. Documentation for this model is described in the report titled: "Draft Technical Addendum to the State Water Project Delivery Reliability Report 2013", also located on DWR's web site at: <http://baydeltaoffice.water.ca.gov/swpreliability/>. Key modeling assumptions used for this effort are consistent with the 2013 SWP DRR and are listed in Table 4 of the Technical Addendum.

CalSim II is continuously being worked on and improved to better represent CVP and SWP operations and fix known problems. The Technical Addendum to the 2013 SWP DRR contains a description of updates and fixes that have occurred since modeling was performed for the BDCP Draft EIRS. Among these changes and fixes are key items that directly affect operation of facilities proposed in BDCP Alternative 4, these items are described on page 4 of 2013 SWP DRR Technical Addendum. Key among these fixes is the correction of the Sacramento River flow requirement for Delta inflow that causes NDD bypass to exceed requirements.

A key component of this independent modeling effort is the development of an acceptable CalSim II Future No-Action (FNA) model scenario. The purpose for developing the FNA Scenario is to produce an operational scenario that is realistic enough to understand how changes proposed in the BDCP will affect operations. The process of developing the FNA involved research and development of CalSim II model updates and several meetings with Reclamation and DWR modeling and operations staff. In addition to changes in the FNA Scenario, CalSim II was updated to better reflect operation of the NDD, CVP and SWP reservoir balancing, DCC gate operations, and CVP/SWP water supply allocations.

Additional Revisions to CalSim II Assumptions

The following changes were made to the 2013 SWP DRR version of CalSim II for this effort:

- San Joaquin River Basin
 - Turned off San Joaquin River Restoration Program (SJRRP) The SJRRP will cause a change to San Joaquin River inflow to the Delta not associated with the BDCP. To avoid adding complications to the identification of BDCP export benefits the SJRRP was not incorporated into the analysis.
 - Tuolumne: updated time-series, lookup tables, and wresl code
 - Turned off SJRA (VAMP) releases
- Updated Folsom flood diagram
- Rice decomposition demand diversions from Feather River
- Dynamic EBMUD diversion at Freeport
- SEP1933 correction to daily disaggregated minimum flow requirements at Wilkins Slough and Red Bluff
- CVP M&I demands are updated to reflect assumptions used by Reclamation
- Yuba Accord Transfer
- Los Vaqueros Reservoir capacity

San Joaquin River Basin

BDCP modeling depicted San Joaquin River Basin operations generally consistent with the actions, programs and protocols in place at the time of NOI/NOP issuance. Some of those conditions are now not representative of current development or operations. With the exception of the assumption for the SJRRP, the independent modeling has revised San Joaquin River Basin operations to reflect more contemporary LOD assumptions. In future level analyses the independent modeling similarly assumes no SJRRP, but only for analysis simplicity concerning BDCP export benefits. Additional analyses may be useful in understanding effects of collectively implementing the BDCP and SJRRP.

The San Joaquin River Basin (SJR) is depicted for current conditions, primarily affected by the operations of the Stanislaus, Tuolumne, Merced, and upper San Joaquin River tributaries. The upper San Joaquin River is currently modeled in a “pre-“ SJRRP condition, consistent with the 2005 CalSim version. The FNA Scenario also models the upper San Joaquin River without the SJRRP. The SJR depicts near-term operations including SWRCB D-1641 flow and water quality requirements at Vernalis met when hydrologically possible with New Melones operations. The Vernalis flow objective is set by SWRCB D-1641 February-June base flow requirements. There are no pulse flow requirements during April and May, and there is no acquired flow such as VAMP or Merced water. D1641 Vernalis water quality requirements are set at 950/650 EC to provide an operational buffer for the requirement. New

Melones is operated to provide RPA Appendix 2E flows as fishery releases and maintains the DO objective in the Stanislaus River through a flow surrogate. Stanislaus River water right holders (OID/SSJID) are provided deliveries up to land use requirements as occasionally limited due to operation agreement (formula). CVP Stanislaus River contractors are provided allocations up to 155 TAF per year in accordance with proposed 3-level plan based on the New Melones Index (NMI). For modeling purposes during the worst drought sequence periods, CVP Stanislaus River contractors and OID/SSJID diversions are additionally cut to maintain New Melones Reservoir storage no lower than 80 TAF. Merced River is operated for Federal Energy Regulatory Commission (FERC) and Davis-Grunsky requirements, and provides October flows as a condition of Merced ID's water rights. The Tuolumne River is operated to its current FERC requirements and current water use needs and has been updated to recent conditions.

Folsom Lake Flood Control Diagram

During wetter years, inflow to Folsom Lake is sufficient to keep the reservoir full while satisfying all demands downstream. When this condition occurs in actual operations, operators increase releases during summer months to maintain higher instream flows and prevent large releases in the fall to evacuate Folsom to satisfy flood control storage requirements. To prevent the model from keeping the reservoir full going into the fall months and then making large releases to comply with flood control storage requirements, the maximum allowable storage during summer months is ramped from full storage in June to flood control levels in the fall. Although this is a common modeling tool, Folsom storage level for the end of September was set too low in the SWP DRR model causing unnecessary releases and resulting in Folsom storage being lower than desired. An adjustment was made to achieve a more realistic summer drawdown for Folsom.

Feather River Rice Decomposition Demand

Demand for rice straw decomposition (decomp) water from Thermalito Afterbay was added to the model and updated to reflect historical diversion from Thermalito in the October through January period. There are approximately 110,000 acres of rice in the Feather River Service Area irrigated primarily with water diverted from Thermalito Afterbay. Although decomp water demand for the Sacramento River has been included in CalSim II since about 2006, this demand has been absent for the Feather River. Inclusion of decomp demand in the version of CalSim II used for this effort results in an increase in Feather River diversion in fall months of about 160,000 AF.

Dynamic EBMUD Diversion at Freeport

Previously the EBMUD operation was pre-determined and input to CalSim II as a time-series. The below criteria was implemented in CalSim II model code to achieve a dynamic representation of EBMUD diversion from the Sacramento River at Freeport.

The EBMUD water service contract is unique. EBMUD's total system storage must be forecast to be below 500 TAF on October 1 for CVP water to be available under the EBMUD contract. In years when this occurs, we assume EBMUD will take the minimum of 65 TAF of CVP water or their CVP allocation (133 TAF * CVP M&I allocations) in the first and second years of any multi-year period when CVP water is available under their contract. In the third year, EBMUD would be limited to 35 TAF of CVP water (assuming diversion of 65 TAF in years one and two) because their contract limits cumulative CVP water over three consecutive years to 165 TAF. The 65, 65, 35 TAF annual diversion pattern then repeats if water is available for four or more consecutive years under the EBMUD contract.

Wilkins Slough Minimum Flow Requirement

Wilkins Slough minimum flow requirements, C129_MIF, includes an adjustment for daily operations based on work with the Sacramento River Daily Operations Model (SRDOM). The flow adjustment for daily flows for September 1933 in the state variable input file appeared unreasonable in the previous model. The flow

adjustment in this month was approximately 1,860 cfs and was requiring release of approximately 100 TAF out of Shasta. Review of the entire time-series of daily adjustments showed the adjustment in this month was an order of magnitude greater than in any other September in the simulation period. The year 1933 is a critically dry year, and the third of four consecutive Shasta Critical years. Historical precipitation records from the consumptive use models for the Sacramento Valley, which serves as the basis of much of the CalSim hydrology, were reviewed to ensure there was no unusual precipitation in this month that may create variations in daily flows. It was determined that this daily adjustment is in error. The daily adjustment for this time-step was set to 10 cfs, the value for August 1933.

CVP M&I Demands

Reclamation M&I contractor demands upstream from the Delta have not been adequately represented in CalSim II until Reclamation updated the model in 2012. A more accurate representation of CVP M&I demands, developed in 2012, was incorporated into the model for this effort.

Yuba Accord Water Transfer

In CalSim, Yuba Accord Water Transfers are limited to releases from New Bullards Bar Reservoir. The release is picked up at Banks Pumping Plant or stored in Oroville and Shasta for later release. The additional release from New Bullards Bar is represented in CalSim through an inflow arc. The subsequent refill of New Bullards Bar is represented in CalSim through a diversion arc. In CalSim II, refill is assumed to always occur in the winter following the transfer. However, in the SWP DRR model, there were a few years in which no transfers took place but refill still occurred in the following winter. This was fixed in the updated baseline by capping refill to the previous summer's total transfer.

Los Vaqueros Reservoir

Expansion of Los Vaqueros Reservoir was completed in 2012. Storage capacity was increased from 103 TAF to 160 TAF. In DWR's BDCP studies, Los Vaqueros capacity was set to 103 TAF. The independent modeling increases Los Vaqueros capacity to 160 TAF.

3.2 Changes to BDCP Operations

San Luis Reservoir Rule-Curve Logic Change

In the independent modeling, San Luis rule-curve logic was refined for both SWP and CVP operations. San Luis rule-curve is used to maintain an appropriate balance between San Luis Reservoir storage and North of Delta reservoirs. The key considerations in formulating rule-curve are as follows:

- Ensure that sufficient water is available in San Luis Reservoir to meet contract allocations when exports alone are insufficient due to various operational constraints.
- Minimize San Luis Reservoir carryover storage to low point criteria (both CVP and SWP) and Article 56 carryover (only SWP). The basic premise is to maintain Reservoir San Luis storage no higher than necessary to satisfy south of Delta obligations to avoid excessive drawdown of upstream storage.

In DWR's BDCP studies, there were significant shortages in Table A and Article 56 deliveries because of an improper balance between upstream and San Luis Reservoir storage. The updated SWP rule-curve logic reduces these shortages but does not eliminate them. Also, the updated CVP rule-curve logic allows for higher CVP allocations without increasing risk of shorting SOD contractors.

Upstream Storage Release to Fill San Luis Reservoir Above Needed Supply

In the BDCP NAA and the independent modeling FNA, the model has a priority to release excess stored water that will likely be released for flood control purposes from Shasta and Folsom storage for export at Jones Pumping Plant to storage in San Luis Reservoir in the late summer and early fall months. The purpose was to get a head start on filling San Luis Reservoir for the coming water year if there is a high likelihood of Shasta or Folsom spilling. This was an assumed CVP/SWP adaptation to the export reductions in the winter and spring months due to the salmon and smelt biological opinions. However, with the NDD facility in Alt 4, winter and spring export restrictions impact CVP exports much less and there is no longer a reason to impose this risk on upstream storage. As such, the weights, or prioritizations, of storage in Shasta and Folsom were raised so that excess water would not be released specifically to increase CVP San Luis storage Reservoir above rule-curve. This was changed in Alt 4 and not the FNA to better reflect how the system may operate under these different conditions.

Delivery allocation adjustment for CVP SOD Ag service and M&I contractors

CVP SOD Ag service and M&I allocations are limited by both systemwide water supply (storage plus inflow forecasts) and Delta export constraints; whereas similar CVP NOD allocations are dependent solely on water supply. This frequently results in SOD water service contractors receiving a lower contract year allocation than NOD water service contractors, especially under the Biological Opinion export restrictions. However, with the NDD facility operations as proposed under Alt 4 H3, the CVP can largely bypass these Delta export restrictions, and the export capacity constraint on CVP SOD allocations was determined to be overly conservative. Therefore, the export capacity component of CVP SOD allocations was removed in the BDCP Alternative and both SOD and NOD CVP allocations are equal and based only on water supply.

Folsom/Shasta Balance

CVP operations were refined in the BDCP Alternative to provide maximum water supply benefits to CVP contractors while protecting Trinity, Shasta, and Folsom carryover storage in the drier years. As a whole, this was accomplished with refinements to allocation logic and San Luis rule-curve. However, in initial study runs, an imbalance between Folsom and Shasta was created; while there was a total positive impact to upstream storage in dry years, there was a negative impact to Folsom storage. This was resolved by inserting Folsom protections in the Shasta-Folsom balancing logic. With these protections, the positive carryover impacts were distributed to Trinity, Shasta, and Folsom.

North Delta Diversion Bypass Criteria

The daily disaggregation method for implementing NDD bypass criteria as implemented in DWR's BDCP model was left mostly intact for the updated BDCP studies. However, there were modifications to properly fit the bypass criteria implementation within the latest CalSim operations formulation. Modifications are as follows:

1. No NDD operations occur in cycles 6 through 9 so that Delta operations and constraints can be fully assessed without NDD interference.
2. Cycles 10 and 11 (Daily 1 and Daily 2 respectively) were added to determine NDD operations given various operational constraints including the NDD bypass criteria.
3. From July to October, bypass criteria are based on monthly average operations (no daily disaggregation). Given the controlled reservoir releases at this time and the constant bypass criteria (5,000 cfs from July to September and 7,000 cfs in October), this was determined to be a reasonable assumption. This also simplified coordination of DCC gate operations with NDD in October which will be discussed later.
4. When warranted by conditions in cycle Daily 1 (cycle 10), the bypass criteria in May and June were allowed to be modeled on a monthly average basis in cycle Daily 2 (cycle 11). This allowed a reduction in the number of cycles necessary to determine the fully allowed diversion under the bypass criteria when

the Delta was in balance and additional upstream releases were made to support diversions from the North Delta.

Delta Cross Channel Gate Reoperation in October

The BDCP Alt 4 results in significantly more October surplus Delta outflow as compared to the baseline. The cause of this Delta surplus at a time when the Delta is frequently in balance is a combination of proposed through-Delta export constraints (OMR flow criteria and no through-Delta exports during the San Joaquin River October pulse period), Rio Vista flow requirements, and DCC gate operations. In DWR's BDCP studies, it was assumed that the DCC gates would be open for the entire month of October thereby requiring much higher Sacramento River flows at Hood in order to meet the Rio Vista flow requirement than if the DCC gates were closed. Whereas in the independent BDCP modeling it was assumed that the DCC gates were closed for a number of days during the month such that the 7,000 cfs NDD bypass criteria would be sufficient to meet the weekly average Rio Vista flow requirements. The intent was to minimize surplus Delta outflow while meeting Delta salinity standards and maintaining enough bypass flow to use the NDD facility for SOD exports. This is an approximation of what is likely to occur in real-time operations under similar circumstances. Further gate closures may be possible as salinity standards allow if operators decide to preserve upstream storage at the expense of NDD diversions. This type of operation would require additional model refinements.

Wilkins Slough minimum flow requirement

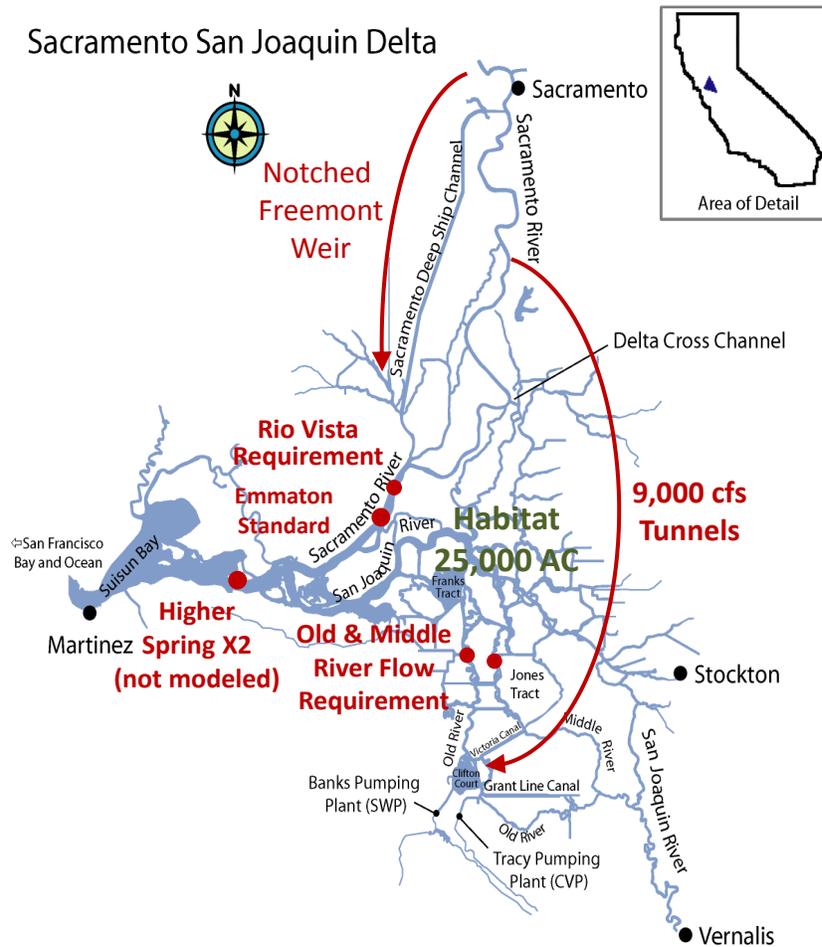
Currently in CalSim II, relaxation of the Wilkins Slough minimum flow requirement is tied to CVP NOD Ag Service Contractor allocations. This does not reflect actual operations criteria where relaxation of the flow requirement is dependent solely on storage conditions at Shasta. From the comparative analysis perspective of our CalSim planning studies, this introduces a potential problem: changes in CVP NOD Ag Service allocations can result in unrealistic changes in required flow at Wilkins Slough, and such changes in Wilkins Slough required flow can result in unrealistic impacts to Shasta storage. To bypass this problem, we assumed that the required flow at Wilkins Slough in the alternative was equal to the baseline.

3.3 Alternative 4 Modeling results

Analysis for this effort was focused on BDCP Alt 4 with existing spring and fall X2 requirements, which corresponds to “Alternative 4 H3” in the Decisions Tree. This modeling is performed without climate change, and includes refined operating criteria for the NDD, CVP and SWP reservoirs, DCC gate closures, and water supply allocations. This modeling includes all Project features that are included in Alt 4 in the BDCP modeling. The Project features are displayed in Figure 39 and summarized as:

- NDD capacity of 9,000 cfs
- Bypass flow requirements for operation of the NDD
- Additional positive OMR flow requirements
- No San Joaquin River I/E ratio
- Changed location for Emmatton water quality standard in SWRCB D-1641
- Additional Sacramento River flow requirement at Rio Vista
- 25,000 acres of additional tidal habitat
- Notched Fremont Weir

Figure 39. Alt 4 Features

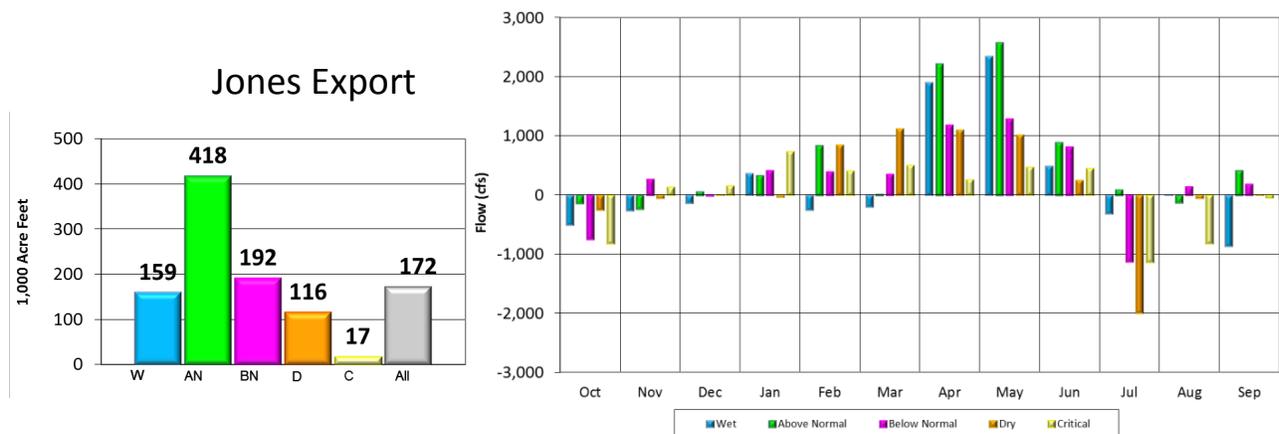


For the purpose of describing results of the independent modeling, the revised Future No Action model scenario is labeled “FNA” and the revised BDCP Alt 4 scenario is labeled “Alt 4”.

CVP/SWP Delta Exports

Average annual exports at Jones pumping plant are about 170 TAF higher in the Alt 4 Scenario compared to the FNA scenario, as seen in Figure 40. Increases generally occur from January through June when Old & Middle River (OMR) criteria limit use of Jones PP in the FNA Scenario. Decreases occur in July in drier year types because the increased ability to convey water in spring months reduces the need to convey water stored in upstream reservoirs in July. Reductions in Jones export in October are partially a function of increases in OMR flow requirements.

Figure 40. Change in Delta Exports at Jones Alt 4 minus FNA



Similar to export at Jones, Banks exports are generally higher from January through June because use of NDD allows pumping that is not possible in the FNA Scenario, as seen in Figure 41. Banks exports are increased during summer months of wetter year types. This is due to earlier wheeling for CVP Cross Valley Canal contractors (without NDD Banks capacity isn’t typically available until Fall in wet years) and wheeling of CVP water through Joint Point of Diversion (JPOD). CVP export at Banks is displayed in **Figure 42**. In wetter years, upstream CVP reservoirs hold more water than can be exported at Jones pumping plant, this water is typically spilled in the FNA scenario. CVP water stored in upstream reservoirs can be released in July, August, and September to support south of Delta beneficial use of water through use of JPOD in Alt 4.

Figure 41. Change in Delta Exports at Banks Alt 4 minus FNA

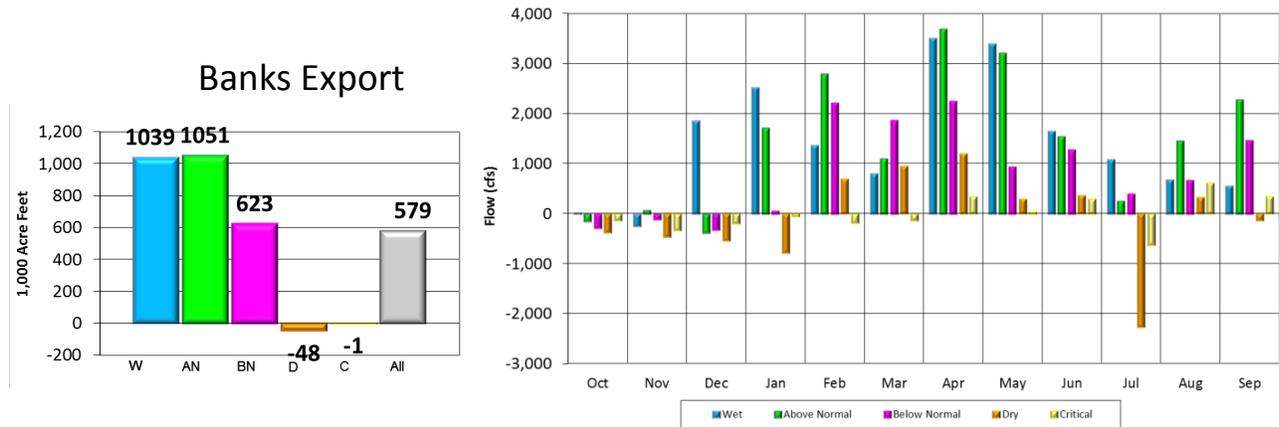
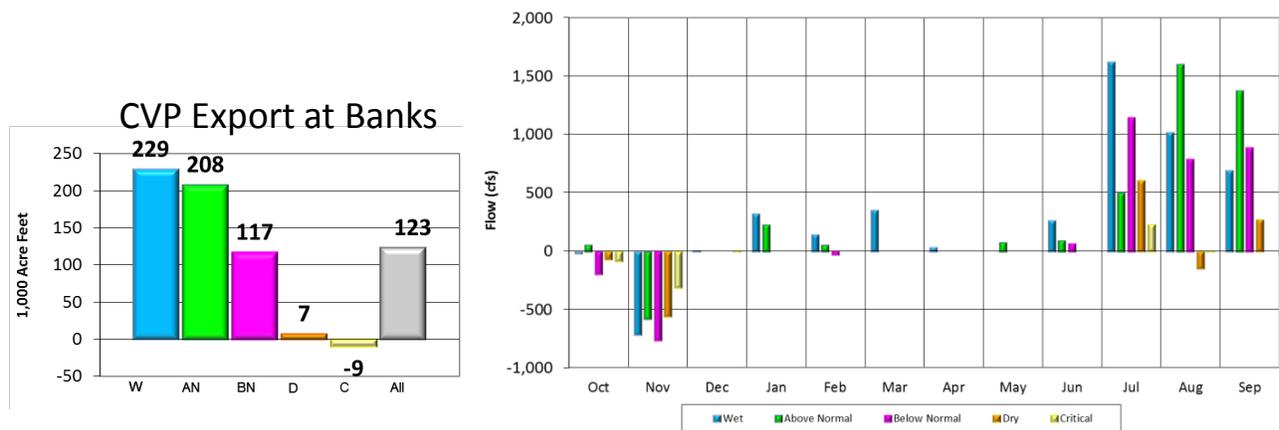


Figure 42. Change in CVP Delta Exports at Banks Alt 4 minus FNA



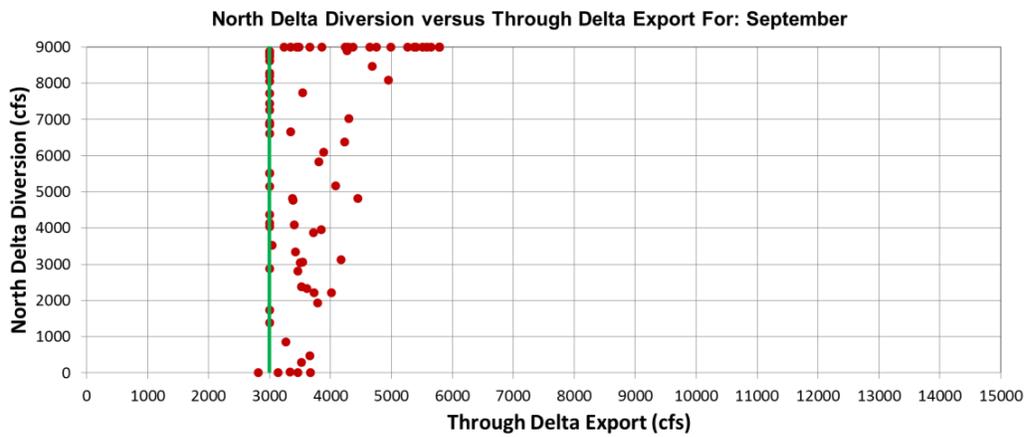
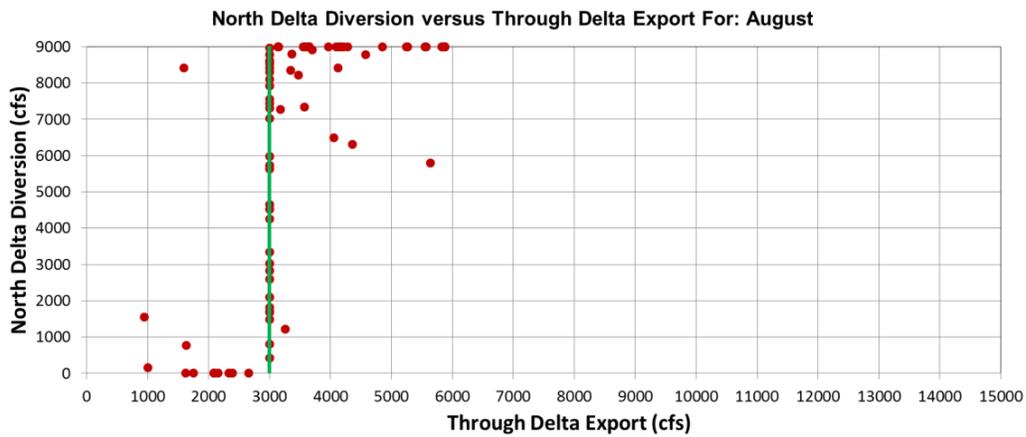
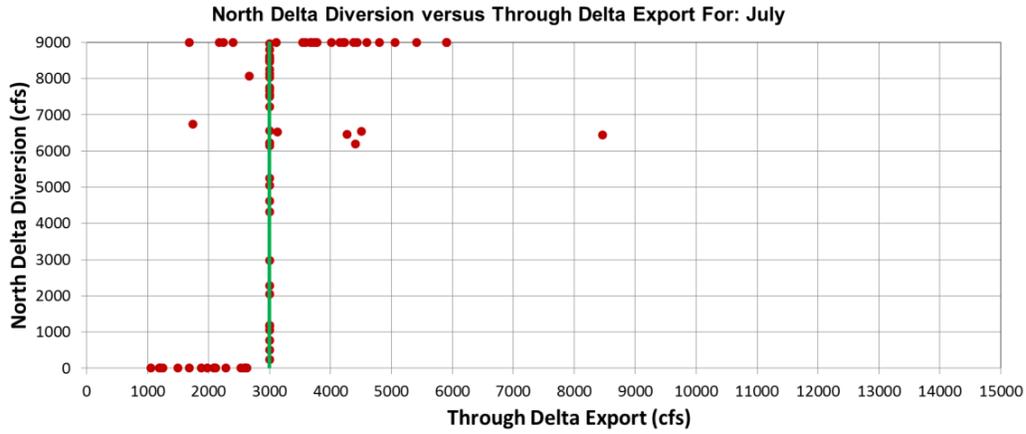
Changes in total, South Delta, and North Delta exports are displayed in Figure 43. Average annual increase in total Delta exports is about 750 TAF, the increases primarily occur in wetter year types with lesser increases in dryer years. South Delta export decreases about 2.53 MAF in Alt 4 relative to the FNA. Export through the NDD is 3.28 MAF in Alt 4, about 58% of total exports are diverted from the North Delta.

Figure 43. Change in Conveyance Source of Exports (Alt 4 minus FNA)



Figure 44 contains modeling results from Alt 4 for July, August, and September that plot NDD against SDD (Through Delta Export). There are many occasions when SDD are 3,000 cfs, which is due to criteria specifying that SDD during this time period need to be at least 3,000 cfs prior to diverting at the NDD facility. Although there are about six occurrences in July and three in August where the model did not satisfy this criterion, this issue has not yet been addressed for this modeling effort.

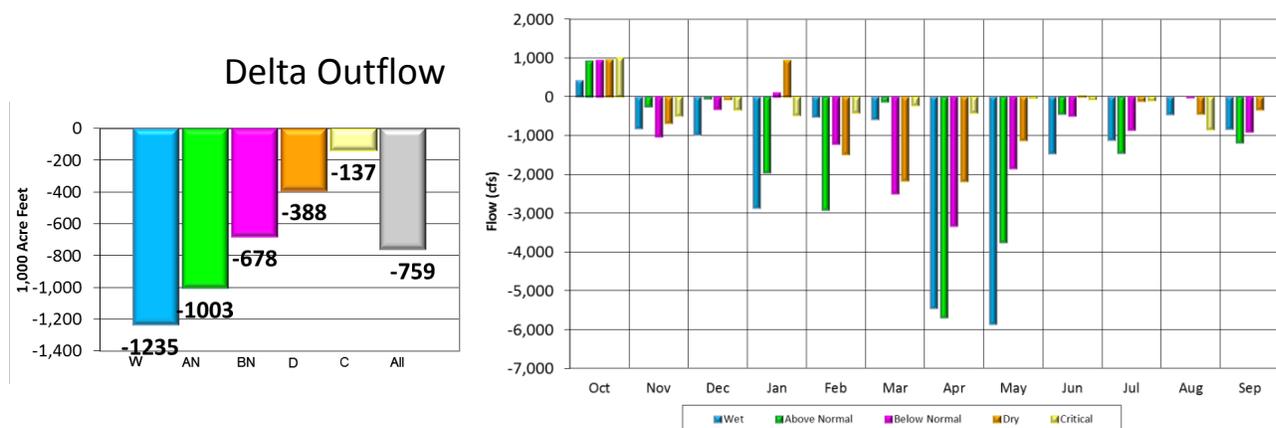
Figure 44. Alt 4 North Delta Diversion Versus South Delta Diversion for July, August, and September



Delta Outflow

Figure 45 contains annual and monthly average changes in Delta outflow by water year type, average annual Delta outflow decreases about 760 TAF in the Alt 4 Scenario relative to the FNA Scenario. The decrease is primarily due to increases in Delta exports, which are about 750 TAF on average. Larger decreases generally occur in January through May when exports are constrained in the FNA Scenario and in the Alt 4 Scenario the NDD can be used to export water. Delta outflow increases in October due to the combination of additional OMR flow requirements that restrict exports and Sacramento River flow requirements at Rio Vista. The additional surplus Delta outflow in Alt 4 was minimized through coordination of the Delta Cross Channel Gate operations with the Rio Vista flow requirements and North Delta Diversion bypass requirements.

Figure 45. Changes in Delta Outflow (Alt 4 minus FNA)



Carryover Storage

Figure 46, Figure 47, Figure 48, and Figure 49 contain exceedance charts for carryover storage and average monthly changes in storage by Sacramento Valley Water Year Type for CVP and SWP upstream reservoirs. CVP/SWP reservoirs tend to be higher in the Alt 4 Scenario relative to the FNA on an average basis. Generally, CVP/SWP reservoirs are higher in storage in dryer year types and can be lower in wetter year types.

Ability to convey stored water from upstream CVP/SWP reservoirs to south of Delta water users is increased in Alt 4 relative to the FNA. Therefore, when upstream reservoirs are at higher storage levels more water is released to satisfy south of Delta water demands. This is the primary reason Shasta, Oroville, and Folsom tend to be lower during summer months of wetter years.

Currently, and in the FNA Scenario, the CVP and SWP ability to export natural flow, or unstored water, is constrained due to SWRCB D-1641 and requirements in the salmon and smelt biological opinions. With the greater ability to export unstored water during winter and spring months in the Alt 4 Scenario, compared to FNA, there is generally a reduced reliance on stored water to satisfy south of Delta demands. The increased ability to export unstored water allows the CVP and SWP to maintain higher storage levels in upstream reservoirs during dryer year types while still maintaining south of Delta deliveries. Carryover storage in the Alt 4 Scenario tends to be higher than the FNA Scenario at lower storage levels, and Alt 4 storage is lower in wetter years when storage levels are higher. In the wettest of years there is enough water in the system that both scenarios have similar carryover storage conditions.

Figure 46. Trinity Reservoir Carryover Storage and Average Monthly Changes in Storage by Water Year Type

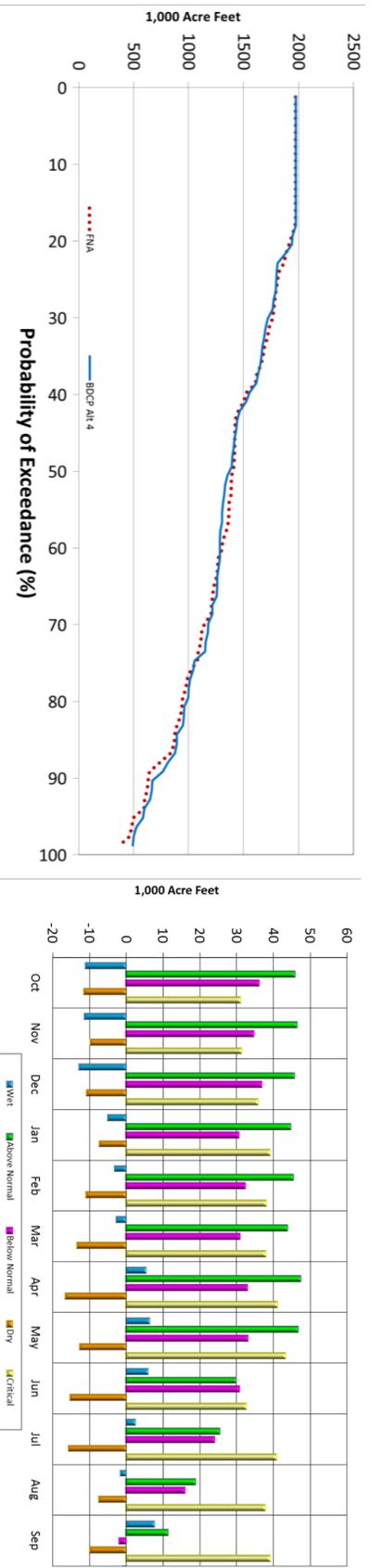


Figure 47. Shasta Reservoir Carryover Storage and Average Monthly Changes in Storage by Water Year Type

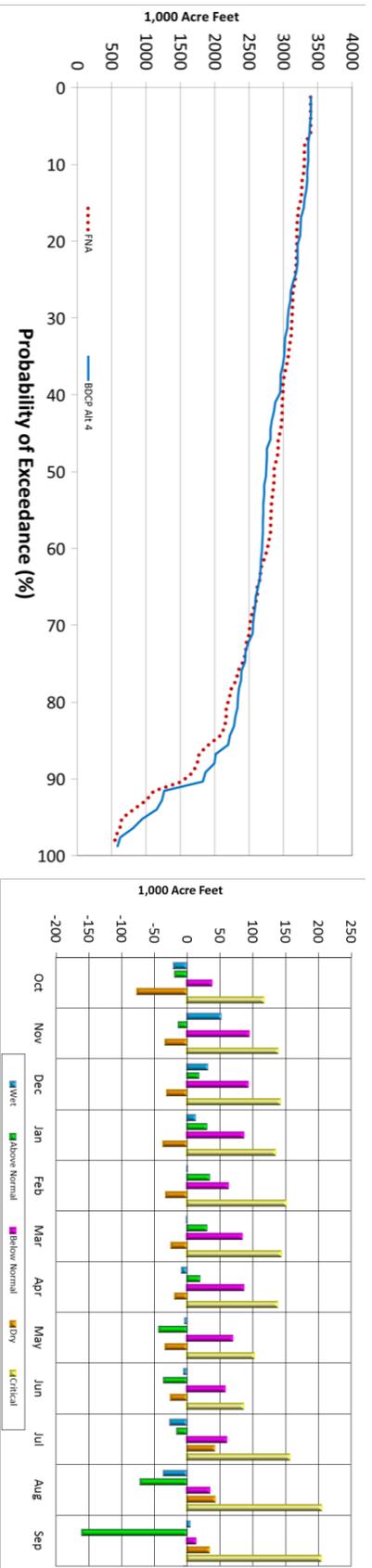


Figure 48. Oroville Reservoir Carryover Storage and Average Monthly Changes in Storage by Water Year Type

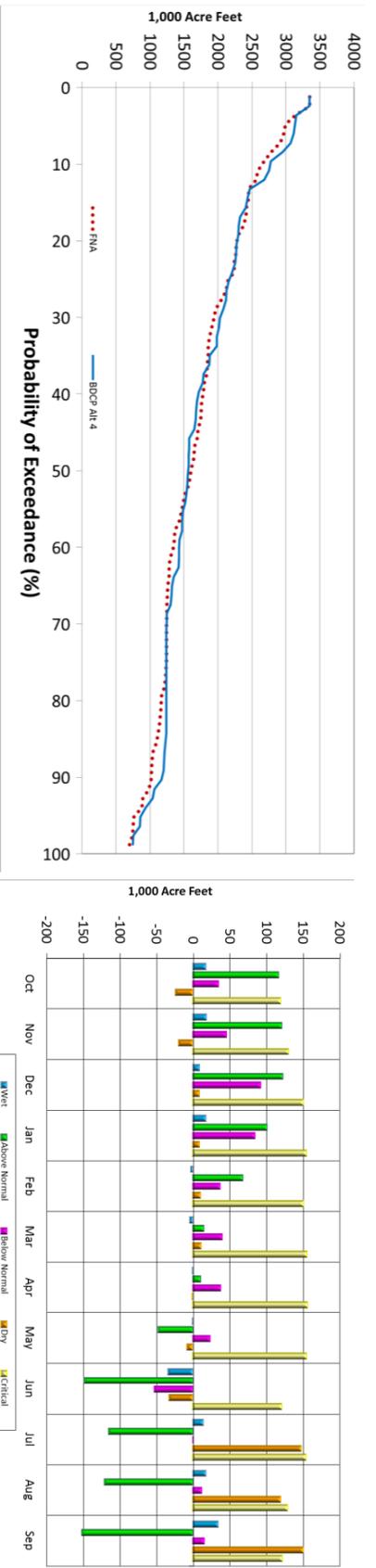
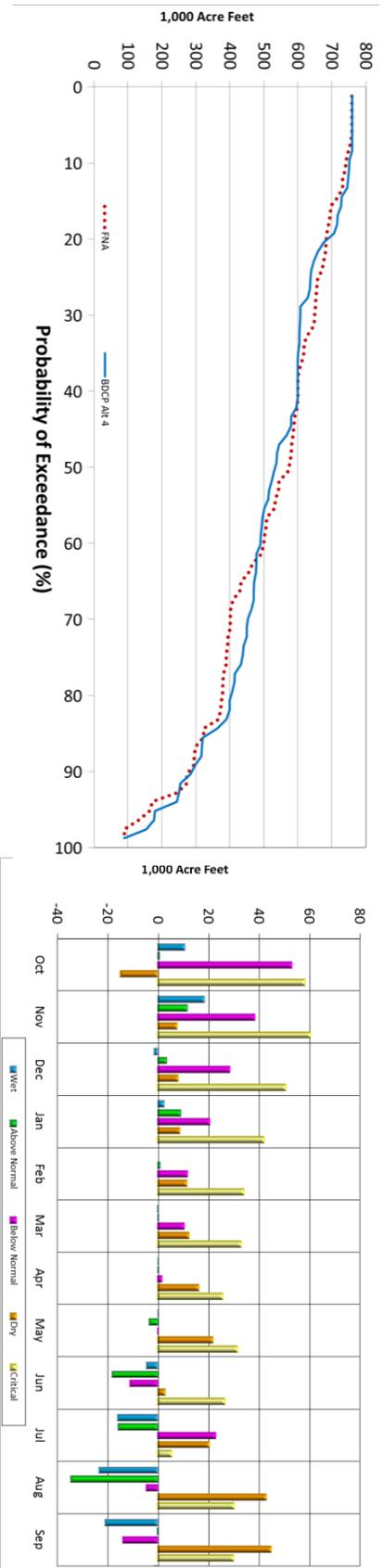


Figure 49. Folsom Reservoir Carryover Storage and Average Monthly Changes in Storage by Water Year Type



San Luis Reservoir Operations

As seen in Figure 50 and Figure 51 below, both CVP and SWP portions of San Luis Reservoir storage fills more regularly in the Alt 4 Scenario. As described earlier in this document, low point in both CVP and SWP San Luis Reservoir is managed to satisfy water supply obligations the model makes during the spring of each year. This is a complex balance involving available upstream storage, available conveyance capacity, delivery allocations, and south of Delta demand patterns. Considering this myriad of variables, there are times when low point in San Luis Reservoir is higher in the Alt 4 Scenario than the FNA Scenario and times when the opposite is true.

Figure 50. SWP San Luis

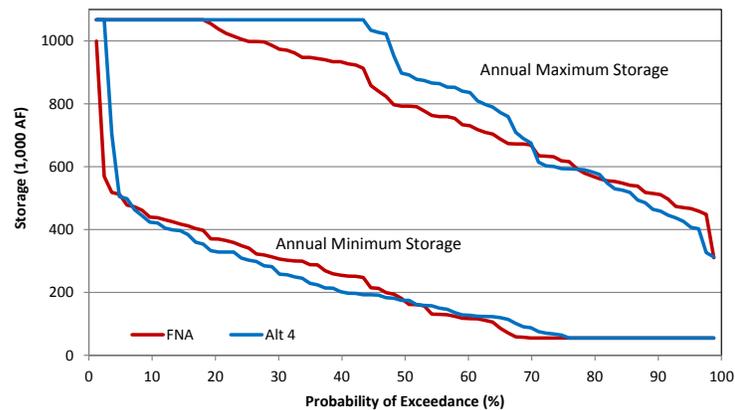
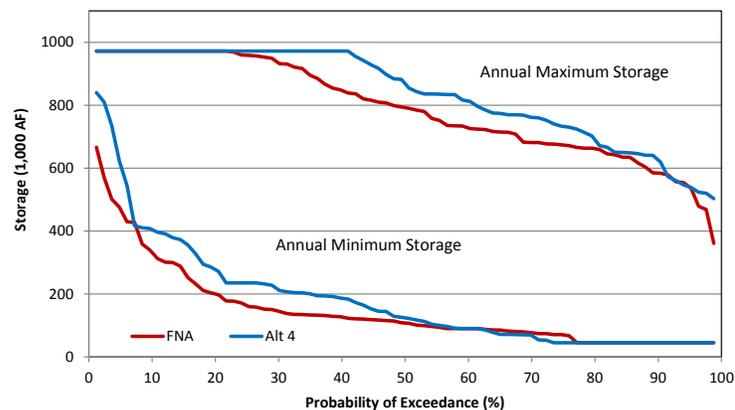


Figure 51. CVP San Luis



CVP Water Supply

As can be seen in Table 5, the independent modeling analysis shows an average increase of approximately 262 TAF of delivery accruing to CVP customers in the Alt 4 Scenario relative to the FNA Scenario, mostly occurring to CVP SOD agricultural customers. Delivery increases are greater in wetter year types with lower increases in dryer years. Figure 52 contains exceedance probability plots for CVP water service contractor deliveries and allocations. Changes in Sacramento River Settlement and San Joaquin River Exchange Contractor deliveries do not occur in the modeling analysis and are not an anticipated benefit of the BDCP. Although modeling demonstrates minor changes to NOD CVP service contractors, this increase is not an anticipated benefit of the BDCP.

Table 5. CVP Delivery Summary

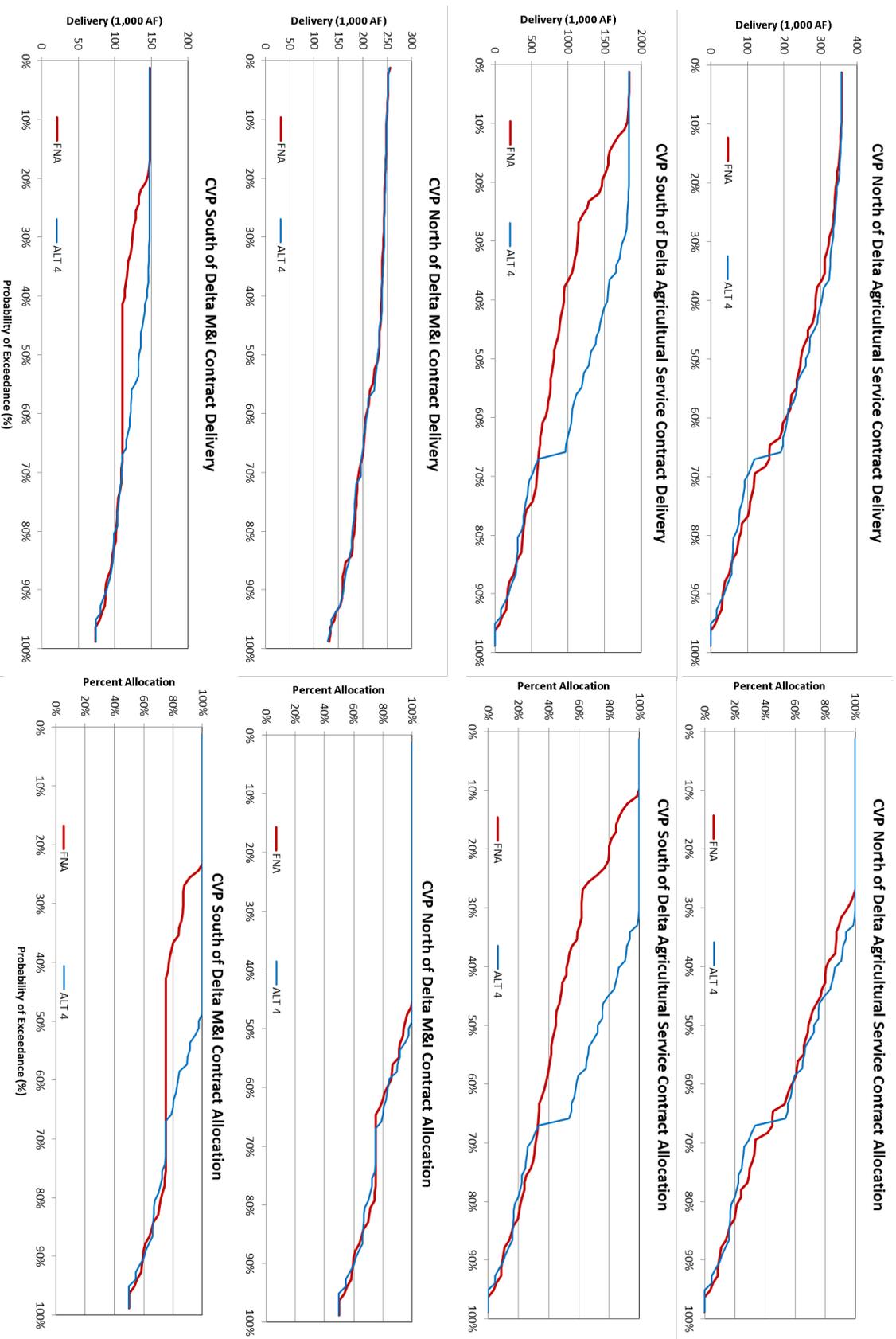
Average Annual CVP deliveries by Water Year Type FNA (1,000 AF)

	AG NOD	AG SOD	Exchange	M&I NOD	M&I SOD	Refuge NOD	Refuge SOD	Sac. Setlmnt	CVP NOD Total	CVP SOD Total
All Years	220	882	852	214	116	87	273	1860	2380	2306
W	327	1408	875	241	135	90	280	1856	2515	2881
AN	284	999	802	221	113	83	258	1716	2304	2341
BN	206	725	875	217	111	90	281	1900	2413	2176
D	138	569	864	195	106	88	277	1896	2317	2000
C	43	202	741	157	87	71	234	1754	2025	1447

Difference: Alt 4 minus FNA (1,000 AF)

	AG NOD	AG SOD	Exchange	M&I NOD	M&I SOD	Refuge NOD	Refuge SOD	Sac. Setlmnt	CVP NOD Total	CVP SOD Total
All Years	2	251	0	0	9	0	0	0	2	260
W	0	305	0	0	10	0	1	0	0	316
AN	10	492	0	1	14	1	0	-2	10	504
BN	12	354	0	5	16	0	-2	1	19	366
D	-10	67	0	-4	4	1	0	-1	-15	72
C	2	27	0	2	2	1	0	-1	4	29

Figure 52. CVP Water Supply Delivery and Allocation



July 11, 2014

SWP Water Supply

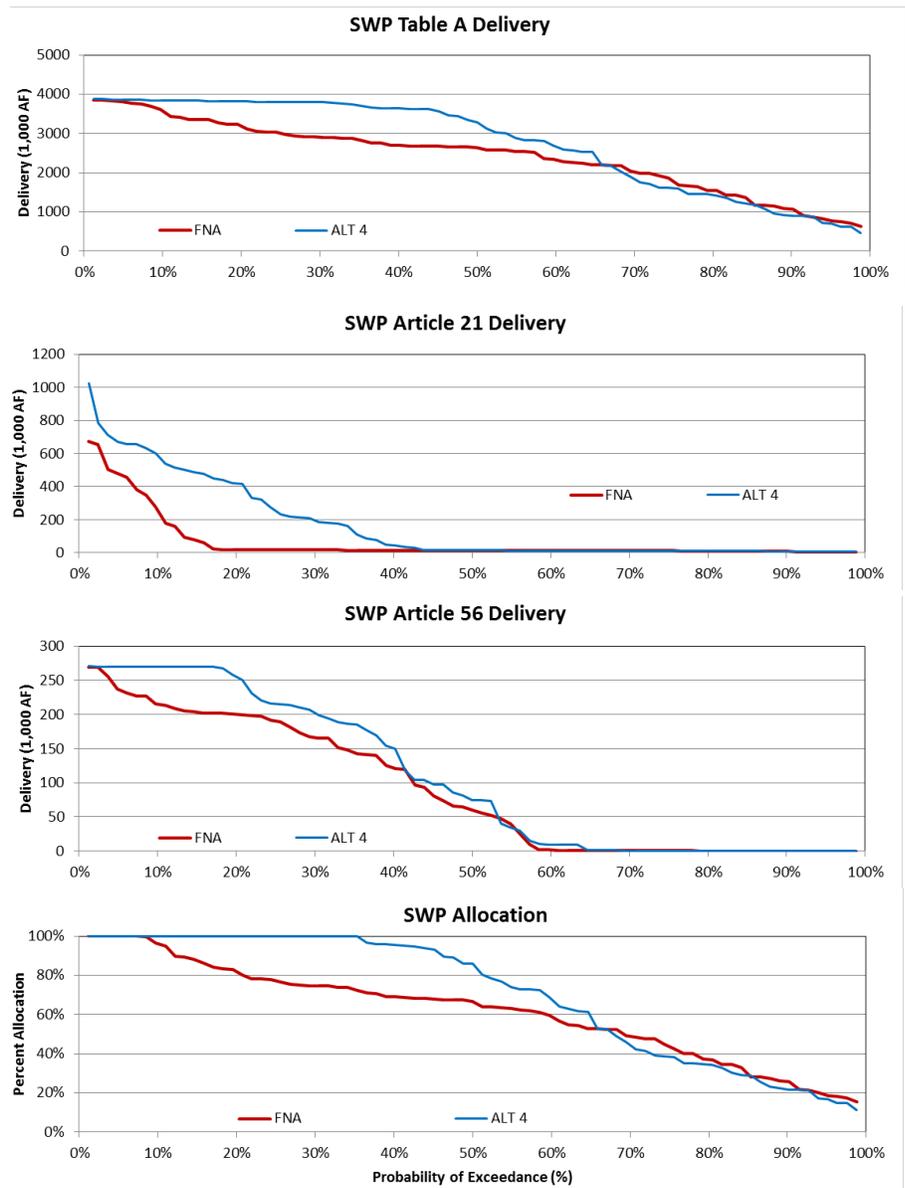
The independent analysis shows an increase in average annual SWP SOD deliveries of approximately 450 TAF, but a reduction in critical year deliveries of approximately 116 TAF. Annual average Article 21 deliveries increase by about 100 TAF and Article 56 increases by about 18 TAF. Figure 53 contains exceedance probability plots for SWP SOD deliveries for the FNA and Alt 4 Scenarios, each of these plots show increases in higher delivery years. Although Table A deliveries increase in 65% of years, there are decreases in 35% of the dryer years (see Table 6).

Table 6. SWP Delivery Summary

FNA				
	Table A	Art. 21	Art. 56	Total
All Years	2426	64	90	2580
W	3221	98	121	3440
AN	2628	86	81	2794
BN	2527	82	95	2703
D	1809	14	70	1893
C	1105	17	48	1170

Difference Alt4 minus FNA				
	Table A	Art. 21	Art. 56	Total
All Years	328	102	18	448
W	525	220	14	759
AN	636	98	-1	733
BN	565	50	31	647
D	-63	41	27	6
C	-124	-8	16	-116

Figure 53. SWP Delivery for Alt 4 and FNA



4 COMPARING INDEPENDENT MODELING AND BDCP MODELING

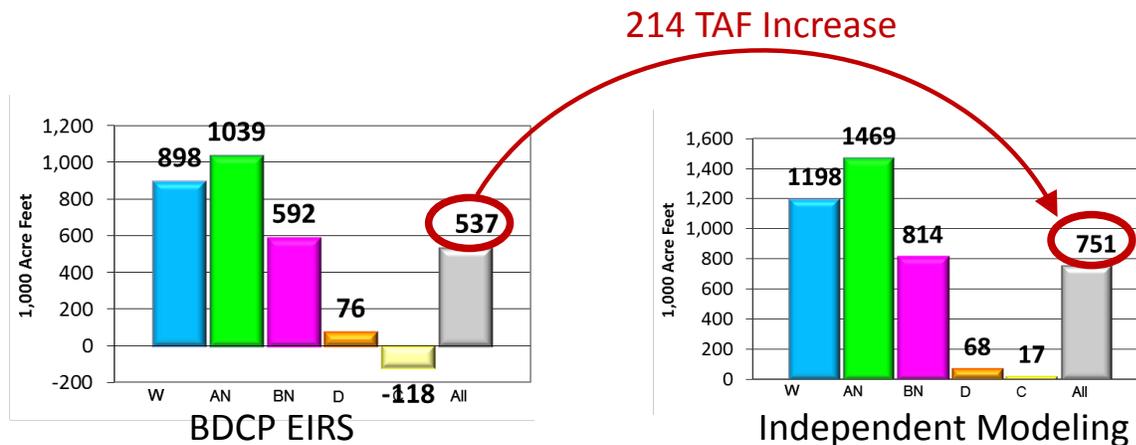
The independent modeling effort originally stemmed from reviews of DWR’s BDCP modeling where we found that BDCP modeling does not provide adequate information to determine how BDCP may affect the system. Based on the premise that the independent modeling portrays a more accurate characterization of how the CVP/SWP system may operate under Alt 4, this comparison is meant to demonstrate the differences between results of a more accurate analysis and BDCP modeling. Differences in results between these modeling efforts are believed to provide insight regarding how effects that BDCP will have on the actual CVP/SWP system differ from modeling used to support the Draft EIRS.

Although thorough comparisons of modeling were performed, only key differences are illustrated for the purpose of this comparison.

Delta Exports

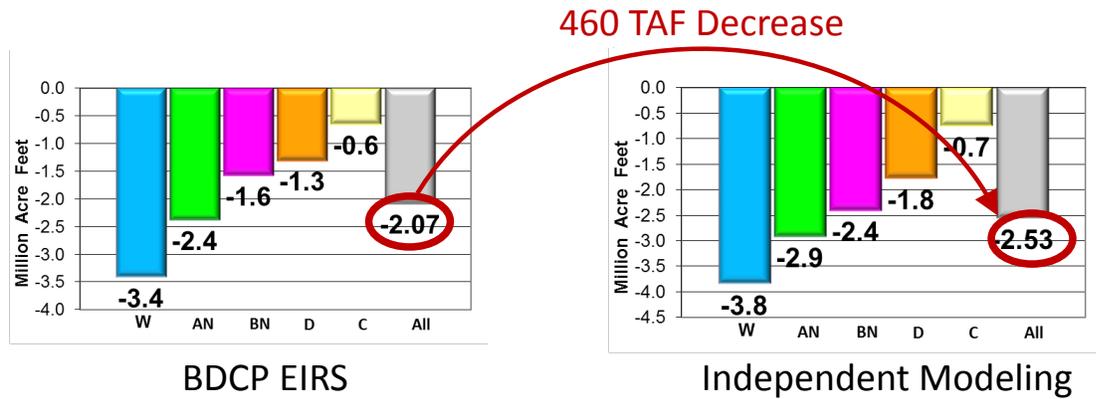
Figure 54 displays changes in the Delta exports for the BDCP modeling (Alt 4-ELT minus NAA-ELT) and for the independent modeling (Alt 4 minus FNA). Independent modeling analysis shows about 200 TAF greater increases in exports than the BDCP modeling. A large component of this difference is due to fixes of known modeling issues, as described in the 2013 SWP DRR. This difference is also attributable to more realistic reservoir operations, more efficient DCC gate operations, changes in water supply allocation logic, and more efficient operation of the NDD.

Figure 54. Result Difference: Delta Exports



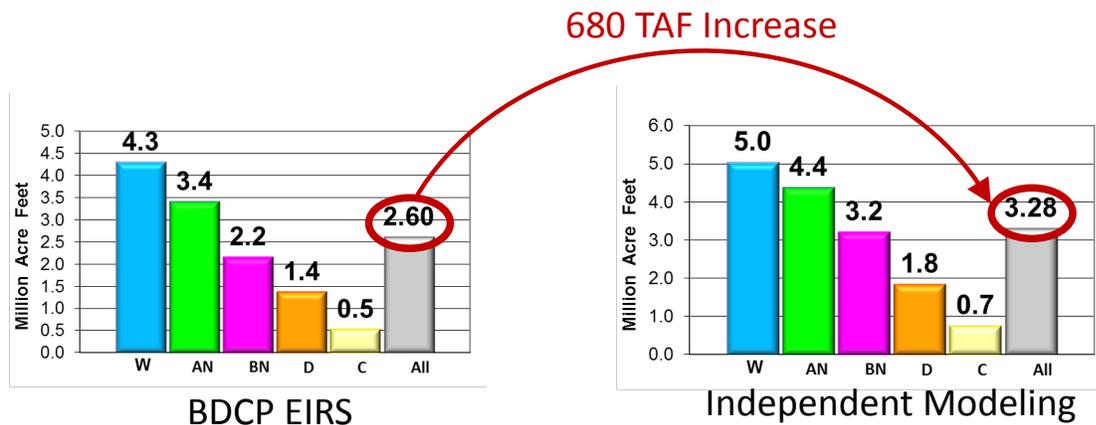
Average annual SDD are decreased by about 460 TAF in the independent analysis compared to the BDCP modeling. A large component of this difference is due to fixes of known modeling issues, as described in the 2013 SWP DRR. These fixes prevent “artificial” bypass criteria from limiting use of the NDD beyond what is intended in the BDCP project description. This difference is also attributable to more efficient DCC gate operations and more efficient operation of the NDD. Figure 55 demonstrates the difference between the BDCP and independent analysis, where SDD decrease by 2.07 MAF in the BDCP analysis and by 2.53 MAF in the independent analysis.

Figure 55. Result Difference: South Delta Diversion



Use of the NDD is 680 TAF greater in the independent analysis relative to the BDCP analysis. A large component of this difference is due to fixes of known modeling issues, as described in the 2013 SWP DRR. These fixes prevent “artificial” bypass criteria from limiting use of the NDD beyond what is described in the BDCP project description. Figure 56 compares average annual NDD in the BDCP to the independent analysis.

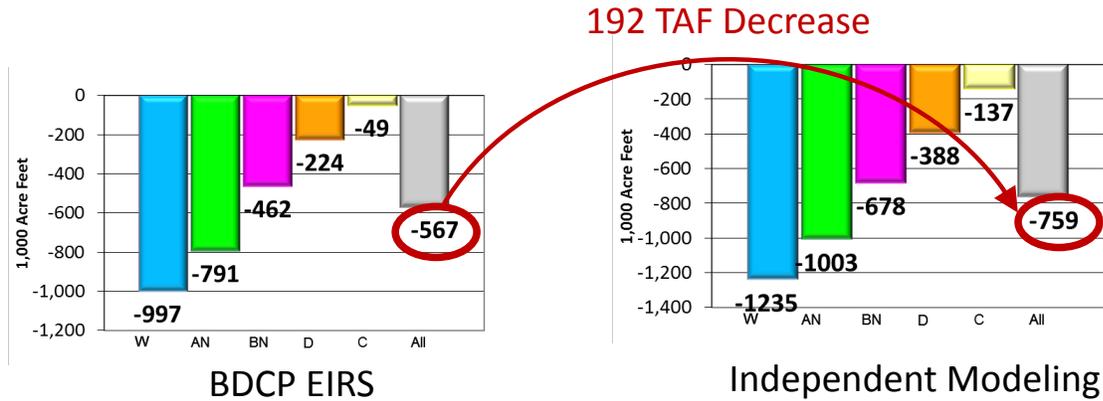
Figure 56. Result Difference: North Delta Diversion



Delta Outflow

Total Delta exports in the independent analysis are about 200 TAF greater than the BDCP modeling analysis with a corresponding decrease in Delta outflow in the independent analysis of about 200 TAF. Figure 57 compares average annual changes in Delta outflow between the independent analysis and BDCP modeling, BDCP modeling shows a decrease of about 567 TAF and the independent analysis shows a decrease of about 759 TAF.

Figure 57. Result Difference: Net Delta Outflow



Reservoir Storage

Reservoir operating rules for Alt4 in the BDCP EIRS modeling are changed relative to the NAA. In the BDCP EIRS modeling of Alt 4 rules are set to releases more water from upstream reservoirs to San Luis Reservoir from late winter through July, reduce releases in August, and then minimize releases to drive San Luis Reservoir to dead pool from September through December. This operation is inconsistent with actual operations and causes reductions in upstream storage from May through August. Figure 58 and Figure 59 contain exceedance probability plots of carryover storage and average monthly changes in storage by water year type for Shasta and Folsom for the BDCP and independent modeling. Although carryover storage for Alt 4 and the NAA is similar in the BDCP EIRS modeling, there is drawdown from June through August that may cause impacts to cold water pool management. In the independent modeling upstream reservoirs are drawn down more in years when storage is available while dryer year storage is maintained at higher levels, this is illustrated in the carryover plots for Shasta and Folsom in Figure 58 and Figure 59.

Figure 58. Result Difference: Shasta Storage

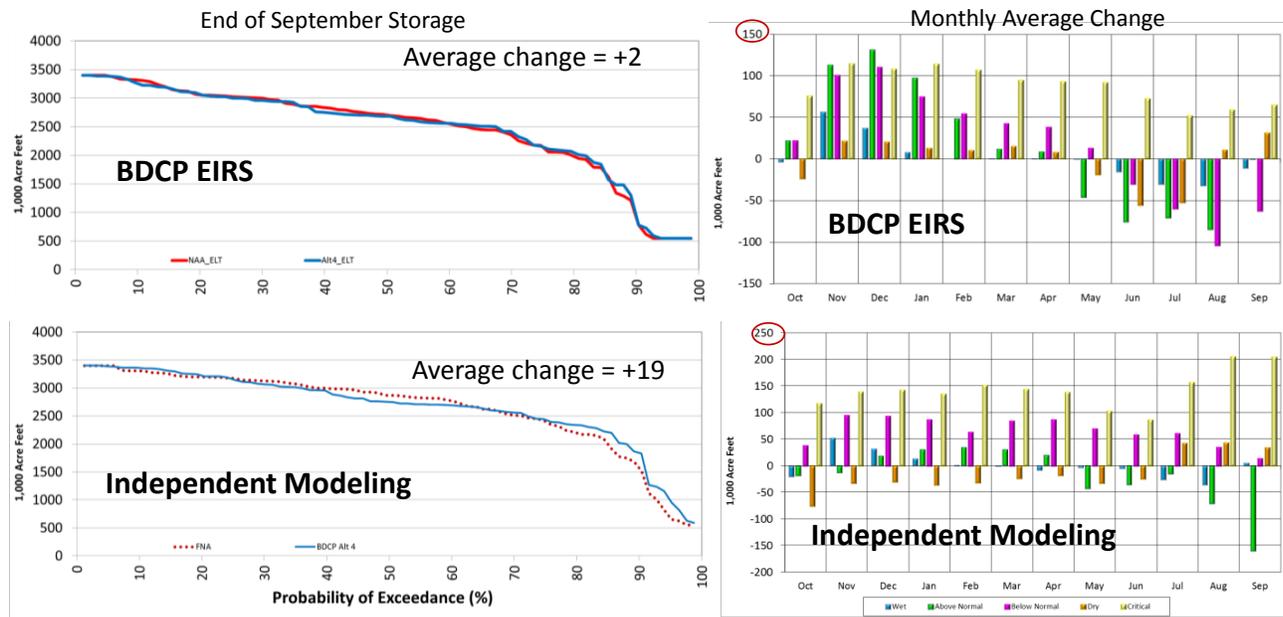
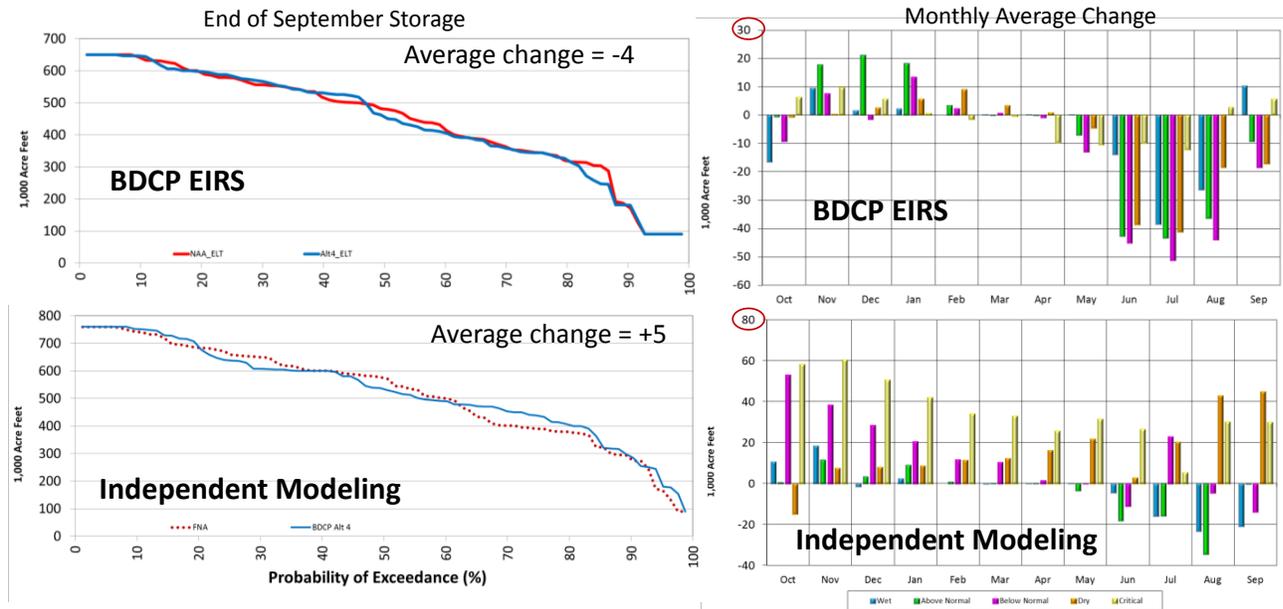


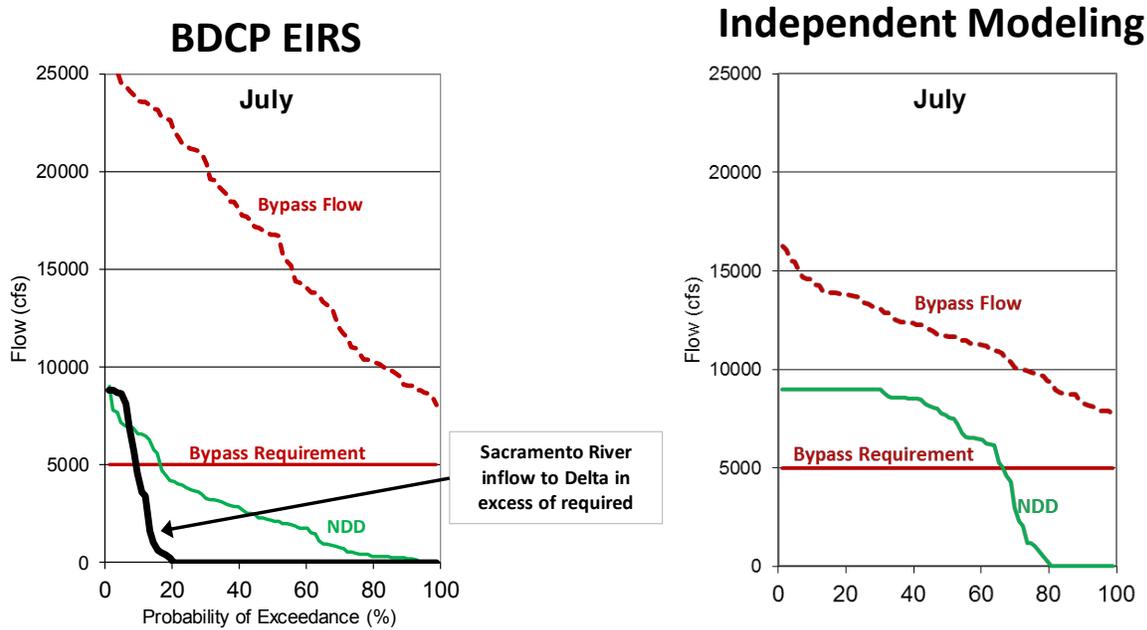
Figure 59. Result Difference: Folsom Storage



North Delta Diversions

Independent modeling shows greater NDD during July and other months because the BDCP EIRS modeling includes artificially high Sacramento River bypass flow requirements. Figure 60 contains exceedance probability plots of Sacramento River required bypass, Sacramento River bypass flow, NDD, and excess Sacramento River flow to the Delta. As can be seen in Figure 60, bypass flow is always above the bypass requirement. The BDCP version of CalSim sets a requirement for Sacramento River inflow to the Delta that the independent modeling does not need in order to satisfy Delta requirements, therefore the NDD is higher in the independent modeling.

Figure 60. NDD, and Sacramento River Flow



Delta flows below the NDD facility

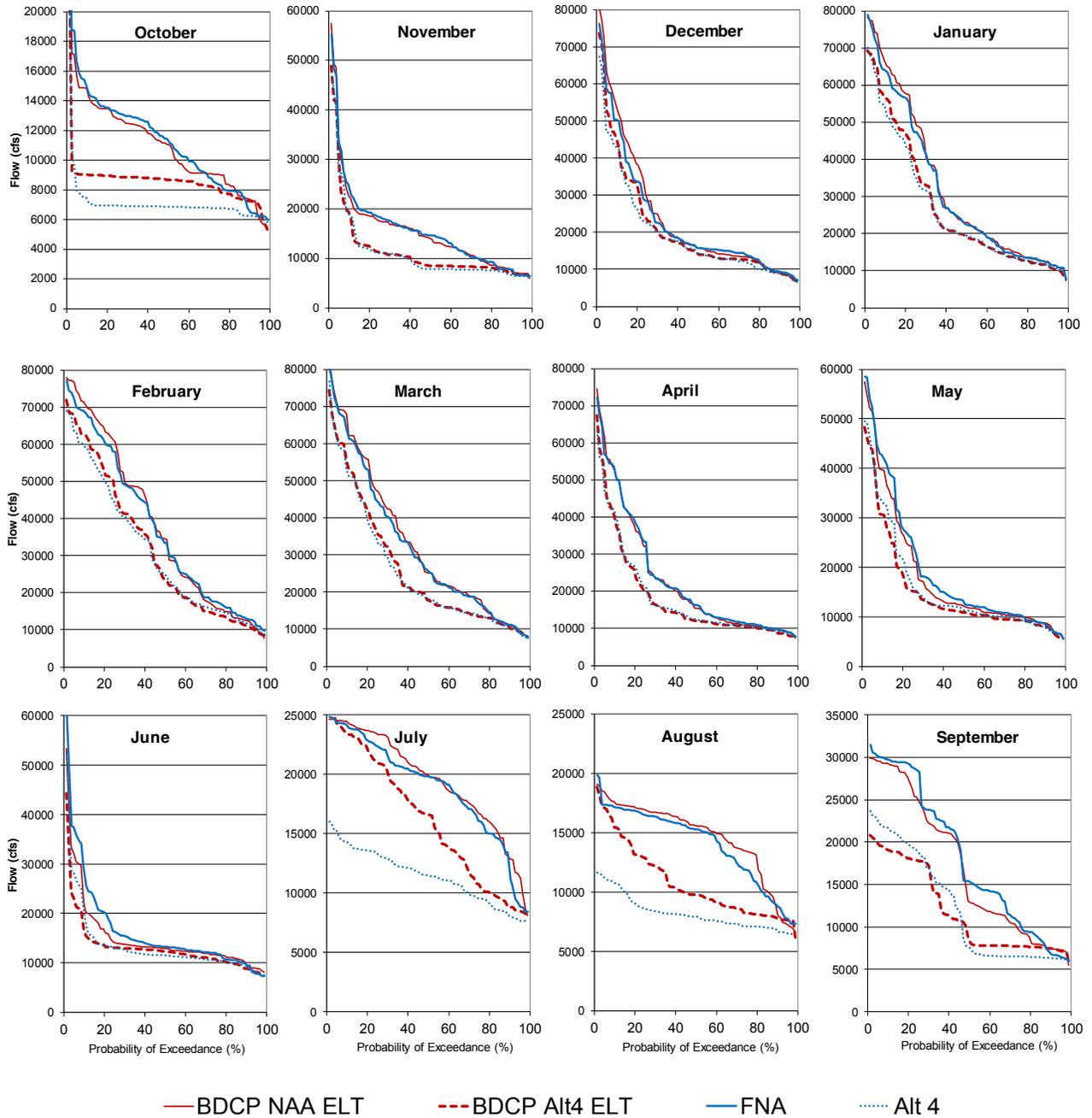
Figure 61 contains monthly exceedance probability plots for Sacramento River below the NDD for the following scenarios: 1) BDCP NAA-ELT, 2) BDCP Alt 4-ELT, 3) independent modeling FNA, and 4) independent modeling Alt 4. The most significant differences in flow changes occur in October, July, August, and September. Changes in Sacramento River flow entering the Delta are a key indicator of changes in interior Delta flows, water levels, and water quality.

For the month of October the independent modeling shows flow below the NDD to be about 2,000 cfs lower than the BDCP modeling. The difference in this month is largely due to reoperation (closure) of the cross channel gate to lessen the amount of Sacramento River flow at Hood necessary to maintain Rio Vista flow requirements downstream of the cross channel gates.

The most substantial difference between the BDCP and independent modeling occurs in July and August. The differences in these two months are primarily attributable to model fixes that have occurred since the BDCP modeling was performed. In the independent modeling, July flows are reduced on average about 7,500 cfs while BDCP shows a reduction of about 3,300 cfs. In the independent modeling August flows are reduced on average about 5,900 cfs while BDCP shows a reduction of about 3,900 cfs.

In the independent modeling September flows are reduced by about 6,100 cfs while BDCP modeling shows a reduction of about 5,300 cfs. The independent modeling shows Sacramento River flow entering the Delta to be about 7,000 cfs 50% of the time, BDCP modeling show Sacramento River flow is about 8,000 cfs 50% of the time.

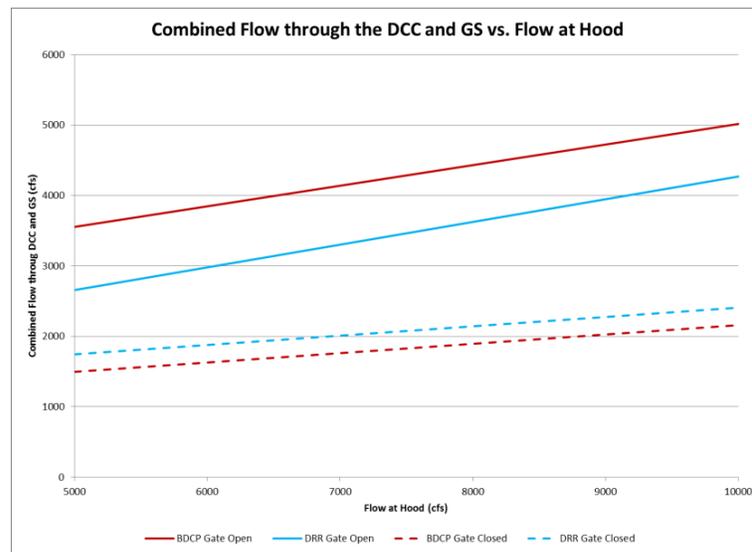
Figure 61. Sacramento River below Hood



Sacramento River water entering the Central Delta

In CalSim, flow through the DCC gate and Georgianna Slough from the Sacramento River into the Central Delta is assumed to be linearly dependent on flow at Hood. There are two linear relationships; one is used when the DCC gates are closed, and the other is used when the DCC gates are open. The 2013 SWP Delivery Reliability Report CalSim II modeling, and therefore our independent modeling, used different linear flow relationships than BDCP. The BDCP and 2013 DRR (and independent) flow relationships for both the open and closed gate conditions are compared in Figure 62. When Sacramento River flow at Hood is in the range from 5,000 cfs to 10,000 cfs the balance between Hood flow, required flow at Rio Vista, and DCC gate operation can affect upstream reservoir operations, SOD exports, and Delta outflow. As shown in Figure 62, given the same flow at Hood and DCC gates closed, the independent analysis will show slightly higher flow into the Central Delta (12% to 17% difference for the Hood flows in the 5,000 cfs to 10,000 cfs range). With DCC gates open the same flow at Hood, the independent analysis will show lower flow into the Central Delta (-15% to -25% difference for the Hood 5,000 cfs to 10,000 cfs range). Figure 63 and Figure 64 show the differences through the DCC and combined flow through the DCC and Georgiana Slough.

Figure 62. Flow through Delta Cross Channel and Georgiana Slough versus Sacramento River Flow at Hood



In addition to the differences in flow equations for portion of Sacramento River entering the interior Delta through the DCC and Georgiana Slough, the DCC gate operations were modified for the month of October. In the independent modeling, the DCC gate is operated to balance the amount of Sacramento River flow needed to meet flow standards at Rio Vista on the Sacramento River and flow needed to meet western Delta water quality. This changed operation often results in DCC gate closures for about 15 days during the month of October. The reduction in flow through the DCC during October can be seen in Figure 64.

Figure 63. Cross Channel Flow

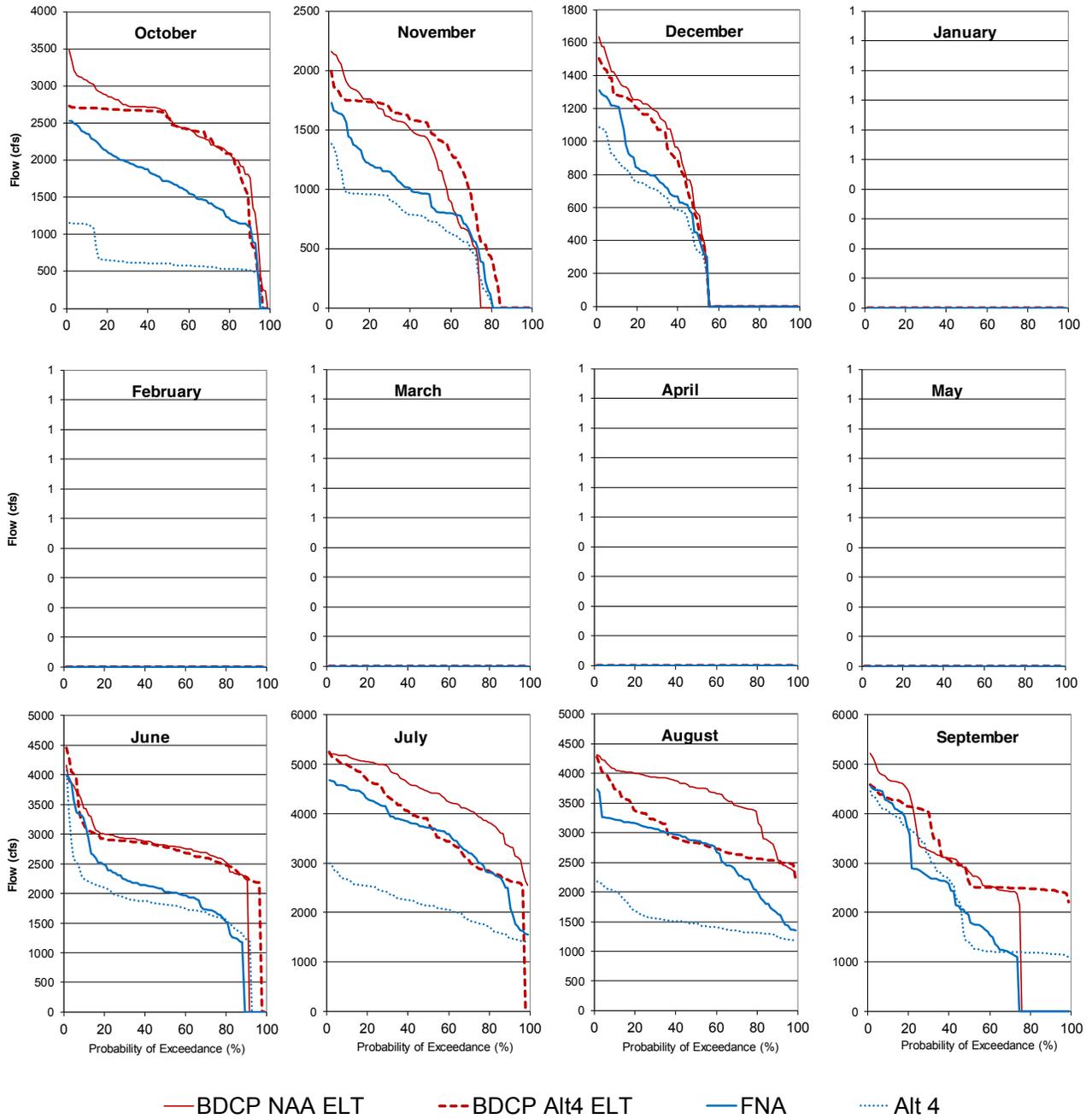
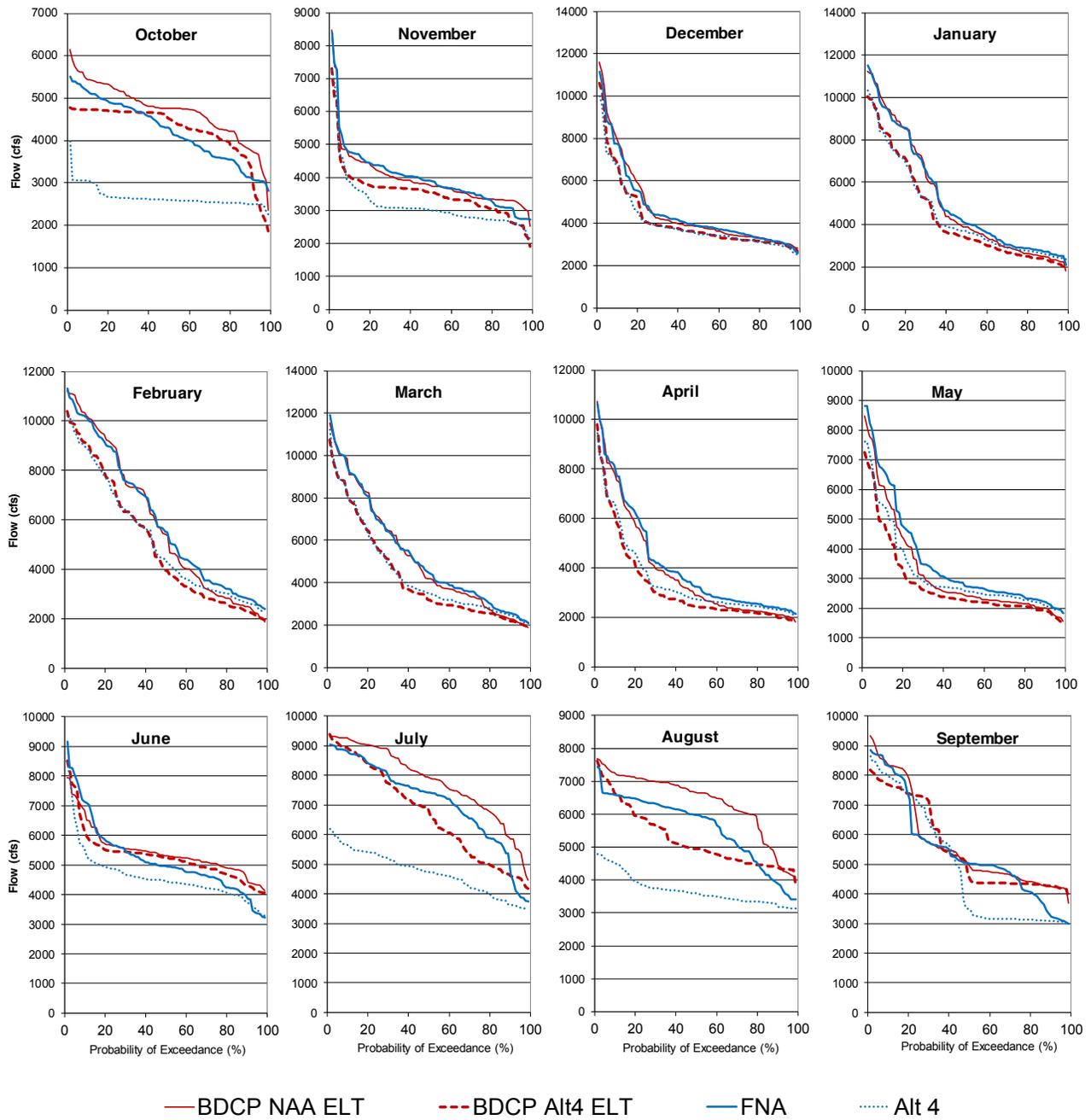


Figure 64. Flow through Delta Cross Channel and Georgiana Slough



Conclusions regarding BDCP effects

Based on the Independent Modeling, the amount of water exported (diverted from the Delta) may be approximately 200 thousand acre-feet (TAF) per year higher than the amount disclosed in the Draft EIR/S. This total represents

- approximately 40 TAF/yr more water diverted and delivered to the SWP south of Delta contractors, and
- approximately 160 TAF/yr more water diverted and delivered to the CVP south of Delta contractors.

The BDCP Model estimates that, under the NAA ELT (without the BDCP), total average annual exports for CVP and SWP combined are estimated to be 4.73 million acre feet (MAF) and in the Independent Modeling FNA combined exports are 5.61 MAF. The BDCP Model indicates an increase in exports of approximately 540 TAF and the Independent Modeling shows an increase of approximately 750 TAF in Alt 4.

The Independent Modeling suggests that Delta outflow would decrease by approximately 200 TAF/yr compared to the amount indicated in the Draft EIR/S.

- This lesser amount of Delta outflow has the potential to cause greater water quality and supply impacts for in-Delta beneficial uses and additional adverse effects on species. To determine the potential effects of the reduced amount of outflow, additional modeling is needed using tools such as DSM2.

The BDCP Model does not accurately reflect the location of the diversions that the SWP and CVP will make from the Delta.

- When the errors in the model are corrected, it reveals that the North Delta intakes could divert approximately 680 TAF/yr more than what was disclosed in the BDCP Draft EIR/S, and
- the amount of water diverted at the existing South Delta facilities would be approximately 460 TAF/yr less than what is projected in the BDCP Draft EIR/S.

Hydrologic modeling of BDCP alternatives using CalSim II has not been refined enough to understand how BDCP may affect CVP and SWP operations and changes in Delta flow dynamics. Better defined operating criteria for project alternatives is needed along with adequate modeling rules to analyze how BDCP may affect water operations. Without a clear understanding of how BDCP may change operations, affects analysis based on this modeling may not produce reliable results and should be revised as improved modeling is developed.



Water Resources • Flood Control • Water Rights

TECHNICAL MEMORANDUM

DATE: October 28, 2015

TO: David Aladjem

FROM: Walter Bourez, Lee Bergfeld, and Dan Easton

SUBJECT: Technical Comments on the Bay Delta Conservation Plan/California Water Fix Partially Recirculated Draft EIR/Supplemental Draft EIS

1. OVERVIEW

This technical memorandum is a summary of MBK Engineers' (MBK) findings and opinions concerning the Bay Delta Conservation Plan (BDCP)/California Water Fix Partially Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS). These findings and opinions include comments specific to the RDEIR/SDEIS document and analysis, and also concern numerous comments previously submitted regarding the BDCP Draft Environmental Impact Report/Draft Environmental Impact Statement (BDCP Draft EIR/EIS). The key findings of MBK's review of the RDEIR/SDEIS are: (a) the description of the proposed project is insufficient for analysis; (b) the project description is inconsistent with the RDEIR/SDEIS's analysis; and (c) issues regarding the analysis that MBK previously identified remain unaddressed. Assumptions, errors, and outdated tools used in the analysis for the BDCP Draft EIR/EIS remain in the RDEIR/SDEIS and result in impractical or unrealistic CVP and SWP operations. The use of the analyses from the BDCP Draft EIR/EIS therefore provides limited useful information about the effects of the proposed California Water Fix project.

2. PROJECT DESCRIPTION IS INSUFFICIENT FOR ANALYSIS

The California Water Fix RDEIR/SDEIS project description in Section 4.1 is insufficient to perform the necessary technical analyses to identify the proposed project's potential environmental effects. There are several specific aspects of the proposed project that require additional description before modeling and technical analyses can be performed to identify potential environmental effects. The following sections describe the key aspects of the project description that require more definition.

2.1 North Delta Diversion Operations Plan/Point of Diversion Prioritization

The RDEIR/SDEIS does not include an operations plan for use of the North Delta Diversion (NDD). An operations plan is necessary to understand and describe the conditions under which the NDD would be used in the context of State Water Project (SWP) and Central Valley Project (CVP) operations, and how SWP and CVP diversions would be prioritized between the existing points of diversion in the South Delta and the NDD. Without describing how the CVP and SWP would be operated with a NDD, it is not possible to analyze the changes in CVP and SWP operations that may occur with the NDD; therefore it is

not possible to determine the environmental effects that would be caused by changes in CVP and SWP operations.

The RDEIR/SDEIS describes the operation of the NDD as follows: “The proposed project operations include a preference for south Delta pumping in July through September to provide limited flushing for improving general water quality conditions and reduced residence times” (p. 4.1-6). These appear to be the only guidelines provided in the RDEIR/SDEIS that describe how the CVP and SWP operators would decide to either export water through-Delta at the existing South Delta diversions or at the NDD facility. This statement is insufficient to analyze NDD facility operations in conjunction with existing South Delta facilities. The following example illustrates this point.

Inflows from upstream reservoir releases and Delta exports are frequently governed by water quality standards in State Water Resources Control Board (SWRCB) Decision 1641 (D-1641) from July through September. Compliance with water quality standards is achieved through the combination of Delta inflows and exports. When water quality standards govern Delta operations, increases in Delta inflows generally allow for increases in Delta exports from the South Delta facilities at less than a one-for-one ratio because Delta outflows must increase to maintain water quality as South Delta exports increase. This additional outflow is commonly referred to as the “carriage water cost” for any additional exports from the South Delta. However, if water quality standards are being met with specific Delta inflow and South Delta export amounts, and if either the CVP or SWP wants to increase Delta exports, there would be no carriage water cost if the water were exported at the NDD. Therefore, 100 percent of any additional Delta inflow could be exported from the NDD, creating a water supply benefit to using the NDD during this period. However, operating the NDD to create this water supply benefit would not be consistent with the RDEIR/SDEIS’s stated operational guideline, which is to “improve general water quality conditions and reduce residence times.” The RDEIR/SDEIS does not provide an adequate description of how the NDD facilities would be operated under this, or any other, condition. Nor does the RDEIR/SDEIS offer any description of how diversions would be prioritized between the NDD and South Delta facilities outside the July through September period. An operations plan for the NDD must be defined before technical analyses of environmental effects can be performed.

2.2 Definition and Source of Additional Spring Outflow

The RDEIR/SDEIS identifies Alternative 4A (ALT 4A) as the preferred alternative (p. 2-20). A component of ALT 4A is a requirement for additional Delta outflow in the spring (P. 4.1-9). However, the project description does not adequately describe the expected quantity, timing, or source of the additional spring outflow. It is not possible to analyze the potential environmental effects associated with providing additional spring outflow without more definition as to the source, quantity, and timing of the flow.

According to the spring outflow section in RDEIR/SDEIS Table 4.1-2,

initial operations will provide a March–May average Delta outflow bounded by the requirements of Scenario H3, which are consistent with D-1641 standards, and Scenario H4, which would be scaled to Table 3-24 in Chapter 3, Section 3.6.4.2 of the Draft EIR/EIS . . . (p. 4.1-9)

This description implies that, when meeting the existing outflow requirements in D-1641, the additional spring outflow would be bounded between zero and 9,200 to 44,500 cubic feet per second (cfs), as defined in Table 3-24 of the BDCP Draft EIR/EIS. While the existing outflow requirements in D-1641 are

well-defined and understood in terms of source, quantity, and timing, the upper bound on this additional required spring outflow is not.

Regarding the source of the additional spring outflow, the RDEIR/SDEIS states:

the proposed project includes spring outflow criteria, which are intended to be provided through acquisition of water from willing sellers. If sufficient water cannot be acquired for this purpose, the spring outflow criteria will be accomplished through operations of the SWP and CVP to the extent an obligation is imposed on either the SWP or CVP under federal or applicable state law. (p. 4.1-6)

The ALT 4A project description does not adequately describe the source of additional spring outflow, a necessary component for analyzing the environmental effects and, particularly, for determining what effects implementing California Water Fix would have on non-participating CVP and SWP contractors and other Sacramento Valley water users. Additional detail is required to identify willing sellers, to describe where sellers would be located, how sellers would provide the additional water, when sellers would be able to provide water, and to provide other similar information. This information must be provided before the potential environmental effects of providing additional spring outflow can be determined. These details must be provided because the environmental effects of making water available through land retirement, groundwater pumping, temporary crop idling, non-CVP/SWP reservoir releases, or water transfers are significantly different, may have different environmental effects and, possibly require different forms of mitigation. Where these environmental effects occur should also be described to ensure that the effects on local ecosystems and economies are disclosed.

Additionally, agricultural water users are typically not irrigating during the entire March through May period. Therefore, there may not be sufficient water available from willing sellers to directly meet increased spring Delta outflow requirements through reductions in agricultural diversions. This may require additional releases of stored water from CVP and SWP reservoirs. This potential is partially acknowledged in the statement that Delta outflow would be provided from a combination of SWP and CVP operations if or when outflow is not available from willing sellers. However, this statement lacks the detail necessary to describe potential environmental effects within the CVP/SWP system. The proposed project should describe under what conditions additional spring outflow would be provided from the CVP, the SWP, or a combination of both projects. These details must be provided before potential environmental effects can be determined, because providing additional water from Shasta Reservoir would have different environmental effects than providing it from Trinity, Oroville or Folsom Reservoir, or through reductions in exports. Providing additional Delta outflow from either the CVP or SWP through any combination of additional reservoir releases or changes in Delta exports would affect the operations of both projects through the Coordinated Operations Agreement (COA). These factors must be considered, defined, and then analyzed before the potential environmental effects can be determined.

How California Water Fix would implement the increased spring outflow component of the preferred alternative must be better described to allow for analyses of environmental effects. The RDEIR/SDEIS's reliance on the effects being bounded by analyses of the BDCP ALT 4 H3 and H4 simulations leaves too much uncertainty concerning the breadth of operational and environmental effects and, likely omits numerous potential environmental impacts.

2.3 Definition and Description of Adaptive Management Process

The RDEIR/SDEIS describes an Adaptive Management Process that may be used to adjust certain operational criteria, including spring Delta outflow requirements, NDD bypass flows, South Delta export operations including Old and Middle River (OMR) flow requirements, and Head of Old River Barrier (HORB) operations. The potential for adjustment in the operational criteria is contained in Table 4.1-2: “Adjustments to the criteria above [NDD bypass, South Delta exports, OMR, and HORB] and these outflow targets [spring Delta outflow] may be made using the Adaptive Management Process . . . ” (p. 4.1-9).

These potential adjustments and the environmental effects are not analyzed in the RDEIR/SDEIS. The RDEIR/SDEIS suggests that the range of the spring Delta outflow requirements would be bounded by two different scenarios, H3 and H4, which are evaluated in Table 4.1-1 of the BDCP Draft EIR/EIS (p. 4.1-5). However, no attempt to quantify the range of effects associated with any of the other criteria is provided in the RDEIR/SDEIS.

Evaluating a range of additional spring outflows without identifying their source, quantity, and timing does not adequately disclose the potential environmental effects associated with the Adaptive Management Process. Providing no description of the likely range of changes in the other criteria that may occur under the Adaptive Management Process is another area where the project description lacks sufficient detail for analysis of potential environmental effects.

3. PROJECT DESCRIPTION IS INCONSISTENT WITH ANALYSIS

As described above, the project description does not contain the specificity necessary to identify, analyze, and disclose the environmental effects of implementing the preferred alternative. Furthermore, the RDEIR/SDEIS’s analyses performed to assess the environmental effects are inconsistent with the description of the project alternatives in the RDEIR/SDEIS. This inconsistency between the project description for the proposed, and ultimately the preferred, alternative and the analysis chosen for that alternative occurs because of reliance on model results and technical analyses conducted for the BDCP Draft EIR/EIS alternatives, notably BDCP Alternative 4 (BDCP ALT 4) Scenarios H3 and H4. The RDEIR/SDEIS states that “the Lead Agencies have determined that they may reasonably rely on the modeling conducted for Alternative 4 to accurately predict the environmental effects of Alternative 4A” (p. 4.1-43, line 17-19).

BDCP Draft EIR/EIS alternatives, however, are fundamentally different in several key areas from the alternatives described in the RDEIR/SDEIS. These key areas are described in the following sections. To support their conclusion that model results for a project analyzed in the BDCP Draft EIR/EIS may be relied upon to “accurately predict” environmental effects for a different proposed project in the RDEIR/SDEIS, the Lead Agencies conducted a sensitivity analysis for the RDEIR/SDEIS. The sensitivity analysis and conclusions are described at the end of this section.

3.1 Tidal Wetland Restoration

The BDCP Draft EIR/EIS’s ALT 4 assumed that 25,000 acres of tidal wetland restoration would be in place as part of the project in the Early Long Term (ELT), at approximately 2025, and that 65,000 acres of tidal wetland restoration would be in place in the Late Long Term (LLT), at approximately 2060. There was no tidal wetland restoration in the No Action Alternative (NAA). In the BDCP Draft EIR/EIS, it was assumed the restored tidal wetlands would influence Delta tidal fluctuations, salinity, and operations. Generally,

when the Delta contained more fresh water and lower salinity, it was expected that less Delta outflow would be necessary to keep it fresh with the wetlands in place because the wetlands served as a bulwark against tidal intrusion. On the other hand, when the Delta contained more salt water, the opposite would be true. More Delta outflow would be necessary to flush salts out because of the retention capacity of the wetlands. In either case, the effect was expected to be significant enough that tidal wetland restoration needed to be represented in the CalSim II simulations of the BDCP project alternatives. Operationally, additional wetlands could result in a different balance of Sacramento River inflows and exports to meet D-1641 standards, which could result in changes in CVP and SWP reservoir releases, allocations, and deliveries.

Depending on the location of the restored tidal wetlands, they could also buffer and reduce the tidal energy that carries salt water into the Delta. This is important when considering that operation of the NDD may reduce the volume of fresh water in the lower Sacramento River used to repel tidal energy and salt water intrusion. In this way, restoring tidal wetlands as part of BDCP ALT 4 reduced the additional salinity intrusion that would otherwise result from an NDD.

The ALT 4A project description in the RDEIR/SDEIS includes 59 acres of tidal wetland restoration (p. 4.1-5), or 0.2 percent of the area included at the ELT in the BDCP Draft EIR/EIS. This area would likely be too small to have a significant effect on Delta water quality, tidal energy, or CVP/SWP operations. However, CalSim II modeling performed for the BDCP Draft EIR/EIS was assumed to represent the operation of the ALT 4A for the RDEIR/SDEIS and was compared to an NAA that did not include any tidal wetland restoration. It is inappropriate to assume that ALT 4A in the RDEIR/SDEIS would have the same effects on Delta water quality, tidal energy, and CVP/SWP operations as the BDCP alternative that would have included nearly 25,000 acres more tidal wetland restoration. The RDEIR/SDEIS's modeling for ALT 4A does not reflect the reality of ALT 4A's significantly reduced amount of restored wetlands.

3.2 Relaxation of the Sacramento River Agricultural Water Quality Compliance Point

BDCP ALT 4 would have relaxed the Sacramento River agricultural water quality compliance point contained in D-1641 from Emmaton to Threemile Slough, a location approximately 3 miles upstream of Emmaton. The project description of ALT 4A in the RDEIR/SDEIS removes the relaxation of this water quality compliance point and leaves compliance at Emmaton, as specified in D-1641 (p. 4.3.4-23). Changing the water quality compliance location to Threemile Slough would require less fresh water flow from the Sacramento River to comply with the water quality standard because Threemile Slough is located further from Suisun Bay and the Pacific Ocean. The change in location for the water quality standard would likely affect the balance between exports and Sacramento River inflow necessary for compliance. Additionally, because meeting a water quality standard at Threemile Slough can be done with less Sacramento River flow, it could allow higher diversions at the NDD facility, or lower releases from upstream reservoirs. Therefore, it is inconsistent and inappropriate for the RDEIR/SDEIS to state that the operational effects in the modeling results for BDCP ALT 4 which includes moving the water quality compliance point, are the same as ALT 4A in the RDEIR/SDEIS, which does not include moving the compliance point.

3.3 Fremont Weir Gates

BDCP ALT 4 included habitat restoration in the Yolo Bypass. One component of the restoration was installation of operable gates on Fremont Weir at the northern end of the Yolo Bypass to allow for more frequent flooding of the bypass. The operable gates would be opened when Sacramento River flows at Freeport exceed 25,000 cfs, and would divert as much as 6,000 cfs of Sacramento River flow into the

Yolo Bypass, depending on the stage of the river. Therefore, opening the Fremont Weir gates would result in up to 6,000 cfs less flow at Freeport.

The ALT 4A project description in the RDEIR/SDEIS removes the Fremont Weir gates from the alternative because they are now considered to be included in the NAA (p. 4.1-23). However, the CalSim II modeling performed for the BDCP Draft EIR/EIS, which included the Fremont Weir gates, is assumed to represent the operation of ALT 4A for the RDEIR/SDEIS and is compared to an NAA that did not include the Fremont Weir gates. It is inconsistent and inappropriate for the RDEIR/SDEIS to attempt to determine the operational impacts of ALT 4A by comparing BDCP ALT 4, which includes the operable gates, to an NAA that does not include the gates. However, unlike the first two inconsistencies described above, this change will likely have lesser impacts on key operational parameters such as reservoir storage, exports and Delta outflow, since the gates would be opened during high-flow events when the system would likely be in a surplus condition.

3.4 RDEIR/SDEIS Sensitivity Analysis

The RDEIR/SDEIS attempts to address the inconsistencies identified above with a sensitivity analysis as described in the RDEIR/SDEIS's Appendix B. In this sensitivity analysis, BDCP ALT 4 is modified to remove the tidal wetland restoration, water quality compliance point relaxation, and Fremont Weir operable gates. No additional modifications were made to the BDCP ALT 4 CalSim II model, including any updates to the model since the analysis was done for the BDCP Draft EIR/EIS (p. B-3).

Appendix B is comprised of three pages of text and 613 pages of figures and tables of results from CalSim II. The conclusions from the sensitivity analysis are summarized in a single paragraph on page B-3.

As shown in the figures Alt4A (H3) and Alt4A (H4) CALSIM II results are generally similar to A4_H3 and A4_H4, respectively. The results indicate that the incremental changes for Alt4A (H3) and Alt4A (H4) when compared to the No Action Alternative are trending similar to A4_H3 and A4_H4, at both ELT and LLT.

It is not reasonable or defensible to rely upon the results of modeling performed for the BDCP Draft EIS/EIR, which considered a project with different physical and operational effects, to accurately predict the environmental effects of a different project compared to a different no project/no action alternative as defined in the RDEIR/SDEIS because CalSim II model results are "generally similar" and "trending similar." Environmental effects should be determined through a project-specific analysis of the potential effects on species and resources. These non-specific conclusions do not provide sufficient information for the public to understand the basis for the RDEIR/SDEIS's conclusions about the significance of project effects. Project-related changes in flows and hydrodynamics can have a significant effect to aquatic species, water quality and beneficial uses of water, and it should not be assumed that environmental effects are the same because model results are "generally" or "trending" similar.

Lastly, the RDEIR/SDEIS includes an acknowledgement that the project description is inconsistent with the analysis.

Nevertheless, there is notable uncertainty in the results of all quantitative assessments that refer to modeling results, due to the differing assumptions used in the modeling and the description of Alternative 4A and the No Action Alternative (ELT). (pp. 4.3.4-1 to 4.3.4-2)

In our opinion, this statement may suggest that preparers of the RDEIR/SDEIS recognized the weakness in the assumption that model results of a fundamentally different project could be compared to a different NAA than described in the RDEIR/SDEIS to “accurately predict” the environmental effects of the proposed project.

4. PREVIOUS COMMENTS REMAIN APPLICABLE

Analysis and conclusions in the RDEIR/SDEIS rely on the model runs developed for the BDCP Draft EIR/EIS, so many of the comments submitted based on our review of the BDCP Draft EIR/EIS apply to the RDEIR/SDEIS. These comments are described in the July 11, 2014 report by MBK Engineers and Daniel B. Steiner, Consulting Engineer, *Review of Bay Delta Conservation Program Modeling* (MBK Report). As described in Appendix B of the RDEIR/SDEIS, no updates were made to the CalSim II modeling to address these previous comments or any other issues previously identified.

The following is a summary of key findings in the MBK Report, which is attached to this technical memorandum.

4.1 Incorporation of Climate Change Ignores Reasonably Foreseeable Adaptation Measures

The following conclusion in the MBK Report’s Executive Summary is applicable to the RDEIR/SDEIS:

The BDCP Model uses assumed future climate conditions that obscure the effects of implementing the BDCP. The future conditions assumed in the BDCP model include changes in precipitation, temperature, and sea level rise. The result of this evaluation is that the modeled changes in water project operations and subsequent environmental impacts are caused by three different factors: (1) sea level rise; (2) climate change; and (3) implementation of the alternative that is being studied.

Including climate change, without adaptation measures, results in insufficient water needed to meet all regulatory objectives and user demands. For example, the BDCP Model results that include climate change indicate that during droughts, water in reservoirs is reduced to the minimum capacity possible. Reservoirs have not been operated like this in the past during extreme droughts and the current drought also provides evidence that adaptation measures are called for long in advance to avoid draining the reservoirs. In this aspect, the BDCP Model simply does not reflect a real future condition. 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; and (3) if droughts become more frequent, the CVP and SWP would likely revisit the rules by which they allocate water during shortages and operate more conservatively in wetter years. The modifications to CVP and SWP operations made during the winter and spring of 2014 in response to the drought supports the likelihood of future adaptations. The BDCP Model is, however, useful in that it reveals that difficult decisions must be made in response to climate change. But, in the absence of making those decisions, the BDCP Model results themselves are not informative, particularly during drought conditions. With future conditions projected to be so dire without the BDCP, the effects of the BDCP appear positive simply because it appears that conditions cannot get any worse (i.e., storage cannot be reduced below its minimum level). However, in reality, the future

condition will not be as depicted in the BDCP Model. The Reviewers recommend that Reclamation and DWR develop more realistic operating rules for the hydrologic conditions expected over the next half-century and incorporate those operating rules into any CalSim II Model that includes climate change. (p. 4)

The CVP's and SWP's operations during the current drought confirm this comment. Operations have been modified to meet human and environmental needs to the extent possible, and preserve some water in reservoir storage to continue to do so if drought condition persist. Modeling assumptions for the RDEIR/SDEIS and simulated operations with climate change are not consistent with recent operations.

4.2 The BDCP Model Was Built on a Benchmark Study with Numerous Inaccuracies

The following conclusion in the MBK Report is applicable to the RDEIR/SDEIS:

CalSim II is continuously being improved and refined. As the regulatory environment changes and operational and modeling staff work together to improve the model's capability to simulate actual operations, the model is continually updated. The BDCP Model relied upon a version of CalSim II that dates back to 2009, immediately after the new biological opinions (BiOps) from the NMFS and the United States Fish and Wildlife Service (USFWS) significantly altered the operational criteria of the CVP and SWP. In the last 4 to 5 years, DWR, Reclamation, and outside modeling experts have worked together to improve the model. Changes include better (more realistic) implementation of the new BiOps and numerous fixes to the code. Since CalSim II is undergoing continual improvements, there will always be "vintage" issues in that by the time a project report is released, the model is likely slightly out of date. However, in this case – with the major operational changes that have occurred in the new regulatory environment – many issues have been identified and fixed in the last 4 to 5 years that have a significant effect on model results. CalSim II modeling for the DWR 2013 Delivery Reliability Report contains numerous modeling updates and fixes that significantly alter results of the BDCP Model. A key modeling revision in the 2013 DWR modeling was fixing an error regarding artificial minimum instream flow requirements in the Sacramento River at Hood. An "artificial" minimum instream flow requirement had been specified; the requirement is artificial in that it does not represent a regulatory requirement, but rather is a modeling technique to force upstream releases to satisfy Delta needs. (p. 14)

4.3 BDCP Model Coding and Data Issues Significantly Skew the Analysis and Conflict with Actual Real-Time Operational Objectives and Constraints

The following conclusion in the MBK Report is applicable to the RDEIR/SDEIS:

Operating rules used in the BDCP Model, specifically regarding Alternative 4, result in impractical or unrealistic CVP and SWP operations. Reservoir balancing rules cause significant drawdown of upstream reservoirs during spring and summer months while targeting dead pool level in San Luis from September through December resulting in artificially low Delta exports and water shortages. CVP allocation rules are set to artificially reduce south of Delta allocations during wetter years resulting in underestimates of diversions at the NDD and the SDD. Operating rules for the Delta Cross Channel Gate do not reflect how the gates may be operated in "With Project" conditions.

Operational logic is coded into the CalSim II model to simulate how DWR and Reclamation would operate the system under circumstances for which there are no regulatory or other definitive rules. This attempt to specify (i.e., code) the logic sequence and relative weighting so that a computer can simulate “expert judgment” of the human operators is a critical element to the CalSim II model. In the BDCP version of the CalSim II model, some of the operational criteria for water supply allocations and existing facilities such as the Delta Cross Channel and San Luis Reservoir are inconsistent with real-world conditions. (p. 18)

Because the RDEIR/SDEIS evaluates Alternative 4A, which is based on Alternative 4, these conclusions now apply to the RDEIR/SDEIS.

4.4 BDCP’s “High Outflow Scenario” is Not Sufficiently Defined for Analysis

MBK and Steiner previously commented on the lack of definition for the additional spring outflow requirement contained in the BDCP Draft EIR/EIS. The following conclusion in the MBK Report Executive Summary is applicable to the RDEIR/SDEIS, which now includes additional spring outflow as an element of Alternative 4A:

The effects of many critical elements of the BDCP cannot be analyzed because those elements are not well-defined. The Reviewers recommend that the BDCP be better defined and a clear and concise operating plan be developed so that the updated CalSim II model can be used to assess effects of the BDCP.

The High Outflow Scenario (HOS) requires additional water (Delta outflow) during certain periods in the spring. The BDCP Model places most of the responsibility for meeting this new additional outflow requirement on the SWP. However, the SWP may not actually be responsible for meeting this new additional outflow requirement. This is because the Coordinated Operations Agreement (“the COA”) would require a water allocation adjustment that would keep the SWP whole. Where one project (CVP or SWP) releases water to meet a regulatory requirement, the COA requires a water balancing to ensure the burden does not fall on only one of the projects. The BDCP Model is misleading because it fails to adjust project operations, as required by the COA, to “pay back” the water “debt” to the SWP due to these additional Delta outflow requirements. Unless there is a significant revision to COA, the BDCP Model overstates the impacts of increased Delta outflow on the SWP and understates the effects on the CVP.

Furthermore, after consulting with DWR and Reclamation project operators and managers, the Reviewers conclude that there is no apparent source of CVP or SWP water to satisfy both the increased Delta outflow requirements and pay back the COA “debt” to the SWP without substantially depleting upstream water storage. It appears, through recent public discussions regarding the HOS, that BDCP anticipates additional water to satisfy the increased Delta outflow requirement and to prevent the depletion of cold water pools will be acquired through water transfers from upstream water users. However, this approach is unrealistic. During most of the spring, when BDCP proposes that Delta outflow be increased, agricultural water users are not irrigating. This means that there is not sufficient transfer water available to meet the increased Delta outflow requirements and therefore, additional release of stored water from the reservoirs would be required. Releasing stored water to meet the increased Delta outflow requirements could potentially impact salmonids on the Sacramento and American River systems due to reductions in the available cold water pool. (p. 5)

4.5 Delta Cross Channel Operational Assumptions Overestimate October Outflow

The following conclusion in the MBK Report is applicable to the RDEIR/SDEIS:

When south Delta exports are low due to regulatory limits, and upstream reservoirs are making releases to meet the instream flow objectives at Rio Vista, operators have the ability to close the Delta Cross Channel (DCC) in order to reduce the required reservoir releases (by closing the DCC a greater portion of water released from the reservoirs stays in the Sacramento River to meet the Rio Vista requirements). As long as the Delta salinity standards are met, operators have indicated that they would indeed close the DCC in this manner (as was done in October and November 2013). In the BDCP Model, the DCC is not closed in this manner. The net result is that the BDCP Model overestimates outflow under such circumstances typically occurring in October.

The overestimated outflow leads to incorrect conclusions regarding the effects of BDCP. For instance, an actual increase in fall outflow could be beneficial for the endangered fish species delta smelt (USFWS, 2008). Therefore, by overestimating outflow in October, the BDCP studies likely overestimate the benefit to delta smelt (Mount et al., 2013). Similarly, an actual increase in fall outflow would reduce salinity in the western Delta, which could be beneficial for in-Delta diverters; therefore, overestimating outflow in October artificially reduces salinity, incorrectly reducing the net impacts on in-Delta diverters. (p. 17)

4.6 San Luis Reservoir Operational Assumptions Produce Results Inconsistent with Real-World Operations

The following conclusion in the MBK Report is applicable to the RDEIR/SDEIS:

San Luis Reservoir (SLR) is an off-stream reservoir located south of the Delta and jointly owned and operated by CVP and SWP. The reservoir is used to store water that is exported from the Delta when available and used to deliver water to CVP and SWP Contractors when water demands exceed the amount of water that can be pumped from the Delta. The decision of when to move water that is stored in upstream reservoirs, such as Shasta, Folsom, or Oroville, through the Delta for export to fill SLR is based on the experience and expert judgment of the CVP and SWP operators.

CalSim II attempts to simulate the expert judgment of the operators by imposing artificial operating criteria; the criteria are artificial in the sense that they are not imposed by regulatory or operational constraints but rather imposed as a tool to simulate expert judgment. One such artificial operating criteria is the SLR target storage level: CalSim II attempts to balance upstream Sacramento Basin CVP and SWP reservoirs with storage in SLR by setting artificial target storage levels in SLR, such that the CVP and SWP will release water from upstream reservoirs to meet target levels in SLR. The artificial target storage will be met as long as there is ability to convey water (under all regulatory and physical capacity limits) and as long as water is available in upstream reservoirs. SLR target storage criteria are also sometimes described in section 4.2 as the "San Luis rule-curve."

In the BDCP Model, CVP and SWP reservoir operating criteria for Alternative 4 H3 ELT differ from the corresponding without project scenario (e.g. NAA-ELT). The difference in criteria and result is primarily driven by changes to the artificial constraint used to determine when to fill SLR: the

SLR target storage. In Alternative 4 H3 ELT, SLR target storage is set very high in the spring and early summer months, and then reduced in August and set to SLR dead pool from September through December. This change in SLR target storage relative to the no action alternative causes upstream reservoirs to be drawn down from June through August and then recuperate storage by cutting releases in September. This change to the artificial operating criteria SLR target storage causes changes in upstream cold water pool management and affects several resource areas.

In addition to changes in upstream storage conditions, changes in SLR target storage cause SLR storage to drop below a water supply concern level (300,000 acre-feet) in almost 6 out of every 10 years under ELT conditions and more than 7 out of every 10 years under LLT conditions for Alternative 4 H3. When storage in SLR drops below this 300,000 acre-foot level, algal blooms in the reservoir often cause water quality concerns for drinking water at Santa Clara Valley Water District. The change in SLR target storage also causes SLR levels to continue to drop and reach dead pool level for the SWP in 4 out of every 10 years and also dead pool level for the CVP in 1 out of every 10 years under the ELT conditions.

Reaching dead pool level in SLR creates shortages to water users south of the Delta. Although some delivery shortages are due to California Aqueduct capacity constraints, the largest annual delivery shortages are a result of inappropriately low SLR target storage. Average annual Table A shortages due to artificially low SLR storage levels increased from 3 TAF in the NAA-ELT scenario to 35 TAF in the Alt4-ELT scenario. Such shortages occurred in 2% of simulated years in the NAA-ELT scenario and 23% of years in the Alt4-ELT scenario. In addition to the inability to satisfy Table A allocations, low storage levels cause loss of SWP Contractors' Article 56 water stored in SLR. Average annual Article 56 shortages were 43 TAF in the Alt4-ELT scenario because of low San Luis storage and 5 TAF in the NAA-ELT scenario. Low San Luis storage causes Article 56 shortages in 27% of simulated years in the Alt4-ELT scenario as compared to 5% of simulated years in the NAA-ELT. Another consequence of low storage levels in SLR is a shift in water supply benefits from Article 21 to Table A.

In summary, the operational assumptions for SLR are unrealistic in Alternative 4 because they create problems in upstream storage reservoirs and create shortages for south of Delta water users that would not occur in the real world. In reaching this conclusion, the Reviewers met with operators from CVP and SWP to review the BDCP Model results and discussed real-time operations. (p. 16)

EXHIBIT C

Comments on the Bay Delta Conservation Plan/California WaterFix Public Review Partially Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS)

October 20, 2015

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Introduction

The following comments on the Bay Delta Conservation Plan (BDCP)/California WaterFix Public Review Partially Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS) primarily focus on the potential effects of the California WaterFix (Alternative 4A) on Sacramento River basin anadromous salmonids.¹ Extensive comments on the original draft EIR/EIS and BDCP as related to anadromous salmonids were previously submitted ([Dave Vogel Comments](#)) and are incorporated here by reference; those comments remain applicable to Alternative 4A.

The RDEIR/SDEIS actively promotes a massive project to export an enormous amount of water from new points of diversion on the Sacramento River to purportedly reduce impacts on fishery resources, as compared to sole use of the existing south Delta water export facilities. Some of the secondary design concepts for the Alternative 4A (the new “preferred alternative”) have changed since the original preferred Alternative 4 was recommended in the 2013 draft EIR/EIS and original BDCP. However, the fundamental design concepts and operations of Alternative 4A (three proposed large 3,000 cfs water diversions) relevant to fish protection, unfortunately, have not. Surprisingly, like the original Alternative 4, many major specific design features and critical operational criteria for Alternative 4A still have not been determined. That information is critically necessary to adequately analyze environment impacts of the project. The RDEIR/SEIS is severely deficient in this regard.

Much like the original draft EIR/EIS and BDCP, the RDEIR/SDEIS continues to overstate potential benefits to fish. For example:

“Alternatives 4A, 2D, and 5A would enable DWR to construct and operate new conveyance facilities that improve conditions for endangered and threatened aquatic species in the Delta while improving water supply reliability. Implementing the conveyance facilities alone would help resolve many of the concerns with the current south Delta conveyance system, would help reduce

¹ Due to the enormity and poor readability of the documents, comments not provided here on any particular statement or element in the RDEIR/SDEIS do not imply agreement.

conveyance threats to endangered and threatened species in the Delta, and would allow for implementing habitat restoration projects on an expedited schedule through the state's EcoRestore program.” (Emphasis added) Page ES-15

No credible evidence to support those conclusions is provided in the RDEIR/SDEIS. As described in detail in previously submitted comments on the draft EIR/EIS and BDCP, the Alternative 4A proposed north Delta water diversions still remain an unprecedented, extremely high-risk experiment with a very high probability of failure for fish protection and an irreversible commitment of resources.² Alternative 4A continues to have questionable benefits and feasibility, and the purported benefits are built upon invalid or dubious assertions. A main concern is that the RDEIR/SDEIS, like the original draft EIR/EIS, has relied extensively on assumptions about juvenile salmonids that are either incorrect or unfounded and is full of highly speculative expectations regarding how implementation of Alternative 4A may or may not affect salmon. Those assumptions are then used as a foundation for definitive conclusions that are unsupported. Adverse impacts to anadromous fish remain a high probability if Alternative 4A becomes reality.

Confusing Organization of the RDEIR/SDEIS

Reviewers of the RDEIR/SDEIS were led to believe that one could simply follow “track changes” to compare how the RDEIR/SDEIS changed compared to the original draft EIR/EIS:

“Revisions are presented in redline/strikeout format. Section numbering and titles from the public draft have been retained. Where large blocks are unchanged, the text has been omitted and replaced with the following text [unchanged text omitted], ...” (Page D.1-1)

Unfortunately, this editing did not occur for the RDEIR/SDEIS Chapter 11 – Fish and Aquatic Resources. Enormous amounts of text were omitted without the statement “unchanged text omitted” and other large-scale changes were made without notation. This circumstance made it exceedingly difficult to review the RDEIR/SDEIS and provide constructive comments. The Delta Independent Science Board (DISB) also found this RDEIR/SDEIS deficiency to be highly problematic (DISB 2015).

The RDEIR/SDEIS implies that the Fish and Aquatic Habitat Analyses Chapter has been revised to respond to comments raised by the public (Page 2-1), but a review of the RDEIR/SDEIS revealed that many fatal flaws identified in previously submitted comments on the draft EIR/EIS and BDCP remain unresolved in the RDEIR/SDEIS.

It is not clear if substantive public comments previously submitted on the draft EIR/EIS and BDCP will actually be incorporated into the final EIR/EIS. The discussion on page ES-14 suggests that all previously submitted comments were considered in the formulation of the

² In this regard, the RDEIR/SDEIS states: “If sufficient operational flexibility to reduce effects on fall-run/late fall-run Chinook salmon habitat is not feasible under Alternative 4 operations, achieving further impact reduction pursuant to this mitigation measure would not be feasible under this Alternative, and the impact on fall-run/late fall-run Chinook salmon would remain significant and unavoidable.” (Page 11-346)

RDEIR/SDEIS, but based on a review of the RDEIR/SDEIS Section 2 (Substantive Draft EIR/EIS Revisions) and Appendix D (Substantive BDCP Revisions), that does not appear to be accurate. Prominent among those omissions include the facts that the RDEIR/SDEIS has not corrected serious deficiencies and errors in the fish models used to evaluate project alternatives, continues to propagate flawed assumptions and oversimplification of juvenile salmonid behavior and adverse impacts caused by the three north Delta intakes, lacks the necessary technical information on fish screen design and operational criteria, has not addressed the anticipated high salmon mortality at the north Delta intakes and in areas downstream from the intakes, and overstates purported benefits of proposed predator control and nonphysical fish barriers without supporting details and scientific justification. If substantive public comments (e.g., serious mistakes in the environmental analyses) on the prior draft EIR/EIS and BDCP are not addressed in Section 2 and Appendix D, it appears the RDEIR/SDEIS failed to make those substantive changes.

Moreover, if the previously submitted comments were not incorporated into the RDEIR/SDEIS “Substantive Revision” sections, it suggests those public comments will not result in substantive revisions to the final EIR/EIS; otherwise those changes would have already been made.

Additionally, there were inappropriate instances of “cutting and pasting” in the RDEIR/SDEIS, adding to the confusion and unreadability of the documents. For example, on Page 11-301, the statement is made:

“Near-field effects of Alternative 5 NDD on spring-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating spring-run Chinook salmon, although there is high uncertainty regarding the overall effects.” (emphasis added).

Alternative 5, however, has one intake, not three; a significant mistake.

Additionally, there are instances where entire paragraphs are repeated verbatim in a careless cut and paste attempt (e.g., Pages D.3-11 and 12).

Use of the So-Called “Best Available Science”

The RDEIR/SEIS environmental documents continue to state that the environmental analyses used the “best available science” (e.g., pages G-4 and 11-62). To the contrary, and despite constructive comments previously submitted for the 2013 draft EIR/EIS and BDCP, the RDEIR/SDEIS still has not incorporated the best available scientific information. A review of the RDEIR/SDEIS indicates that much of the available scientific information was misused and/or misinterpreted, and substantial quantities of critically important scientific information were incorrect, outdated, overlooked, or perhaps purposefully not included. As previously described in detail ([Dave Vogel Comments](#)), many of the assumptions concerning anadromous salmonids continue to be in error in the RDEIR/SDEIS for analyses of Alternative 4A. The conclusions contained in the RDEIR/SDEIS are biased because the documents are predicated on information that is highly tenuous, speculative, and substantially misleading. The documents frequently

overlook highly relevant scientific facts and instead rely upon limited or erroneous information that is outdated or incorrect. Numerous examples are provided in [Dave Vogel Comments](#). The RDEIR/SDEIS appears to selectively “pick and choose” reports and opinions that support its conclusions while ignoring science that supports different and sometimes opposite conclusions. To summarize, like the original draft EIS/EIR and BDCP, the RDEIR/SDEIS analyses do not use the best available science, and lack scientific objectivity.

Conservations Measures and Environmental Commitments

The alternatives described in the original draft EIS/EIR and BDCP were extremely reliant on numerous “Conservation Measures” to offset the adverse impacts on fish caused by construction and operation of the north Delta water intakes. The discussion of the Conservation Measures in the RDEIR/SDEIS is very confusing because, in some instances, it appears that Conservation Measures have now been removed from Alternative 4A (e.g., Page ES-13) and will instead be pursued by the separate “EcoRestore” program. However, in other instances, they remain as part of “WaterFix” to offset impacts caused by the Alternative 4A three north Delta intakes (e.g., Pages 2-21, D.1-1). Adding further confusion, the RDEIR/SDEIS documents frequently use the term Conservation Measures for Alternative 4A, whereas it appears the documents should have consistently used the term Environmental Commitments (Page ES-13). The RDEIR/SDEIS frequently goes back and forth using both terms, making analysis an extremely complex task and disabling the reader from any certain understanding of the project definition and impacts.

Location of Alternative 4A Intakes

The RDEIR/SDEIS continues to fail to recognize the severe problems for fish protection caused by the poor siting of the three intakes for Alternative 4A. To the contrary, the RDEIR/SDEIS implies that the locations selected were based on the “best available science”:

“Appendix 3F, Intake Locations Analysis, of the Draft EIR/EIS and the fish screen analysis (Appendix 5B, Entrainment, of the Draft BDCP) identified potential intake locations through an iterative process involving engineers and resource experts most familiar with existing facility operations, river hydrology, and the biological resources in the Delta. This process included convening a Fish Facilities Technical Team (state and federal regulatory agency and industry experts), conducting a Value Planning Study, and participating in numerous collaborative meetings with technical staff from the various agencies and consultants collaborating in the BDCP process to discuss evolving information.”
Page G-4

The RDEIR/SDEIS cites a July 2011 Technical Memorandum by the Fish Facilities Technical Team (FFTT) to justify various components of the proposed new large fish screens for Alternative 4A. An examination of that document confirms the facilities’ unsuitable locations. In terms of hydraulic and physical conditions for fish protection, the proposed north Delta intakes are sited in some of the worst locations. As stated by FFTT (2011), *“There is a high level of uncertainty as to the type and magnitude of impacts that these diversions will have on covered fish species that occur within the proposed diversion reach”* (emphasis added). In

reality, the FFTT was provided with poor options for fish protection due to the unique, unfavorable sites for water withdrawal from the north Delta. It appears that the team had no choice but to recommend only general criteria that were severely constrained by the site-specific conditions of the various intakes, and not criteria necessary to protect fish. The FFTT (2011) stated that the proposed north Delta intake fish screens "... *make it challenging to literally apply sweeping velocity criteria ...*" (discussed below). It is evident from the original draft EIR/EIS that all of the numerous sites evaluated for the intakes (including the RDEIR/SDEIS' new "preferred" Alternative 4A) are poor for fish protection (refer to [Dave Vogel Comments](#)). The sites selected for Alternative 4A were not chosen because those locations would provide good protection for fish but, instead, they were viewed as more favorable (but still bad) among the worst sites.

"State-of-the-Art" Fish Screens for Alternative 4A

The RDEIR/SDEIS frequently states that "state-of-the-art" fish screens will be installed in front of the three north Delta intakes for Alternative 4A. However, due to the numerous problems with the proposed screens (described in detail in previously submitted comments: [Dave Vogel Comments](#)), they cannot be deemed "state-of-the-art" because such screens have never been constructed. The DISB (2015) also cast doubt on the dubious conclusions of the effectiveness of the proposed fish screens. Indeed, the actual criteria for the proposed fish screens still have yet to be finalized (Page 11-66). The Alternative 4A north Delta intake fish screens do not possess the critically important features to control hydraulic conditions and many other features for safe salmon passage. Table 3.4.1 "Key Uncertainties and Potential Research Actions Relevant to CMI" (Pages D.3-27 to 30), Table 3.6-5 "Monitoring Actions for Covered Fish Performance Focus Area" (Pages D.3-156 to 165), and Table 3.6-15 (Pages D-191 to 192) confirm that there are major unknowns in how the intake screens should be designed and how they will perform (e.g., sweeping velocities, sedimentation, basic screen criteria, in-screen refugia, velocity distributions, fish survival, predation, etc.). For example, the RDEIR/SDEIS states:

"Ten key uncertainties in Table 3.6-15 concern aspects of the design, operation, and performance of the proposed north Delta intakes. They include hydraulic and hydrodynamic studies, considerations related to entrainment and impingement, design and siting of refugia, effects on salmonid and smelt performance, and predation studies. Predation in general is a dominant theme among the key uncertainties, represented in 10 different potential studies." (Page D-195)

With so many uncertainties (these and more are described in previously submitted comments: [Dave Vogel Comments](#)), the proposed fish screens cannot be considered state-of-the-art.

Inadequate Sweeping Velocities

The proposed fish screens for the Alternative 4A intakes cannot function properly to meet existing criteria for salmon protection. As detailed in previously submitted comments ([Dave Vogel Comments](#)), the screens will fail to meet the fishery resource agencies' existing criteria for sweeping velocities. In sharp contrast to modern fish screens constructed elsewhere in the Central Valley, the three proposed Alternative 4A north Delta intakes would be positioned in

only very slight (or “gentle”³) river bends, or relatively straight sections of the river channel, and lower gradient reaches of the river precluding the ability to provide sufficient sweeping velocities. For fish screens of the nature contemplated for Alternative 4A (again, not “state-of-the-art”), high sweeping flows and velocities are critically necessary to protect juvenile salmon because it reduces exposure time to the screen face (lessening the likelihood of impingement and physical injury against the screens). The estimated fish exposure times are extreme⁴ and vastly inferior to fish protection measures designed and implemented at other fish screens throughout the Central Valley, and would certainly result in adverse effects on salmon (e.g., fry impingement). Fish impingement and injury can result when exposure time to the screens is too long (USBR 2006). Very large numbers of salmon fry (the weakest swimming early life stage) will be exposed to the long screens. The RDEIR/SDEIS admits its analysis of this issue is simply a “general discussion” (Page 11-66). It is not clear why the RDEIR/SDEIS did not use the widely available best science concerning this critical element (e.g., Fisher 1981, NMFS 1997, Swanson et al. 2004a, Swanson et al. 2004b, USBR 2006, CDFW 2010).

Predation and Environmental Commitment 15: Localized Reduction of Predatory Fishes (Predator Control)

As with the original draft EIR/EIS and BDCP, the RDEIR/SDEIS also does not provide any factual understanding of how the Alternative 4A diversions and the corresponding structures would impact juvenile salmon as a result of predation. As detailed in previously submitted comments ([Dave Vogel Comments](#)), the screens will likely be a major problem for juvenile salmon as a result of predation. This is briefly acknowledged in the RDEIR/SDEIS: “*Predation at the north Delta would be increased due to the construction of the proposed SWP/CVP water export facilities on the Sacramento River.*” (Page 11-364). Although the RDEIR/SDEIS now admits that the north Delta intakes would likely attract piscivorous fish and increase predation on salmon in the vicinity of the intake structures⁵, the RDEIR/SDEIS goes to considerable effort to downplay associated risks of predation by advocating “controlling” or “managing” predation in the future⁶ through undefined measures. However, Section 3.4.15 of the RDEIR/SDEIS admits that effective management of predation is simply “hypothesized” and recommends numerous future “feasibility assessment studies” to address all the uncertainties associated with predator control. Despite the many uncertainties, the RDEIR/SDEIS fails to describe valid or proven remedial actions that would be undertaken to rectify predation problems that will likely surface after the facilities are constructed. Instead, the RDEIR/SDEIS states that it will use undefined “predator control” as a potential remedy.⁶ Additionally, predation mortality at the Alternative 4A north Delta intakes will likely occur even when the diversions are not in operation. That impact on young salmon was not taken into account in the RDEIR/SDEIS. Although impingement and entrainment would not transpire during non-diversion periods, predation mortality on salmon will still undoubtedly occur.

In the consistent pattern presented in the RDEIS/SEIR and throughout the original draft BDCP environmental documents of overstating fish benefits, Environmental Commitment 15:

³ As described in the original BDCP documents (draft BDCP EIR/EIS, Appendix 3F, Intake Location Analysis).

⁴ See e.g., draft BDCP Page 5.B-304.

⁵ See e.g., Pages 11-133, 11-247, 11-300, 11-303, 11-364.

⁶ See e.g., Pages 11-242, 11-246, 11-298, 11-304.

Localized Reduction of Predatory Fishes (Predator Control) (previously Conservation Measure 15) is portrayed as an action that will definitively provide positive results:

“This action would reduce populations of predatory fishes at locations of high predation risk (i.e., predation hotspots) associated with construction and operation of the proposed water conveyance facilities. This action would be applied only to the reach of the Sacramento River adjacent to the north Delta intakes and to Clifton Court Forebay. Environmental Commitment 15 would remove predator refuge habitat and reduce predator abundance in the construction areas. At a minimum, Environmental Commitment 15 will target the removal of an amount of predator refuge commensurate with the amount that may be created by construction of water conveyance facilities. These measures are expected to fully mitigate any indirect effect on predation rates associated with construction.” Page G-8

As detailed in comments previously provided ([Dave Vogel Comments](#)), exploring ways to control predator problems after the facilities are constructed is highly speculative and not credible. The fact remains that there are numerous areas in the Delta where localized predation “hot spots” have long been known to occur, yet no actions have been taken to fix those problem areas. From a practical standpoint, Environmental Commitment 15’s proposed effectiveness must first be demonstrated by: 1) initially working on alleviating predation problems at existing areas, and 2) learning from those actions prior to building massive new structures. For example, the severe predation problem areas in front of the Tracy Fish Facilities and immediately behind the Clifton Court Forebay gates have been known for decades (Coulston 1993, Gingras 1997, Vogel 2011, Wunderlich 2015). It should be proven that those areas can be fixed prior to building the north Delta intakes. The lack of progress in addressing known predation problems at existing export facilities does not inspire confidence that predation problems at the proposed north Delta diversions would be handled effectively. The potential mitigation of impacts from Alternative 4A is not established by simply proposing untested, unspecified actions that would be attempted at some future date after the north Delta intakes become operational.

Salmon Losses at the North Delta Intakes

The RDEIR/SDEIS acknowledges that there will be substantial losses of salmon at each of the north Delta intakes. This is evident where the RDEIR/SDEIS compares the adverse impacts on fish resulting from the five-intakes, three-intakes, two-intakes, and one-intake alternatives:

“It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 3 new intakes would be considerably lower than those expected from having 5 new intakes in the river.” (emphasis added) (Page 11 – 242)

“It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 2 new intakes would be considerably lower than those expected from having 5 new intakes in the river.” (emphasis added) (Page 11 – 352)

“It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 1 new intake would be considerably lower than those expected from having 5 new intakes in the river.” (emphasis added) (Page 11 – 301)

In attempts to analyze the specific impacts on salmon caused by predation losses at the north Delta intakes, the RDEIR/SDEIS used two methods to estimate salmon mortality: a fixed 5% loss per intake and a bioenergetics model⁷. As an initial matter, the RDEIR/SDEIS states that the 5% overall salmon mortality per intake is a “*conservative assumption*” and “*represents an upper bound estimate*”.⁷ There is no scientific basis provided anywhere in the RDEIR/SDEIS for those statements. To the contrary, the combined mortality caused by impingement and predation at each intake is likely to be considerably higher than assumed in the RDEIR/SDEIS based on numerous reasons provided in previously submitted comments ([Dave Vogel Comments](#)). Secondly, the bioenergetics model used for the RDEIR/SDEIS greatly underestimated salmon mortality at the intakes. The bioenergetics modeling only accounted for striped bass predation, greatly underestimating salmon losses. There was no consideration of losses attributable to Sacramento pikeminnow or black bass which would be expected. For example, Nobriga and Feyrer (2007) state: “*Striped bass, largemouth bass, and Sacramento pikeminnow are three of the major predators of juvenile and small adult fishes in the Delta.*” Notably, Odenweller and Brown (1982) concluded that Sacramento pikeminnow is one of the most important potential predatory fish species at future fish facilities on the lower Sacramento River. Pikeminnow are common and a well-known predator on salmon in the Sacramento River and Delta, especially in severely altered riverine environments that would be created by the Alternative 4A north Delta intakes. Furthermore, a considerable amount of error was introduced when the RDEIR/SDEIS bioenergetics modeling only accounted for small striped bass predation on larger-sized juvenile salmon and not small and large striped bass predation on smaller-sized salmon.⁸ Therefore, that modeling effort substantially underestimated striped bass predation. Here again, the RDEIR/SDEIS analysis has not used the best available science.

Additionally, it is reasonable to assume that there would be extensive variability in salmon mortality among the three intakes. For example, the highest mortality would likely occur at the downstream-most screen because juvenile salmon would be more concentrated with river flow due to the upstream water withdrawals from the other two intakes, and would likely be in a more-weakened condition and consequently more vulnerable to predation.

It is important to emphasize that the majority of Chinook salmon in the Sacramento Valley - the most important spawning and rearing habitats for salmon in California - would need to migrate past the three proposed north Delta diversions.

⁷ See e.g., Pages 11 – 133, 134, 244, 247, 296, 300, 303, 324.

⁸ “*Loboschefskey and Nobriga (2010) provide estimates of striped bass predation rates on “small prey” and “large prey.” This bioenergetics analysis incorporates only the large prey equation, although smaller salmon fry would fall under the small prey category. The large prey predation regression was based on data for small striped bass (69 to 478 millimeters [mm]); thus they mainly reflect responses of juvenile striped bass. Therefore, they are not as applicable for larger striped bass and for larger sized prey fishes.*” (draft BDCP Page 5.F-16)

Environmental Commitment 16: Nonphysical Fish Barriers (NPB)

A key Environmental Commitment (16) proposed in the RDEIR/SDEIS for Alternative 4A is the installation of nonphysical barriers (NPBs) under the highly questionable ability to divert juvenile salmon away from unfavorable outmigration routes through the Delta⁹. This measure is puzzling because of the RDEIR/SDEIS' apparent faith in the success of future, yet-to-be-designed NPBs as a proposed measure to benefit salmonids. Indeed, the RDEIR/SDEIS admits uncertainties about NPBs and analyzed the proposed action only through a "qualitative discussion" (Page 11-65). The limitations and uncertainties associated with NPBs are described in detail in previously submitted comments on the draft EIR/EIS and BDCP: ([Dave Vogel Comments](#)). Such barriers remain unproven for overall fish protection and should not be proposed as a positive remedial action for salmon to offset deleterious effects of Alternative 4A on salmon. If and when testing of behavioral barriers are shown to be effective at the sites proposed, then those measures could be proposed, but not before. As admitted in the RDEIR/SDEIS, "*Further investigations are necessary to determine whether, and under what conditions, nonphysical barriers may be appropriate.*" (Page D.3-76)

In summary, Environmental Commitment 16, like Environmental Commitment 15, is yet another proposed action within the RDEIR/SDEIS with highly tenuous outcomes in which purported fish benefits are assumed, while acknowledging numerous uncertainties as to the potential effectiveness of this measure. The DISB was also critical of the RDEIR/SDEIS in this regard (DISB 2015). Environmental Commitments 15 and 16 are non-specific, based on limited or no supporting data, have highly questionable benefits, and may actually create worse conditions for salmonids than the existing environmental baseline. There is no question that Alternative 4A's proposed three massive north Delta water diversions, fish screens, and indirect effects of operations will have some degree of negative consequences to salmonids, likely very severe. Again, the RDEIR/SDEIS clearly has not used the best available science.

Bypass Flows Downstream of the Alternative 4A Intakes

The RDEIR/SDEIS has not adequately addressed the reduced flow in the Sacramento River downstream from the proposed multiple, large-scale water diversions. When the diversions are in operation, flows in downstream areas will unquestionably be affected. The RDEIR/SDEIS acknowledges that "*Reduced flows below the north Delta intakes may increase predation potential.*" (Page 11-327) Additionally, reduced flows in the vicinity of Georgiana Slough is likely to increase the proportion of salmon entering the central Delta where fish mortality is high (Perry *et al.* 2015).

Confusingly, the RDEIR/SDEIS states: "*The exact triggers and responses for RTO [Real Time Operations] at the north Delta diversions are still under development.*" (Page D.3-25) Furthermore, the actual criteria for the proposed fish screens still has not yet been finalized (Page 11-66). Without this critically necessary information, how can one estimate effects on fish?

⁹ See e.g., Pages 11-65, D.3-10, D.3-12, D.3-73, D.3-74.

Unequal Transfer of Adverse Impacts to Sacramento River Basin salmonids from the South Delta to the North Delta

The RDEIR/SDEIS's purported benefits for Sacramento River salmonids resulting from the Alternative 4A three north Delta diversions is to supposedly alleviate present-day adverse impacts caused by the south Delta diversions (e.g., Page 11-62). The Alternative 4A concept is to reduce south Delta diversions in wet years by diverting more water from the north Delta and then, in dry years, rely on the south Delta diversions. Unfortunately, this is completely opposite of favorable conditions for Sacramento River basin salmonids. Sacramento River salmonids have a higher survival rate in wet years than in dry years (Brandes and McLain 2001, Michel *et al.* 2015). Reducing Delta inflow during wet years as a result of the north Delta diversions would be expected to reduce survival rates for Sacramento River basin salmonids, not increase them. For example, the RDEIR/SDEIS states: "*Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD [north Delta diversions] intakes due to reduced flows in this area.*"¹⁰ Reduced flows in downstream reaches will increase fish transit time and exposure to predators¹¹ and magnify diversion of fish into Georgiana Slough where survival is poor (Page 11-327, Perry *et al.* 2015).

Additionally, under existing conditions, only a portion of the Sacramento River basin salmonids are adversely impacted by south Delta exports whereas the north Delta diversions will influence a far greater portion of the salmonids resulting in disproportionate impacts. Misleading statements in the RDEIR/SDEIS suggest overall benefits to salmon result from reduced entrainment due to implementation of Alternative 4A (e.g., Page 11-62). Entrainment reduction, as portrayed in the RDEIR/SDEIS, is linked to the south Delta export facilities, not north Delta intakes. Entrainment reduction at the south Delta facilities does not offset the greater adverse impacts caused by impingement and predation anticipated at the Alternative 4A north Delta intakes. Again, a much greater number of Sacramento River salmonids will be exposed to those diversion sites compared to the south Delta export facilities.

Figure 1 below provides a conceptual depiction of this problem. Site-specific mortality (red dots in Figure 1) of salmon is anticipated at each of the three water diversion intakes and at the non-physical barrier at the Georgiana Slough flow split. Increased reach-specific mortality (red lines in Figure 1) is anticipated downstream of the three diversion intakes because of problems caused by reduced flows compared to baseline conditions. No change in mortality is anticipated to be caused by the Delta Cross Channel gate operations because it is assumed that the gates would be closed during the period when the three north Delta diversions would operate. Also, it is assumed that changes in salmon mortality in Cache Slough, the lower Sacramento River downstream of Cache Slough, the lower Mokelumne River, and San Joaquin River would not be measureable because of the extremely large tidal influence in these regions.

¹⁰ See e.g., Pages 11-243, 11-246, 11-250, 11-290, 11-298, 11-301, 11-305, 11-312, 11-330, 11-352, 11-366, 11-372, 11-379.

¹¹ "*Higher flows correspond to higher velocities and faster travel times, reducing the time smolts are exposed to predators.*" (Høgåsen 1998, as cited by Michel *et al.* 2015).

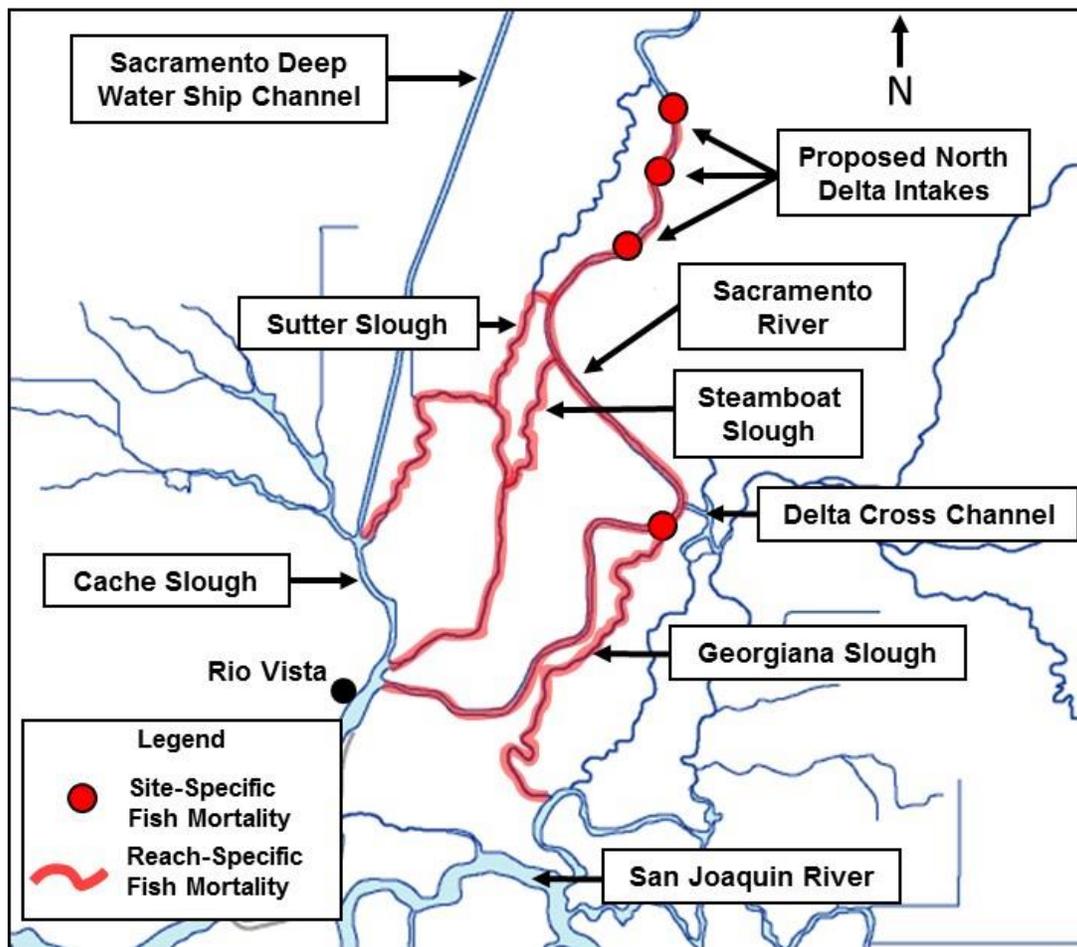


Figure 1. Diagram of the north Delta depicting areas where increased juvenile salmon mortality is anticipated if the “WaterFix” Alternative 4A was implemented.

Use of Fish Models for the RDEIR/SDEIS Analyses

The RDEIR/SDEIS used a variety of models to assess potential effects on salmon resulting from implementation of Alternative 4A and to compare alternatives.¹² Although large numbers of salmon fry enter the Delta each year, none of the fish models were capable of evaluating Alternative 4A’s effects on this smaller-sized salmon life stage. Previously submitted comments on the draft EIR/EIS and BDCP provided extensive details of the invalidity of many of those models that have carried through, unchanged, into the RDEIR/SDEIS. Although models are never perfect in predicting effects on salmon, those used for the RDEIR/SDEIS were particularly constrained because of a lack of empirical data, incorrect data, and very low reliability and confidence in the models’ outputs. As pointed out in prior comments, with so many questionable or erroneous assumptions built into the models based on incomplete, incorrect, or highly speculative information, the models, in reality, have a very low sensitivity for adequately providing any meaningful analyses for the RDEIR/SDEIS.

¹² See e.g., Table 11-15, pages 11-65 through 11-74 and Table 11-16, pages 11-75 through 11-77.

Overstatement of Benefits to Salmon without Supporting Justification

As in the original draft EIR/EIS and BDCP (see previously submitted [Dave Vogel Comments](#)), the RDEIR/SDEIS again provides highly speculative, overly optimistic and definitive projections on benefits to salmon without supporting scientific justification¹³:

“Increasing the through-Delta survival of juvenile salmonids will be accomplished by maximizing survival rates at the new north Delta intakes, increasing survival rates at the south Delta export facilities, reducing mortality at predation hotspots, increasing habitat complexity through restoration actions along key migration corridors, guiding fish originating in the Sacramento River away from entry into the interior Delta, and ensuring pumping operations do not increase the occurrence of reverse flows in the Sacramento River at the Georgiana Slough junction. The BDCP’s contribution toward addressing these factors is anticipated to improve conditions for juvenile salmonids and thus increase survival throughout the Plan Area, thereby contributing to increased abundance of emigrating juvenile and immigrating adult salmonids.” (Page D.3-7)

As extensively described in previously submitted comments, the best available scientific information confirms the opposite of those claims: ([Dave Vogel Comments](#)).

Cumulative Impact Analyses

The RDEIR/SDEIS Cumulative Impact Analyses (Section 5) of effects on salmon are flawed and its assumptions are unreasonable and incorrect. Contrary to the conclusions stated in Section 5, the adverse effects of Alternative 4A would be cumulatively significant and the project’s incremental adverse effects on Sacramento River basin salmon would be cumulatively considerable. The RDEIR/SDEIS is built on a false premise that implementation of Alternative 4A would be beneficial for salmonids (Page D.3-7) with no supportive scientific foundation. To the contrary, as described above, the best scientific evidence indicates the project-specific effects would be detrimental to juvenile salmon.

While acknowledging that adverse impacts to salmon would occur as a result of implementation of Alternative 4A, the RDEIR/SDEIS is almost totally reliant on unproven and undefined measures to mitigate those impacts through the future use of predator control and nonphysical barriers (i.e., Environmental Commitments 15 and 16). The presumed success of those mitigative measures is inappropriate and not plausible, in particular, because the RDEIR/SDEIS has provided no credible evidence to support the effectiveness of those measures.

Additionally, as previously described, the RDEIR/SDEIS failed to acknowledge that there will be an unequal transfer of negative impacts to Sacramento River basin salmonids from the south Delta to the north Delta. The best available information indicates that much greater detrimental impacts to salmonids will occur from the north Delta intakes and operations as compared to any possible beneficial impacts caused by entrainment reduction in the south Delta. The

¹³ The DISB (2015) was also critical of the RDEIR/SDEIS in this regard.

RDEIR/SDEIS Cumulative Effect Analyses failed to account for the fact that a far greater portion of Sacramento River salmonids will be exposed to the unfavorable conditions caused by the north Delta intakes and operations than those exposed to harmful conditions caused by the south Delta intakes.

Furthermore, the criteria for the north Delta intake screens still have not been finalized, but it is evident, based on the best available scientific information and unfavorable locations of the screens, site-specific impingement and predation at the three intakes will occur and probably be severe. Cumulative adverse impacts on salmonids caused by impingement will be considerable but are not even addressed in the RDEIR/SDEIS Section 5 analyses. Cumulative adverse impacts on salmonids caused by predation at the intakes will be also be considerable but are speculatively addressed only through unproven and undefined predator control measures.

Also, reduced flows in the salmon migration habitats in large reaches downstream of the three north Delta intakes when in operation, will likely cause increased mortality of salmon. Here again, the cumulative adverse impacts to salmonids are anticipated to be considerable but are not addressed in the RDEIR/SDEIS Section 5 analyses.

In conclusion, for multiple reasons, the best available scientific information indicates that the WaterFix Alternative 4A would contribute considerably to significant cumulative adverse impacts to salmon.

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EXHIBIT D

Technical review of portions of the revised draft Environmental Impact Report and supplemental draft Environmental Impact Statement (RDEIR/SDEIS) for the California WaterFix

Prepared for:

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By

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28 October, 2015

Introduction

The Sacramento-San Joaquin Delta (the Delta) is a critically important aquatic ecosystem to the state of California. Located at the interface of Sacramento and San Joaquin river watersheds, the Delta supports diverse aquatic and terrestrial species, many of which are currently threatened or endangered. Delta inflows include runoff from approximately 40% of the land in California and water in the Delta supports the agricultural, municipal, and industrial land uses of millions of citizens. At present, the Delta is considered to be in a state of crisis. In recent years, the relative abundances of several fish species have been estimated to be at the lowest levels on record, and infrastructure related to water exports has been characterized as aging and highly susceptible to earthquake damage and sea level rise. The needs to improve the population status of many Delta fish species and to modernize the existing water conveyance system prompted the Department of Water Resources (DWR) and several state and federal water contractors, in coordination with the United States Bureau of Reclamation (Reclamation), to develop a strategy for improving ecological functions in the Delta and water supply reliability in California. This strategy was formally described in the Bay-Delta Conservation Plan (BDCP), which at its core, outlined activities to construct new water intake structures in the north Delta while simultaneously pursuing a large-scale and long-term habitat restoration program within the greater Delta.

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In December 2013, a Draft Environmental Impact Report/Environmental Impact Statement (draft EIR/EIS) for the proposed BDCP was released for public review, and comments were submitted by the end of July 2014. The comments received were wide-ranging and raised concerns about the size and scale of the BDCP's activities, impacts on air and water quality, noise effects stemming from construction, and the proposed 50-year permit period for incidental take of protected fish species in light of uncertainty regarding future effects of climate change and long-term effectiveness of proposed habitat restoration efforts.

After receiving these comments, the lead agencies significantly modified the BDCP – primarily Alternative 4 – by formulating new sub-alternatives that would have an incidental take authorization period much less than the BDCP's 50 years, and that would have only limited amounts of habitat restoration. The resulting proposal is called the "California WaterFix." Improving water conveyance infrastructure and limited amounts of habitat restoration are proposed for California WaterFix, while all remaining habitat restoration activities now would be in a separate project, California EcoRestore. The revised draft Environmental Impact Report and supplemental draft Environmental Impact Statement (RDEIR/SDEIS), which was released for public review in July 2015, details changes made to the BDCP that would be included in the California WaterFix project. I have reviewed portions of the RDEIR/SDEIS (see the Appendix for a list of the specific sections I reviewed). This document summarizes my conclusions regarding the RDEIR/SDEIS's statements and analyses as they pertain to impacts that would result from construction and operation of the proposed California WaterFix water conveyance facilities on delta smelt and longfin smelt.

Brief summary of California WaterFix

The proposed California WaterFix project would involve the construction and operation of new water intake structures in the north Delta. Water would be diverted at three intakes (each with a capacity of 3,000 cfs) located on the bank of the Sacramento River and then conveyed to the south Delta via two underground tunnels.

Pumps associated with the present CVP and SWP intake facilities in the south Delta create 'reverse flows' whereby water from the north and central Delta is pulled southward (upstream) rather than flowing downstream toward San Pablo Bay and San Francisco Bay. These reverse flows pull eggs, larvae, and adult fishes toward the pumps and thus create direct and indirect adverse impacts on the populations of these fish species. The proposed conveyance system for the north Delta would not create reverse flows, and the RDEIR/SDEIS suggests that the operational flexibilities provided by the proposed new conveyance system would reduce reliance on south Delta exports and thereby reduce reverse flows in the Delta and allow water

diversions and operations to better reflect natural seasonal flow patterns. Relatively modest ecosystem restoration of 2,100 acres is included in the RDEIR/SDEIS's proposed project for mitigation of only north Delta construction activities.

General conclusions

I previously prepared a document dated 9 July 2014, titled "Technical review of the Bay-Delta Conservation Plan (BDCP) and related Environmental Impact Review (EIR)." That document described in detail several deficiencies of the BDCP and the December 2013 draft EIR/EIS. Those comments addressed five general points: (1) by failing to consider the experiences of other major aquatic ecosystem restoration efforts, the BDCP and draft EIR/EIS were not based on a complete analysis using best available science; (2) the draft EIR/EIS did not use the best available science to evaluate the benefits of its proposed habitat-restoration activities; (3) the draft EIR/EIS improperly relied only on qualitative methods to determine the BDCP's likely net effects on covered fish species and improperly failed to use available quantitative modeling to evaluate these net effects; (4) the draft EIR/EIS improperly failed to include an uncertainty analysis in its estimates of the potential benefits of the BDCP to covered fish species; and (5) the proposed adaptive management measures in the BDCP and draft EIR/EIS were not adequately developed. The RDEIR/SDEIS does not address these comments and deficiencies previously identified apply to the proposed California WaterFix project.

The following paragraphs describe my general conclusions regarding the RDEIR/SDEIS's effects analysis on fishes in the Delta as it relates to the proposed California WaterFix project.

- 1.) As noted in my review of the original BDCP, integrating documented outcomes of other large-scale manipulations and restoration efforts in aquatic ecosystems into the effects analysis would greatly strengthen the foundations of the impacts analyses in the RDEIR/SDEIS. As it stands now, the RDEIR/SDEIS is just a compendium of analyses, modeling (quantitative and qualitative), and conjecture when information is limited. Describing the effects analysis in the context of several real-world examples where intended and unintended outcomes have been evaluated would be a vast improvement.
- 2.) Related to the preceding point, construction and restoration activities conducted elsewhere have almost universally experienced unforeseen effects, and these effects generally have been adverse to resident biota. Therefore, even if the conclusions of the RDEIR/SDEIS all are accurate, which is highly unlikely, its overall effects analysis still should be viewed as an exceedingly optimistic best case scenario.

- 3.) Much of the RDEIR/SDEIS's detailed discussions regarding effects from construction and operation of California WaterFix facilities are focused on fish population abundance (i.e., numbers of eggs, larvae, juveniles, and adults potentially impacted). Also important, however, are potential changes to the vital rates of various fish life stages that underpin overall fish population dynamics. Largely absent from the RDEIR/SDEIS's effects analysis is any detailed discussion of how California WaterFix activities might alter survival, growth, maturation schedules, and reproductive success over short, medium, and long time periods. Enhancing overall productivity of the Delta ecosystem is certainly a central theme to California EcoRestore. However, understanding the potential impacts of California WaterFix activities on fish population vital rates is key because adverse effects to these parameters can often be more detrimental than overall population losses.

- 4.) The RDEIR/SDEIS systematically identifies a wide variety of potential impacts resulting from proposed construction and operation activities. Each impact is discussed in detail and statements regarding the nature (beneficial, detrimental) and scale (minimal, significant) of each are provided. However, in reality, each of the identified impacts would not occur in isolation. It is very likely that there would be synergistic and interactive effects from the various known and unforeseen impacts, yet there is no discussion of this concept in the RDEIR/SDEIS. Synergistic and interactive effects have the potential to exacerbate or offset individual effects such that outcomes could be more or less extreme than the originally anticipated individual effects.

Specific conclusions

Delta smelt

The RDEIS/SDEIS acknowledges that construction and maintenance of the proposed new north Delta intakes and screens would occur entirely within designated critical habitat for delta smelt (Section 4, subsection 4.3.7, p. 4.3.7-2). The overarching mitigation strategy described in the RDEIR/SDEIS calls for construction during periods of the year when various life stages of delta smelt are perceived to be largely absent from the project footprint, primarily summer and fall (June-October). However, the RDEIR/SDEIS indicates that delta smelt eggs, larvae, and adults could be present in the north Delta during a portion of the proposed in-water construction period for the intakes (June), in the east Delta during the proposed construction period for barge landings (June-July), and in the south Delta during the proposed construction period at Clifton Court Forebay and the Head of Old River (June-July). Acknowledged construction impacts on delta smelt include temporary increases in turbidity, accidental spills, disturbance of

contaminated sediments, underwater noise, fish stranding, in-water work activities, loss of spawning, rearing, or migration habitat, and altered predator-prey relationships. The deficiencies in the analysis of these impacts are discussed below.

Turbidity – Construction would unavoidably lead to increased water column turbidity through the resuspension of sediments. The RDEIR/SDEIS notes that delta smelt (and other Delta fishes) have evolved and adapted to survive in generally turbid conditions, and it suggests that increases in turbidity are expected to generally improve habitat conditions. Areas within the Delta with higher turbidity (measured as Secchi depth) have been linked to higher encounter probabilities (Feyrer et al. 2007; 2011) and relative abundances of delta smelt (Latour 2015) but considerable uncertainty remains as to the underlying mechanism or mechanisms supporting these observations.

Higher turbidity could provide refugia from predators and associated top-down impacts, which would support the RDEIR/SDEIS's conclusion that construction related increases in turbidity might be beneficial. However, the elevated presence and relative abundance of delta smelt in turbid waters could be due to bottom-up processes and increased food concentrations (phytoplankton, zooplankton) in those areas. In this case, resuspension of inorganic sediment stemming from construction activities would not be expected to yield any measurable benefits to delta smelt since food concentrations would not be increased. Untangling and quantifying the relative importance of top-down and bottom-up forcing on biotic populations is a major theme in ecology that is generally difficult to accomplish and certainly unresolved in the Delta. The RDEIR/SDEIS's conclusion of improved habitat conditions in the Delta from increased turbidity is based on an oversimplified view of food web ecology in the Delta, and it fails to acknowledge the very real possibility that this conclusion is incorrect.

Accidental spills – Unintended releases of contaminants such as cement, oil, fuel, hydraulic fluids, paint, and other materials during California WaterFix construction activities could occur. The RDEIR/SDEIS delineates several Spill Prevention, Containment, and Countermeasure Plans (SPCCP) that presumably represent state-of-the-art best practices for preventing accidental spills and managing them should they occur.

Disturbance of contaminated sediments – The RDEIR/SDEIS notes that the California WaterFix construction footprint includes areas with known or potentially contaminated sediments. Therefore, resuspension of sediments resulting from construction activities would disperse resident contaminants into the water column.

The RDEIR/SDEIS also acknowledges that few chemical data are available for the sediments within the construction site. Therefore, it can be assumed that contaminant impacts on delta smelt and other biota from sediment disturbance are difficult to quantify and predict.

The RDEIR/SDEIS states that because toxins enter the water column attached to sediment, their movement is closely linked to turbidity (Section 4, subsection 4.3.7, p. 4.3.7-11). From this point, the RDEIR/SDEIS infers that contaminant impacts on delta smelt would be minimal because of outlined mitigation strategies to minimize turbidity, and also because construction would take place during months when delta smelt are perceived to be absent from the project footprint (June – October).

However, the complexities associated with fate of disturbed sediment contaminants are far greater than those acknowledged by the RDEIR/SDEIS. Within estuarine systems, contaminants partition between aqueous (overlying water) and solid (sediment, suspended particulate matter) phases. The partitioning behavior (contaminant sorption) and spatial distribution of contaminants are highly regulated by site-specific hydrodynamics, biogeochemical processes, and environmental conditions (redox, pH, salinity, and temperature; Eggleton and Thomas 2004). Grain size of sediments can also impact sorption, where fine-grained bottom sediments tend to accumulate contaminants and act as reservoirs. Bottom disturbances can cause changes in sediment chemistry and aid contaminant remobilization, which in turn can result in desorption (change of state) and transformation of contaminants into more bioavailable or toxic chemical forms (Eggleton and Thomas 2004). The RDEIR/SDEIS fails to acknowledge key details regarding the dynamics of disturbed sediment contaminants, and, as a result, its conclusion of minimal impacts on delta smelt is based on an oversimplified, and probably incorrect, analysis.

Underwater noise – The creation of underwater noise is an unavoidable effect of the proposed California WaterFix construction activities. Table 4.5.7-1 (Section 4, subsection 4.3.7, p. 4.3.7-14) in the RDEIR/SDEIS provides a summary of the distances and total impacted area subject to pile driving noise levels that exceed interim injury and behavioral thresholds of fishes. The distance estimates greatly exceed (by factors of 5 to 6) the average width of the water body at the three proposed intake sites in the north Delta. Areal estimates of impact are also sizeable (approximately 40 to 90 acres), suggesting appreciable spatial domains surrounding each intake site would be adversely affected by underwater noise.

The field of underwater noise stemming from construction activities would bisect the Sacramento River into two disjointed segments, and successful fish movement between the two segments would not likely occur. Such an impact would very likely have adverse effects on localized movements of resident fishes, including delta smelt. The RDEIR/SDEIS states that construction activities creating notable underwater noise would be restricted to summer and fall (June-October) when delta smelt are not present in the California WaterFix project footprint. The basis for this conclusion is Table 11-8, Chapter 11, Section 11.3.1.1 in Appendix A (p. 11-53) of the RDEIR/SDEIS, which depicts delta smelt abundance in the north Delta as low

during those months. However, this table does not cite any formal data sets or studies on the spatiotemporal distribution of delta smelt in the north Delta as foundational material for this conclusion.

Appendix 11A of the original BDCP provides descriptions of covered species and cites several peer-reviewed manuscripts that provide information on the abundance and distribution of delta smelt (e.g., Nobriga et al. 2008, Merz et al. 2011, Sommer et al. 2011). But, those studies were based on data from field activities that utilized fixed-station sampling designs primarily located far to the south and west of the proposed north Delta construction site. Long-term fish community data within the proposed north Delta construction footprint are limited. Based on a map of survey locations for Delta fish monitoring programs, there appears to be: (a) one Fall Midwater Trawl (FMWT) and beach seine survey site close to intake 3; (b) one FMWT and one beach seine site south of intake 5; and (c) one beach seine site north of intake 2 (Merz et al. 2011). However, it is unclear how often those few locations have been sampled and the breadth of available data to support the RDEIR/SDEIS's conclusions is likely inadequate to draw definitive conclusions about delta smelt abundance in the north Delta during summer and fall (June-October).

Fish stranding – Installation of cofferdams would have the potential to trap delta smelt and other aquatic organisms. The RDEIR/SDEIS attempts to dismiss this potential impact by stating that restricting construction to summer and fall (June-October) would minimize impacts since delta smelt abundance within the construction zone is assumed to be low during that time period. The above comments about the validity of assumptions regarding the spatiotemporal distribution of delta smelt also apply here. Additionally, it should be noted that any trapped delta smelt eggs would be lost, and, given the fragility of delta smelt (Sommer et al. 2011), larvae, juveniles, and adult fish are unlikely to survive the capture and handling procedures associated with attempted rescues and relocations.

In-water works –The RDEIR/SDEIS's argument that the proposed timing of construction operations would coincide with low delta smelt abundance within the north Delta project footprint is used to conclude that impacts from in-water works also would be minimal. The above comments about the validity of assumptions regarding the spatiotemporal distribution of delta smelt also apply here.

Loss of spawning, rearing, or migration habitat – The RDEIR/SDEIS acknowledges that in-water construction activities would temporarily or permanently alter habitats for delta smelt spawning and rearing (Section 4, subsection 4.3.7, p. 17). It states that these habitat impacts would be limited in overall scope and would not be expected to affect delta smelt population productivity. Construction of intake structures would alter 2.6 miles of the Sacramento River channel margin, and cofferdams used to isolate work areas would temporarily reduce the

riverine width by only 10%. The RDEIR/SDEIS states that this amount of affected habitat constitutes only small fraction of the total available migration and rearing habitat available to delta smelt, and that there is no evidence that the affected areas are uniquely important to the overall viability of the delta smelt population.

However, no formal data set or scientific studies were cited to support this conclusion. Based on a search of the peer-reviewed literature, it appears that the spatial extent of the delta smelt spawning and rearing grounds is not well understood, particularly in the north Delta. That is, I was unable to find a study that comprehensively delineates the spawning and nursery habitat for delta smelt. Sommer et al. (2011) reported on the spawning migration of delta smelt and concluded that fish exhibit considerable variability in spawning behavior, which is a concept contrary to the prevailing viewpoint that all individuals synchronously migrate during winter. The limited understanding of delta smelt spawning and nursery locations combined with newly emerging ideas about spawning behavior creates notable uncertainty that is not acknowledged in the bare conclusions reached by the RDEIR/SDEIS.

Predation – The RDEIR/SDEIS acknowledges that the addition of new permanent underwater and overwater structures would have the potential to create congregation areas for avian and fish predators of delta smelt. However, the RDEIR/SDEIS concludes that that new pilings and overwater structures would create only a small increase in the overall suitable predator habitat. But a comprehensive understanding of predation impacts on delta smelt is lacking, so it is difficult to place the predation conclusions of the RDEIR/SDEIS into a meaningful context.

Results of striped bass and other fish predator diet composition studies in the Delta have shown very little consumption of delta smelt (Nobriga and Feyrer 2007; Nobriga and Feyrer 2008). However, these studies were temporally abbreviated, and each acknowledged potential biases due to spatial limitation of predator stomach collections. Therefore, systematic temporal and spatial diet composition studies of piscivorous fishes are necessary to more fully understand predation impacts of larger fishes. The limited understanding of predation impacts creates uncertainty that is not acknowledged in the bare conclusions reached by the RDEIR/SDEIS.

AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt – The RDEIR/SDEIS states that Alternative 4A would result in lower overall entrainment of delta smelt when compared to existing conditions. Figures 11-4A-1 and 11-4A-2 (Section 4, Subsection 4.3.7, p. 22) show average annual estimated proportions of the larval/juvenile and adult delta smelt populations lost to entrainment at the south Delta export facilities, respectively, for various water conveyance alternatives and precipitation scenarios. These figures raise two major concerns.

First, to estimate proportions of the population lost, the overall total population size must be known. Empirically based estimates of total delta smelt population size do not exist, so the information in the figures must be based on a simulated delta smelt population (e.g., particle tracking model as in AQUA-21 for longfin smelt). Although hydrodynamic models can be calibrated and validated quite well (i.e., close representation of the actual physical dynamics of aquatic systems), effectively linking them to biological organisms can be challenging, particularly for higher trophic levels fishes. I am not intimately familiar with the analyses underpinning the delta smelt entrainment conclusions in the RDEIR/SDEIS, but in general, caution has been recommended when trying to forecast with so called end-end-models (single framework dealing with physiochemical descriptors up to biological organisms; Rose et al. 2010).

Second, the results summarized in the bar chart figures are based on a regression analysis, which is a statistical procedure used to estimate relationships among variables from data. Each bar height represents the estimated mean proportion juveniles/adults lost to entrainment, however, absent from the figures are associated estimates of precision (standard errors, confidence intervals). When applying regression techniques, standard scientific practices involve reporting results both in terms of the estimated quantities and their precision (Draper and Smith 1998). For many of the water conveyance alternatives compared, the bar heights are similar. If confidence intervals for the mean proportions were provided, I suspect that many of them would be overlapping, which would indicate no effective statistical differences among them. Stated differently, the lower estimated proportions of juveniles/adults lost to entrainment for the Alternative 4A scenarios are only statistically different (which is the basis for inference) than the estimated proportions associated with existing conditions if the respective confidence intervals of the estimated means do not overlap. The lack of precision estimates in these figures makes it impossible to assess the statistical validity of the RDEIR/SDEIS's statements that improvements in delta smelt entrainment could be realized.

AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for Delta Smelt –

The RDEIR/SDEIS states that Alternative 4A would not limit the availability of delta smelt spawning habitat. The above comments about the uncertainty of the spatial extent of delta smelt spawning and nursery grounds also apply here.

AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt – In this section, the RDEIR/SDEIS relies heavily on the approach and results of Feyrer et al. (2011), which was a study aimed at developing an annual habitat index for delta smelt (although see methodological concerns raised by Manly et al. (2015) and the subsequent response by Feyrer et al. (2015)). Irrespective of methodological criticisms, it is important to note that Feyrer et al. (2011) based their analysis on the presence/absence of delta smelt in long-term midwater trawl

collections. Assessment of habitat quality for a fish species involves examining a suite of metrics that represent different aspects of a species population dynamics and utilization of space within an ecosystem. Typical metrics include, but are not limited to: presence/absence, localized abundance, production which depends on growth and survival, and reproductive success. While the Feyrer et al. (2011) study is an important contribution, it considers only one of the many metrics often used in habitat quality studies. The absence of other key metrics from Feyrer et al. (2011), and by association, the RDEIR/SDEIS implies that a great deal is not known about essential habitat for delta smelt. The RDEIR/SDEIS therefore lacks key information and contains bare conclusions about the effects of operations of the proposed project on delta smelt rearing habitat.

AQUA-6: Effects of Water Operations on Rearing Migration Conditions for Delta Smelt – The RDEIR/SDEIS states that operation of the north Delta intakes could reduce sediment loads that affect water turbidity. Water clarity could be increased slightly and the RDEIR/SDEIS notes that this could negatively influence habitat quality for delta smelt. The above comments about the uncertainty pertaining to underlying mechanisms supporting the importance of turbidity to delta smelt also apply here.

Longfin smelt

The RDEIR/SDEIS's discussion of California WaterFix construction impacts on longfin smelt is less detailed than that for delta smelt because longfin smelt's distributional overlap with the California WaterFix construction footprint is perceived to be smaller. Distribution of longfin relative abundance has been shown to be generally west of that of delta smelt (Rosenfield and Baxter 2007, Latour 2015), so recent scientific findings support this general conclusion. However, there is still uncertainty regarding the extent to which longfin smelt utilize areas within the California WaterFix's proposed north Delta construction footprint since that region does not appear to be intensively sampled by existing fish monitoring programs (Merz et al. 2011).

Analyses of specific effects on longfin smelt stemming from proposed construction activities and operation strategies are summarized in Impacts AQUA 19-32. These generally discuss many of the same topics raised in the effects analyses for delta smelt: turbidity, underwater noise, contaminants, predation, entrainment, etc. Therefore, many of the above comments concerning the RDEIR/SDEIS's deficiencies with respect to delta smelt also apply to the RDEIR/SDEIS's effect analysis for longfin smelt.

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Appendix

Sections of the RDEIR/SDEIS reviewed.

- Executive Summary, Subsection 3.1 – Improved Fish and Aquatic Habitat Analyses (pp. ES-21 to ES-25), http://baydeltaconservationplan.com/RDEIRS/0_ExecSumm.pdf
- Section 1, Subsection 1.3 – Contents of the RDEIR/SDEIS (pp. 1-30 to 1-33), http://baydeltaconservationplan.com/RDEIRS/1_Introduction.pdf
- Section 2, Subsection 2.1 – Substantive DEIR/DEIS revisions to Fish and Aquatic Habitat Analyses (pp. 2-1 to 2-5), http://baydeltaconservationplan.com/RDEIRS/2_Substantive%20Revisions.pdf
- Section 4, Subsection 4.1 (partial) – Introduction and Description of Alternative 4A (pp. 4.1-1 to 4.1-21), http://baydeltaconservationplan.com/RDEIRS/4_New_Alternatives.pdf
- Section 4, Subsection 4.1.6 – Assumptions for the Purposes of Analysis (pp. 4.1-42 to 4.1-43)
- Section 4, Subsection 4.2.10 (partial) – Impacts of No Action Alternative Early Long Term (pp. 4.2-49 to 4.2-51)
- Section 4, Subsection 4.3.7 (partial) – Impacts of Alternative 4A on Delta Smelt and Longfin Smelt (pp. 4.3.7-1 to 4.3.7-44)
- Appendix D, Subsection D.3.2, Substantive BDCP Revisions – Conservation Measures (pp. D.3-18 to D.3-19, D.3-44 to D.3-46, D.3-76 to D.3-80), http://baydeltaconservationplan.com/RDEIRS/Ap_D_SubRev.pdf