Appendix 5D

Water Transfer Analysis Methodology and Results

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5D.1 Introduction

This appendix provides a detailed description of the transfers analysis presented in Chapter 5 of the EIS/EIR, including assumptions, methodology, and detailed results. The purpose of the analysis is to provide an assessment of the relationship of cross-Delta water transfers to the BDCP alternatives. For purposes of this analysis, cross-Delta transfers are considered to be transfer water that originates upstream of the Delta and flows into the Delta or flows through the BDCP facilities to the SWP and CVP export pumps.

The results of the analysis are intended to provide comparative estimates of the relative magnitude of cross-Delta transfers between existing conditions, no action alternative, and the BDCP alternatives, rather than absolute forecasts of transfer activity. The analyses provide a factual basis for estimating how changes from existing conditions to the No Action Alternative will affect transfers, how each alternative will affect transfers in comparison with existing conditions, and how each alternative will affect such transfers relative to the No Action Alternative.

The analysis first estimates the demand for supplemental water. It then assumes that about 50 percent of that demand would be sought from upstream-of-Delta transfer sources, up to the assumed amount of available supplies from willing sellers.

5D.2 Effects on Water Transfers

Water deliveries by the SWP and CVP vary with hydrology, upstream consumptive use of water, environmental and regulatory constraints, existing storage and conveyance capacities, and a variety of additional factors. A comparison of the predicted future deliveries under the No Action Alternative as compared to the existing condition shows a decrease in SWP and CVP deliveries into the future as in-basin consumptive use of water increases. Climate change, sea level rise, and certain regulatory assumptions (including meeting fall X2 requirements) also tend to reduce the water available for allocation in the future. The demand for supplemental supplies to help offset that decline will tend to increase the demand for water transfers.

Historical information reveals certain patterns of water transfers as related to hydrology and project deliveries. Water transfer demand and completed transfers have increased over time and consumptive use of water in California has increased. The transfer demand increases are especially related to drier year types and lower SWP and CVP allocations.

Typically there are few purchases of water from the upstream-of-Delta region in the wetter year types to supplement project supplies, although there may be such purchases for environmental purposes and/or for storage in a water bank. For any such transfers, there is a material risk that the water cannot be exported, either because: the Delta could be in excess conditions through the summer, precluding the accounting of any transfers; the CVP and SWP are using all available pumping capacity to move project supplies; or the wetter year types have suppressed local demand, increased local supplies, and project allocations are adequate.

Some water agencies in the export service area have suffered from chronic water supply decreases, especially the San Luis and Delta-Mendota Water Authority (Authority), representing numerous CVP contractors in the export service area. The Authority has contracted for a number of transfers to augment their annual supply, and has focused on areas south of the Delta to avoid reliance on the Delta export pumps to move transfer water except in the driest year types. These transfers are addressed in Appendix 5C, Federal Water Purchase Programs in California.

In the drier years, the Authority actively seeks cross-Delta transfers in addition to its participation in the Yuba Accord dry year water purchase program. In 2001, it participated in a forbearance program whereby CVP contractors upstream of the Delta did not take certain CVP supplies, allowing them to flow to the Delta and augment CVP exports to the Authority and others.

The SWP contractors have been active participants in water transfers as well in the drier years. DWR has also conducted a number of drought water banks and dry year programs to help California water agencies through droughts and dry year sequences.

5D.2.1 Method of Analysis and Assumptions

The analysis is based on the assumption that cross-Delta transfers are sensitive to the allocations of the SWP and CVP, and that the lower the allocations below some trigger threshold, the greater the demand for such transfers.

Transfer capacity at the Delta export pumps operated by DWR and Reclamation has historically been a major factor in the ability to move such transfers, and may be a continuing constraint in the future. The potential cross-Delta transfer volume may be limited by the capacity of the export facilities, by regulatory constraints, and by the availability of water for transfer from willing sellers upstream of the Delta. However, those constraints tend to be less in the low allocation years when there is less SWP and CVP water to export. This analysis does not place any limits on conveyance capacity through the in-Delta channels or through the BDCP facilities at this time.

Currently, the CVP and SWP only account for water transfers released during balanced conditions, when the projects are releasing stored water to maintain Delta standards. During excess conditions, there is more Delta inflow than needed to meet Delta standards and support targeted Delta export pumping. Under excess conditions, any new transfer water released to the Delta would merely increase Delta outflow, and would not be considered transfer water because it could not be delivered to any buyers downstream of the export pumps. Transfer water released during balanced conditions can allow the projects to either reduce the amount of water released from storage and thereby benefit from the increase in water released as transfer water, or increase exports, and account for that water as passing to the downstream buyers when it is exported.

As noted in Chapter 5, the water transfers analysis assumes available upstream-of-Delta water transfer supplies of 600,000 and 1,000,000 acre-feet in any single year. The cross-Delta transfer supply obtained from reservoir re-regulation, crop idling, and groundwater substitution and related actions may be limited due to a number of practical factors, such as the ability to contract for 20 percent of all eligible crop acreage in a timely manner without triggering public hearings as well as comply with required avoidance and mitigation measures to protect the giant garter snake; the willingness of potential sellers to engage in a transfer in any single year; the low probability that more than 600,000 acre-feet from reservoir re-regulation, crop idling, groundwater substitution, and related actions would be sought in the initial year of a series of low allocation years, considering banking programs, other transfers agreements, and other sources available to contractors; and the

effects of local shortages in the water transfer source areas on the availability of surplus water to transfer in the subsequent years of extended dry periods.

The 2008 Biological Assessment for the OCAP assumed 600,000 acre-feet of cross-Delta transfers as a likely amount for consideration in the Biological Opinions. However, the 2008 Biological Assessment also stated at Page 12-39: "Water transfers would increase Delta exports from about 0 to 500,000 acre-feet (af) in the wettest 80 percent of years and potentially more in the driest 20 percent years, and up to 1,000,000 af in the most adverse Critical year water supply conditions."

For this reason, as well as to provide a bookend for environmental impact analysis purposes, this analysis also examines the magnitude and frequency of cross-Delta transfers in the case of 1,000,000 acre-feet of water being available for transfer in any year. Appendix 5C provides information on potential sources of transfer water in the areas upstream of the Delta, and this appendix provides tables of relative transfer frequency and magnitude for each BDCP alternative assuming 1,000,000 acre-feet of transfer water could be available.

Records of past cross-Delta transfers from 1995–2012 were reviewed to identify the years in which there were spikes in such transfers to estimate the project allocation percentages that tend to stimulate demand for cross-Delta transfers. Table 5D-1 illustrates the hydrologic year types, SWP and CVP allocations, and estimated cross-Delta water transfers. The table shows that recent transfer volumes are substantially less than either 600,000 or 1,000,000 acre-feet. This lower historical range may reflect less severe drought conditions during the 1995–2012 period than historical droughts in the 1930s and late 1980s-early 2000s (and higher allocations during this period than the very low allocation percentages shown in CALSIM II output in some of the drier years in the period of analysis), lack of confidence by buyers to commit to purchases given limited Delta export capacity, further constrained by the current limited transfer "window" of July 1–September 30 without further ESA consultation, and other factors.

If the supply from upstream-of-Delta willing seller sources is less than assumed in this analysis, there would be fewer transfers under all the alternatives, including the existing conditions, but the trends and relative impacts would still be valid. In such a case, the impacts would be conservatively overstated.

Table 5D-1 indicates that cross-Delta transfer interest generally accompanies the dry year periods and low allocations. Comparing the years when cross-Delta transfer activity picks up with allocations, and considering Delta export constraints on transfers, SWP demand for cross-Delta transfers increases noticeably at allocations below 50 percent, and CVP demand for cross-Delta transfers increases below 40 percent.

Table 5D-1. Cross-Delta Transfer History, 1995–2012

Year	Sacramento River Year Type	San Joaquin River Year Type	SWP Percent Allocation	CVP San Joaquin Ag Percent Allocatio	Active Cross- Delta Transfer Program	Cross-Delta Transfers Without EWA, AF	EWA Cross-Delta Transfers, AF	Cross-Delta Transfers With EWA, AF
1995	W	W	100	100	No	0		0
1996	W	W	100	95	No	0		0
1997	W	W	100	90	No	0		0
1998	W	W	100	100	No	0		0
1999	W	AN	100	70	No	0		0
2000	W	AN	90	65	No	0		0
2001	D	D	39	49	Yes	298,806	105,000	403,806
2002	D	D	70	70	Yes	22,000	142,143	164,143
2003	AN	BN	90	75	EWA Only	0	69,914	69,914
2004	BN	D	65	70	EWA Only	0	118,700	118,700
2005	BN	W	90	85	No	0	6,044	6,044
2006	W	W	100	100	No	0	0	0
2007	D	C	60	50	EWA Only	0	125,000	125,000
2008	C	C	35	40	Yes	169,186		169,186
2009	D	D	40	10	Yes	274,551		274,551
2010	BN	AN	50	45	Yes	264,165		264,165
2011	W	W	80	80	No	0		0
2012	BN	D	65	40	Yes	84,781		84,781

The data are shown both with the Environmental Water Account (EWA) program cross-Delta transfers and without. The EWA purchased and transferred water to offset Delta export pumping curtailments, transferring water in every year from 2001–2007 regardless of hydrology (except 2006 when Delta conditions were sufficiently wet that excess conditions prevailed all summer, precluding all cross-Delta transfers). The EWA cross-Delta transfers are larger in the drier years due to the increase in Delta pumping capacity available for transfers. In the wetter year types, the EWA purchased more of its transfer water from south of Delta sources.

The EWA is not considered a reliable indicator of cross-Delta demand by the SWP and CVP because export curtailments occurred in all year types to protect fish, and the source (upstream or downstream of the Delta) of the replacement water was dependent on predicted cross-Delta transfer capacity rather than on contractor demand for supplemental water supplies. Therefore the EWA cross-Delta transfers should not be considered in estimating the likely SWP and CVP allocations that triggered cross-Delta demand in the 1995–2012 period.

Based on an analysis of the historic transfer activity, SWP allocations below 50 percent and CVP allocations below 40 percent appear to trigger a significant increase in efforts to secure north-of-Delta transfer water. Using these approximations, DWR developed a spreadsheet to estimate the demand for supplemental supplies necessary to bring the SWP and CVP project deliveries up to the 50 percent and 40 percent levels, respectively when allocations are less than those values. A broad range of methods is used by water agencies to help offset delivery reductions from the SWP and

CVP, such as withdrawing stored reservoir water, extracting stored or banked groundwater, intensified conservation, tapping other local or imported sources, idling cropland, and other methods. In the drier year types, water obtained from cross-Delta transfers plays an important role in meeting critical south-of-Delta demands.

The amount of that supplemental water necessary to assure SWP and CVP project supplies of at least 50 percent and 40 percent allocations, respectively, could exceed 1,500,000 acre-feet in drought years similar to those in the 1930s and the 1990s, based on the analyses of deliveries derived from the CALSIM II modeling output for the 82-year period covered.

The focus of this analysis is on the cross-Delta transfer implications of the BDCP alternatives, and therefore an estimate of the potential volume of water that could be transferred across the Delta through either the existing Delta channels or through BDCP facilities and the relative frequency of such transfers is required.

The potential cross-Delta transfer volume may be limited by the capacity of the export facilities, by regulatory constraints, and by the availability of water for transfer from willing sellers upstream of the Delta. Two values for the potential supply of cross-Delta transfer supplies are used in the analysis, 600,000 acre-feet and 1,000,000 acre-feet.

It should be noted that in the 1991 Drought Water Bank DWR executed contracts for the purchase of 821,000 acre-feet of water. However, 40 percent of that contracted amount was developed through crop idling in the Delta region, and based on the experience gained in 1991, DWR no longer approves similar transfers. There has been a significant evolution in the understanding of how much water can be made available from various types of transfer such as crop idling or groundwater substitution, as well as potential impacts associated with large scale transfers from a single region.

No allowance is included in the analysis for the multi-year effects of droughts on the upstream-of-Delta transfer water supplies that could be available from willing sellers. Those supplies will decrease during a multi-year drought. Many potential sellers will also experience water shortages of their own as a result of multi-year droughts due to the imposition of shortages under SWP and CVP settlement contracts or reductions in surplus reservoir storage. Groundwater substitution programs can generally be operated for a number of consecutive years, as is the case under the Yuba Accord, but after several years of a drought, increased in-basin demands may result in conditions that would limit the opportunities for additional groundwater pumping for transfers.

Because this analysis does not attempt to quantify the reductions in transfer supplies in the later years of a multi-year drought, the estimate of cross-Delta transfers is conservatively overstated in those types of events. Historically, such droughts occurred in the 1929–1935 period and again in the 1987–1992 period. Therefore the cross-Delta transfers during the later years of those drought periods would be less than either the 600,000 acre-foot or 1,000,000 volumes used for this analysis, but no quantification of how the supply would diminish during droughts has been made. The estimates of 600,000 and 1,000,000 acre-feet being available overstates the potential volume of cross-Delta transfers in such conditions.

The estimates of cross-Delta transfer demand assume that the SWP and CVP contractors would attempt to replace approximately half of the supply deficits below the 50 percent and 40 percent allocation thresholds respectively with cross-Delta transfers, up to the assumed maximum available supply.

The assumption that half of the supply deficits would be sought from cross-Delta transfers for each project is based on similar but separate considerations for the SWP and the CVP. Many of the SWP contractors, particularly those with the highest contract amounts (e.g., MWDSC, KCWA, SCVWD) have extensive storage and/or banking arrangements. Diamond Valley Lake (MWDSC) and the Kern County area water banks (multiple banking contractors) are examples. This analysis assumes that the SWP contractors, on average, will draw on sources of stored water and limit cross-Delta transfers to no more than 50 percent of the supplemental demand, and no more than their proportion of the limited available upstream-of-Delta supply available from willing sellers.

For the CVP contractors, the Authority has arranged numerous transfer programs that are confined to the San Joaquin Valley to increase supply reliability and minimize the risk of depending on cross-Delta transfers. However, because the Authority has less banking and storage capacity relative to its contract amount as compared the SWP contractors as a group, it still requires cross-Delta transfers to meet the 40 percent equivalent allocation in a low allocation year. This analysis assumes that the CVP contractors, on average, will draw on their limited sources of stored water and their San Joaquin Valley transfer arrangements, and will limit cross-Delta transfers to no more than 50 percent of the supplemental demand, and no more than their proportion of the available upstream-of-Delta supply. A discussion of some of the San Joaquin Valley transfers the Authority draws upon to meet some of its need is presented in Appendix 5C.

In periods where allocations would be below the thresholds for two and three consecutive years, that demand (but not the supply) would be augmented slightly to help address multi-year deficiencies with transfers. These demand estimates are capped by the 600,000 and 1,000,000 acre-feet supply assumptions, respectively, and the supply shared equally between the SWP and CVP in the analysis regardless of any export constraints. Tables of transfer amounts reflecting both the 600,000 and 1,000,000 acre-foot supply assumptions are presented at the end of this Appendix.

5D.3 Cross-Delta Transfers Spreadsheet Assumptions

- Cross-Delta transfer demand starts when SWP allocations fall below 50%, or when CVP allocations fall below 40%.
- For each 1% decrease below 50% SWP allocation, 2,000 acre-feet of cross-Delta demand is created (about half of the 4,100 acre-feet of loss of Table A).
- For each 1% decrease below 40% CVP allocation, 900 acre-feet of cross-Delta demand is created (about half of the 1,965 acre-feet of loss of contract supply).
- For each two-year period where the sum of the SWP allocations is less than 90%, additional cross-Delta transfer demand is added.
- For each two-year period where the sum of the CVP allocations is less than 70%, additional cross-Delta transfer demand is added.
- For each three-year period where the sum of the SWP allocations is less than 125%, additional cross-Delta transfer demand is added.
- For each three-year period where the sum of the CVP allocations is less than 100%, additional cross-Delta transfer demand is added.

- Total Cross-Delta transfers, measured as inflow to the Delta, are capped at 600,000 acre-feet, or 1,000,000 acre-feet, based on potential supplies. Although available transfer supplies will be reduced in multi-year droughts, no quantification of the decrease is attempted.
- The CVP and SWP share the available 600,000 acre-feet and 1,000,000 acre-feet equally, but if one project does not require 300,000 acre-feet (or 500,000 acre-feet), the other project receives the balance.
- Only SWP Table A deliveries and CVP south-of-Delta agricultural service area contract deliveries are used in the spreadsheet computations.

In working with the spreadsheet and modifying the variables, the resulting estimates will change, but the relationship between the respective alternatives remains very similar. Different assumptions within the basic spreadsheet structure do not alter the amount of water needed to restore supplies to the 50 percent and 40 percent threshold levels, and do not appear to alter the relative change in transfer demand from upstream-of-Delta sources between the alternatives or as compared to existing conditions (CEQA analysis) or to the No Action Alternative (NEPA analysis).

The analysis therefore presents estimates of two different parameters: an estimate of the supplemental supply required to bring SWP and CVP project supplies to the 50 percent and 40 percent equivalent allocation amounts, and an estimate of cross-Delta water transfers that is assumed to be sought from willing sellers up to a combined maximum of 600,000 or 1,000,000 acre-feet in any one year to offset about 50 percent of that demand for supplemental supplies.

The analyses consider only the SWP Table A allocation amounts as reported in the CALSIM II output, and the south-of-Delta CVP agricultural service area deliveries (export service area), also as reported in the CALSIM II output. The SWP values are converted to percentage allocations based on the Table A value of 4,164,000 acre-feet, reflecting the approximate maximum in the CALSIM II output, which is slightly greater than the current 4,156,336 acre-feet of contractual Table A for the 2021-2035 period. The CVP values are converted to percentage allocations based on the contract supply amount of 1,965,000 acre-feet for the agricultural water service contractors located south of the Delta as reported by Reclamation in its periodic allocation press releases.

The computations exclude SWP Article 21 water, Article 56 water, and other water categories available under the SWP long-term water supply contracts. Article 21 water is primarily available in the wetter year types, and is not available to offset dry year shortages unless stored in the contractors' facilities in the wetter periods for later use. Article 56 water stored outside of an SWP contractor's service area and carryover water can be available to supplement supplies and help offset part or all of the delivery shortages implied by low Table A allocations for some contractors. The availability of these supplies is not readily predictable within the time frames of the analysis, and no attempt is made to quantify them. Nevertheless, those supplies can materially reduce transfer demand, especially at the onset of a dry period. Some contractors do not have storage programs and are more dependent on a consistent annual supply, and their demand for transfer water will develop more rapidly with lower allocations.

The CVP municipal and industrial contractors located south of the Delta are not included in the analysis because they are subject to much less severe reductions than the agricultural contractors, and their volume is about 8 percent of the agricultural contract amount. While those shortages can still trigger cross-Delta transfer demands, the total volume of transfer demands as shown in the analysis exceeds the available cross-Delta supply such that the inclusion of these M&I demand shortages would not alter the conclusions of the analysis.

The analysis has not been limited or constrained by cross-Delta transfer capacity, although such constraints are currently a factor in the export of transfers, as discussed in Section 5.2.2.2. In the future, transfer supplies could be moved in the BDCP facilities or across the Delta, depending on operational and regulatory constraints, and transfer capacity is likely to limit actual cross-Delta transfers at times. However, this analysis does not place any such limits on conveyance capacity through the in-Delta channels or through the BDCP facilities at this time.

The results of the analysis are presented in terms of the number of years in which demand for cross-Delta transfers would likely be generated under these assumptions in comparison to the existing conditions and No Action Alternative and the estimated average annual transfer volume generated by the estimated demand in terms of a percentage increase or decrease relative to the existing conditions and the No Action Alternative.

Since publication of this Appendix 5D, three new sub-alternatives have been evaluated as part of the revised documents. Alternatives 2D, 4A, and 5A have been added to those under active consideration. The following text and one table update the documentation of transfers to consider these new sub-alternatives.

Three different analyses are considered in the determination of how new Alternatives 2D, 4A, and 5A would affect the analyses in this Appendix 5D. The first looks at the sensitivity analysis conducted in the re-circulated DEIS/DEIR in Appendix B for both the ELT and LLT time periods and covers only Alternative 4/4A. The second analysis looks at Alternatives 2/2D and 5/5A for only the ELT time period. The second analysis used the more recent modeling to generate Delta export estimates. Similar to the second analysis, the third analysis also used the more recent modeling and estimated maximum cross-Delta transfers for t he CWF/BDCP sub-alternatives and Existing Conditions. For Alternative 4A, the third analysis incorporates modeling results from operational Scenario H3+. See Section 5.3.4.2 for more information on Scenario H3+.

In the first analysis, Alternative 4A would make small changes to the estimated combined average annual CVP and SWP Delta exports relative to Alternative 4. Because the demand for cross-Delta transfers is assumed to be a direct function of those exports, it is appropriate to estimate the differences between Alternatives 4 and 4A. Table B shows the relative changes in those exports for Alternatives 4 H3 and 4 H4 based on the results of the CALSIM II sensitivity analysis in Appendix B, specifically Figures 35 and 71.

Note that these export values include added exports beyond the Table A and CVP agricultural exports used in the analyses in this appendix, and therefore are greater than the values shown for SWP and CVP deliveries in the tables later in this section.

Table B. Comparison of Long-Term Annual Distribution of SWP and CVP Delta Exports for Alternatives 4A H3, 4A H4, 2D, and 5A

Alternative	TAF	%
Alternative 4 H3 ELT	5,265 TAF	
Alternative 4A H3 ELT	5,292 TAF	
Difference	**27 TAF**	**0.5%**
Alternative 4 H3 LLT	4,945 TAF	
Alternative 4A H3 LLT	5,006 TAF	
Difference	**61 TAF**	**1.2%**
Alternative 4 H4 ELT	4,705 TAF	
Alternative 4A H4 ELT	4,725 TAF	
Difference	**20 TAF**	**0.4%**
Alternative 4 H4 LLT	4,414 TAF	
Alternative 4A H4 LLT	4,477 TAF	
Difference	**63 TAF**	**1.4%**
Alternative 2 ELT	5,389 TAF	
Alternative 2D ELT	5,382 TAF	
Difference	**-7 TAF**	**-0.1%**
Alternative 5 ELT	5,183 TAF	
Alternative 5A ELT	5,166 TAF	
Difference	**-17 TAF**	**-0.3%**

Table B indicates that combined annual average SWP and CVP Delta exports would be 0.4 to 0.5 percent greater in the ELT time frame, which would decrease transfer demand to a similar degree below the estimates for Alternatives 4 H3 and 4 H4. In the LLT time frame, combined annual average SWP and CVP Delta exports would be 1.2 to 1.4 percent greater, which would also decrease transfer demand to a similar degree below the estimates for Alternatives 4 H3 and 4 H4.

As noted in Section B.1.2 of Appendix B, Alternative 4A operational criteria are similar to Alternative 4, and would fall within the range of Alternative 4 H3 and H4 decision tree outcomes. Because of the very small differences in exports indicated by the sensitivity analysis, the estimates of changes in transfer demand provided in Appendix 5D and Chapter 5 for Alternatives 4 H3 and 4 H4 are adequately representative of transfer demand under Alternatives 4A H3 and 4A H4.

A second analysis was performed to estimate the differences in combined annual average SWP and CVP Delta exports between Alternatives 2 and 2D and 5 and 5A in the ELT period. That analysis showed slight decreases for both of the sub-alternatives. In that analysis, the average annual SWP and CVP Delta exports showed reductions of 0.1 to 0.3 percent (see Table B) between the original Alternatives (2 and 5) and new sub-Alternatives (2D and 5A) in the ELT time period.

A third analysis was conducted using the more recent modeling and the estimated combined SWP and CVP exports, tabulating transfer frequency and volume for existing conditions, the No Action Alternative, and Alternatives 2D, 4A, and 5A. The values are not directly comparable to the original analyses presented in this appendix because of differing modeling assumptions and inclusion of Article 56 carryover water within the SWP deliveries used in this more recent modeling. The newer

modeling shows a greater difference between deliveries under the No Action Alternative as compared to existing conditions than was shown by the prior modeling.

The results in terms of transfer frequency and average combined SWP and CVP transfer volume are shown in Table C. Transfer frequency under existing conditions is lower in this modeling than prior modeling (43 percent below versus 52 percent in Table 5D-5) and combined transfer volume is less as well. Frequency of transfers and average volumes are greater in the newer modeling for the No Action Alternative and each of the sub-alternatives compared to prior modeling. However, the trends are similar for the alternatives in terms of there being greater transfer demands under the alternatives than under existing conditions, and lower transfer demands compared to the No Action Alternative.

Table C. Combined SWP and CVP Computed Maximum Cross-Delta Transfers for BDCP Sub-Alternatives and Existing Conditions, 600,000 AF Supply

	Frequency of Transfers ELT	Average Transfer Volume, TAF ELT
Existing Conditions	43%	125
No Action	56%	208
Alt 2D	48%	200
Alt 4A	45%	178
Alt 5A	45%	187

In conclusion, because of the very small differences in exports indicated by the first two analyses and the similar trends observed between the prior and more recent modeling (see third analysis), the estimates of changes in transfer demand provided in Appendix 5D and Chapter 5 for Alternatives 2, 4 H3, 4 H4, and 5 are adequately representative of transfer demand under Alternatives 2D, 4A H3, 4A H4, and 5A.

5D.4 Supplemental Supply Demand Tables and Figures

Figures 5D-1 and 5D-2 illustrate the triggering of the demand for added water used as the basis for the analysis of cross-Delta transfer demand. Total demand for supplemental water is assumed to comprise the entire volume of water below the horizontal red line and the various alternatives.

Tables 5D-2 through 5D-9 provide the detailed results of the spreadsheet analysis, and Figures 5D-3 through 5D-8 provide a graphical view of the results.

Table 5D-2 provides a summary of the SWP and CVP deliveries, resulting allocation percentage, average annual supplemental demand, and the percentage of years in which supplemental demand would occur. The tables illustrate the decline in SWP and CVP deliveries that would occur between existing conditions and No Action as a result of the external influences of increased upstream consumptive use of water, climate change, implementing the fall X2 standard, and other factors independent of BDCP alternatives. The table clearly shows that transfer demand will increase in the future without the BDCP facilities.

Table 5D-2. Supplemental Demand to Reach SWP and CVP Allocations of 50% and 40% Respectively, By Alternative, and By Project

Summary Results in TAF or Percent of Years, Supplemental Demand to Reach 50% SWP, 40% CVP Allocations												
	SWP Table A Deliveries			SWP Table A Allocation %			SWP Supplemental Demand			SWP Supplemental Demand Frequency		
Alternatives	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT
Existing	2,474			59%			100			21%		
No Action		2,443	2,304		59%	55%		142	191		23%	35%
Alternative 1		3,075	2,862		74%	69%		97	133		15%	20%
Alternative 2		2,844	2,696		68%	65%		144	184		22%	28%
Alternative 3		3,037	2,817		73%	68%		103	158		17%	27%
Alternative 4 H1		2,965	2,790		71%	67%		123	171		18%	24%
Alternative 4 H2		2,427	2,294		58%	55%		182	231		32%	37%
Alternative 4 H3		2,782	2,639		67%	63%		158	207		26%	33%
Alternative 4 H4		2,271	2,141		55%	51%		237	302		40%	43%
Alternative 5		2,714	2,517		65%	60%		141	201		23%	29%
Alternative 6		1,993	1,849		48%	44%		560	639		48%	52%
Alternative 7		2,070	1,908		50%	46%		535	609		50%	51%
Alternative 8		1,537	1,397		37%	34%		779	845		66%	72%
Alternative 9		2,401	2,282		58%	55%		179	225		33%	39%
	CVP SOD Ag Deliveries			CVP SOD Ag Allocation %			CVP Supplemental Demand			CVP Supplemental Demand		
	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT
Existing	869			44%			134			46%		
No Action		798	685		41%	35%		194	252		49%	61%
Alternative 1		1,045	901		53%	46%		137	202		34%	43%
Alternative 2		901	784		46%	40%		167	223		39%	49%
Alternative 3		1,037	896		53%	46%		140	205		34%	40%
Alternative 4 H1		975	885		50%	45%		151	192		35%	43%
Alternative 4 H2		955	857		49%	44%		150	194		35%	46%
Alternative 4 H3		892	775		45%	39%		165	221		40%	50%
Alternative 4 H4		851	740		43%	38%		175	234		45%	56%
Alternative 5		902	777		46%	40%		167	223		37%	49%
Alternative 6		588	541		30%	28%		346	374		68%	68%
Alternative 7		577	544		29%	28%		344	366		67%	68%
Alternative 8		514	469		26%	24%		394	422		71%	74%
Alternative 9		769	667		39%	34%		205	266		46%	61%

Table 5D-3 shows the combined annual average supplemental demand and combined percentage of years in which supplemental demand would occur. Note that supplemental water demand for Alternatives 1-5 is less than the No Action Alternative demand, while Alternatives 6-9 exhibit higher demands.

Table 5D-3. Supplemental Demand to Reach SWP and CVP Allocations of 50% and 40% Respectively, By Alternative, SWP and CVP Combined

	SWP/CVP Combined Frequency		SWP/CVP Combined Volume	
Alternatives	ELT	LLT	ELT	LLT
Existing	46%		235	
No Action	49%	62%	336	443
Alternative 1	34%	43%	234	335
Alternative 2	39%	49%	311	407
Alternative 3	35%	40%	242	363
Alternative 4H1	35%	43%	274	363
Alternative 4H2	41%	50%	332	425
Alternative 4H3	40%	50%	323	428
Alternative 4H4	50%	59%	411	536
Alternative 5	38%	50%	308	424
Alternative 6	68%	68%	906	1,013
Alternative 7	67%	68%	879	976
Alternative 8	73%	79%	1,174	1,267
Alternative 9	50%	62%	384	491

Figures 5D-3 and 5D-4 summarize graphically the data given in Tables 5D-2 and 5D-3.

5D.4.1 Estimated Cross-Delta Transfer Tables

Table 5D-4 provides a summary of the SWP and CVP deliveries, resulting allocation percentage, average annual cross-Delta transfers, and cross-Delta transfer frequency assuming that the supply from willing sellers in any one year would be 600,000 acre-feet. The tables again illustrate the decline in SWP and CVP deliveries that would occur between existing conditions and No Action as a result of the external influences of increased upstream consumptive use of water, climate change, implementing the fall X2 standard, and other factors independent of BDCP alternatives. The table clearly shows that transfer demand will increase in the future without the BDCP facilities.

Table 5D-4. SWP and CVP Allocations and Computed Maximum Cross-Delta Transfers for BDCP Alternatives and Existing Conditions, 600,000 AF Supply

Summary Results in TAF or Percent of Years, Cross-Delta Transfers Subject to 600,000 AF Supply												
	SWP Table A Deliveries			SWP Table A Allocation %			SWP Average Cross-Delta Transfers			SWP Cross-Delta Transfer Frequency		
Alternatives	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT
Existing	2,474			59%			57			23%		
No Action		2,443	2,304		59%	55%		71	94		28%	39%
Alternative 1		3,075	2,862		74%	69%		42	50		15%	21%
Alternative 2		2,844	2,696		68%	65%		58	71		22%	29%
Alternative 3		3,037	2,817		73%	68%		42	61		17%	27%
Alternative 4 H1		2,965	2,790		71%	67%		47	64		18%	27%
Alternative 4 H2		2,427	2,294		58%	55%		87	95		37%	41%
Alternative 4 H3		2,782	2,639		67%	63%		65	80		26%	33%
Alternative 4 H4		2,271	2,141		55%	51%		111	129		44%	50%
Alternative 5		2,714	2,517		65%	60%		60	81		27%	37%
Alternative 6		1,993	1,849		48%	44%		157	170		57%	62%
Alternative 7		2,070	1,908		50%	46%		158	183		59%	62%
Alternative 8		1,537	1,397		37%	34%		227	243		77%	85%
Alternative 9		2,401	2,282		58%	55%		82	106		39%	45%
	CVP SOD Ag Deliveries			CVP SOD Ag Allocation %			CVP Average Cross-Delta Transfers			CVP Cross-Delta Transfer Frequency		
	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT
Existing	869			44%			89			51%		
No Action		798	685		41%	35%		129	187		51%	67%
Alternative 1		1,045	901		53%	46%		95	144		35%	46%
Alternative 2		901	784		46%	40%		113	146		40%	56%
Alternative 3		1,037	896		53%	46%		98	139		35%	46%
Alternative 4 H1		975	885		50%	45%		100	123		37%	49%
Alternative 4 H2		955	857		49%	44%		88	117		37%	50%
Alternative 4 H3		892	775		45%	39%		109	146		41%	57%
Alternative 4 H4		851	740		43%	38%		104	151		46%	61%
Alternative 5		902	777		46%	40%		107	143		39%	57%
Alternative 6		588	541		30%	28%		202	208		76%	74%
Alternative 7		577	544		29%	28%		205	211		74%	77%
Alternative 8		514	469		26%	24%		208	216		78%	82%
Alternative 9		769	667		39%	34%		129	198		51%	66%

Table 5D-5 shows the combined SWP and CVP cross-Delta transfers assuming a supply of 600,000 acre-feet from willing sellers in any one year. The cross-Delta transfers for Alternatives 1-5 are all less than the No Action Alternative, while Alternatives 6-9 exhibit higher transfer amounts. Table 5D-5 shows that the BDCP facilities under the preferred alternative 4 H3 would reduce cross-Delta transfers as compared to the No Action Alternative.

Table 5D-5. Combined SWP and CVP Computed Maximum Cross-Delta Transfers for BDCP Alternatives and Existing Conditions, 600,000 AF Supply

	SWP/CVP Combined Frequency		SWP/CVP Combined Volume	
Alternatives	ELT	LLT	ELT	LLT
Existing	52%		146	
No Action	52%	68%	201	280
Alternative 1	35%	46%	137	194
Alternative 2	40%	56%	171	217
Alternative 3	37%	46%	140	200
Alternative 4H1	37%	49%	148	187
Alternative 4H2	44%	55%	175	212
Alternative 4H3	41%	57%	174	227
Alternative 4H4	52%	66%	215	279
Alternative 5	40%	59%	167	224
Alternative 6	77%	77%	359	378
Alternative 7	76%	79%	364	393
Alternative 8	82%	88%	435	459
Alternative 9	55%	67%	211	304

Table 5D-6 summarizes the changes in the average annual cross-Delta transfers that would occur for each alternative relative to existing conditions and the No Action Alternative in terms of percentage of years that transfers would occur as well as the volume in acre-feet estimated for those transfers.

Table 5D-6. Relative and Numerical Changes in Average Annual Cross-Delta Transfers Relative to the CEQA and NEPA baselines, 600,000 acre-feet Supply

	Percent change in Cross-Delta transfers from Existing Conditions	Percent change in Cross-Delta transfers from No Action LLT	Change in Cross-Delta transfers from Existing Conditions, TAF	Change in Cross-Delta transfers from No Action LLT, TAF
Alternative 1	33%	-31%	49	-86
Alternative 2	49%	-22%	72	-63
Alternative 3	37%	-29%	54	-81
Alternative 4 H1	28%	-33%	41	-93
Alternative 4 H2	45%	-24%	66	-68
Alternative 4 H3	56%	-19%	81	-53
Alternative 4 H4	92%	0%	134	-1
Alternative 5	54%	-20%	78	-57
Alternative 6	160%	35%	233	98
Alternative 7	170%	40%	247	113
Alternative 8	215%	64%	313	179
Alternative 9	109%	8%	158	24

Figures 5D-3 and 5D-4 summarize graphically the data given in Tables 5D-4 through 5D-6.

The following charts provide the estimates of transfer frequency and volumes for the assumption that 1,000,000 acre-feet of water is available for cross-Delta transfer in all years.

Table 5D-7 provides a summary of the SWP and CVP deliveries, resulting allocation percentage, average annual cross-Delta transfers, and cross-Delta transfer frequency assuming that the supply from willing sellers in any one year would be 1,000,000 acre-feet. The tables again illustrate the decline in SWP and CVP deliveries that would occur between existing conditions and No Action as a result of the external influences of increased upstream consumptive use of water, climate change, implementing the fall X2 standard, and other factors independent of BDCP alternatives. The table clearly shows that transfer demand will increase in the future without the BDCP facilities.

Table 5D-7. SWP and CVP Allocations and Computed Maximum Cross-Delta Transfers for BDCP Alternatives and Existing Conditions, 1,000,000 AF Supply

Summary Results in TAF or Percent of Years, Cross-Delta Transfers Subject to 1,000,000 AF Supply												
	SWP Table A Deliveries			SWP Table A Allocation %			SWP Average Cross-Delta Transfers			SWP Cross-Delta Transfer Frequency		
Alternatives	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT
Existing	2,474			59%			78			23%		
No Action		2,443	2,304		59%	55%		102	129		28%	39%
Alternative 1		3,075	2,862		74%	69%		60	74		15%	21%
Alternative 2		2,844	2,696		68%	65%		83	98		22%	29%
Alternative 3		3,037	2,817		73%	68%		61	90		17%	27%
Alternative 4 H1		2,965	2,790		71%	67%		72	91		18%	27%
Alternative 4 H2		2,427	2,294		58%	55%		118	137		37%	41%
Alternative 4 H3		2,782	2,639		67%	63%		90	110		26%	33%
Alternative 4 H4		2,271	2,141		55%	51%		151	187		44%	50%
Alternative 5		2,714	2,517		65%	60%		83	114		27%	37%
Alternative 6		1,993	1,849		48%	44%		249	274		57%	62%
Alternative 7		2,070	1,908		50%	46%		245	275		59%	62%
Alternative 8		1,537	1,397		37%	34%		372	392		77%	85%
Alternative 9		2,401	2,282		58%	55%		114	142		39%	45%
	CVP SOD Ag Deliveries			CVP SOD Ag Allocation %			CVP Average Cross-Delta Transfers			CVP Cross-Delta Transfer Frequency		
	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT	Existing	ELT	LLT
Existing	869			44%			130			51%		
No Action		798	685		41%	35%		178	263		51%	67%
Alternative 1		1,045	901		53%	46%		137	203		35%	46%
Alternative 2		901	784		46%	40%		157	215		40%	56%
Alternative 3		1,037	896		53%	46%		140	196		35%	46%
Alternative 4 H1		975	885		50%	45%		146	176		37%	49%
Alternative 4 H2		955	857		49%	44%		131	170		37%	50%
Alternative 4 H3		892	775		45%	39%		154	214		41%	57%
Alternative 4 H4		851	740		43%	38%		147	221		46%	61%
Alternative 5		902	777		46%	40%		157	205		39%	57%
Alternative 6		588	541		30%	28%		297	317		76%	74%
Alternative 7		577	544		29%	28%		303	324		74%	77%
Alternative 8		514	469		26%	24%		321	342		78%	82%
Alternative 9		769	667		39%	34%		181	284		51%	66%

Table 5D-8 shows the combined SWP and CVP cross-Delta transfers assuming a supply of 1,000,000 acre-feet from willing sellers in any one year. The cross-Delta transfers for Alternatives 1-5 are all less than the No Action Alternative, while Alternatives 6-9 exhibit higher transfer amounts. Table 5D-8 shows that the BDCP facilities under the preferred alternative 4 H3 would reduce cross-Delta transfers as compared to the No Action Alternative.

Table 5D-8. Combined SWP and CVP Computed Maximum Cross-Delta Transfers for BDCP Alternatives and Existing Conditions, 1,000,000 AF Supply

	SWP/CVP Combined Frequency		SWP/CVP Combined Volume	
Alternatives	ELT	LLT	ELT	LLT
Existing	52%		208	
No Action	52%	68%	281	393
Alternative 1	35%	46%	197	277
Alternative 2	40%	56%	240	313
Alternative 3	37%	46%	201	286
Alternative 4H1	37%	49%	218	266
Alternative 4H2	44%	55%	249	307
Alternative 4H3	41%	57%	244	324
Alternative 4H4	52%	66%	298	408
Alternative 5	40%	59%	240	320
Alternative 6	77%	77%	546	591
Alternative 7	76%	79%	548	599
Alternative 8	82%	88%	692	734
Alternative 9	55%	67%	295	426

Table 5D-9 summarizes the changes in the average annual cross-Delta transfers that would occur for each alternative relative to existing conditions and the No Action Alternative in terms of percentage of years that transfers would occur as well as the volume in acre-feet estimated for those transfers.

Table 5D-9. Relative and Numerical Changes in Average Annual Cross-Delta Transfers Relative to the CEQA and NEPA baselines, 1,000,000 acre-feet Supply

	Percent change in Cross-Delta transfers from Existing Conditions	Percent change in Cross-Delta transfers from No Action LLT	Change in Cross-Delta transfers from Existing Conditions, TAF	Change in Cross-Delta transfers from No Action LLT, TAF
Alternative 1	33%	-30%	69	-116
Alternative 2	51%	-20%	105	-79
Alternative 3	38%	-27%	78	-107
Alternative 4 H1	28%	-32%	59	-126
Alternative 4 H2	48%	-22%	99	-86
Alternative 4 H3	56%	-17%	116	-68
Alternative 4 H4	96%	4%	200	15
Alternative 5	54%	-19%	112	-73
Alternative 6	185%	51%	383	199
Alternative 7	189%	53%	392	207
Alternative 8	254%	87%	526	342
Alternative 9	105%	9%	218	34

Figures 5D-3 and 5D-4 summarize graphically the data given in Tables 5D-7 through 5D-9.

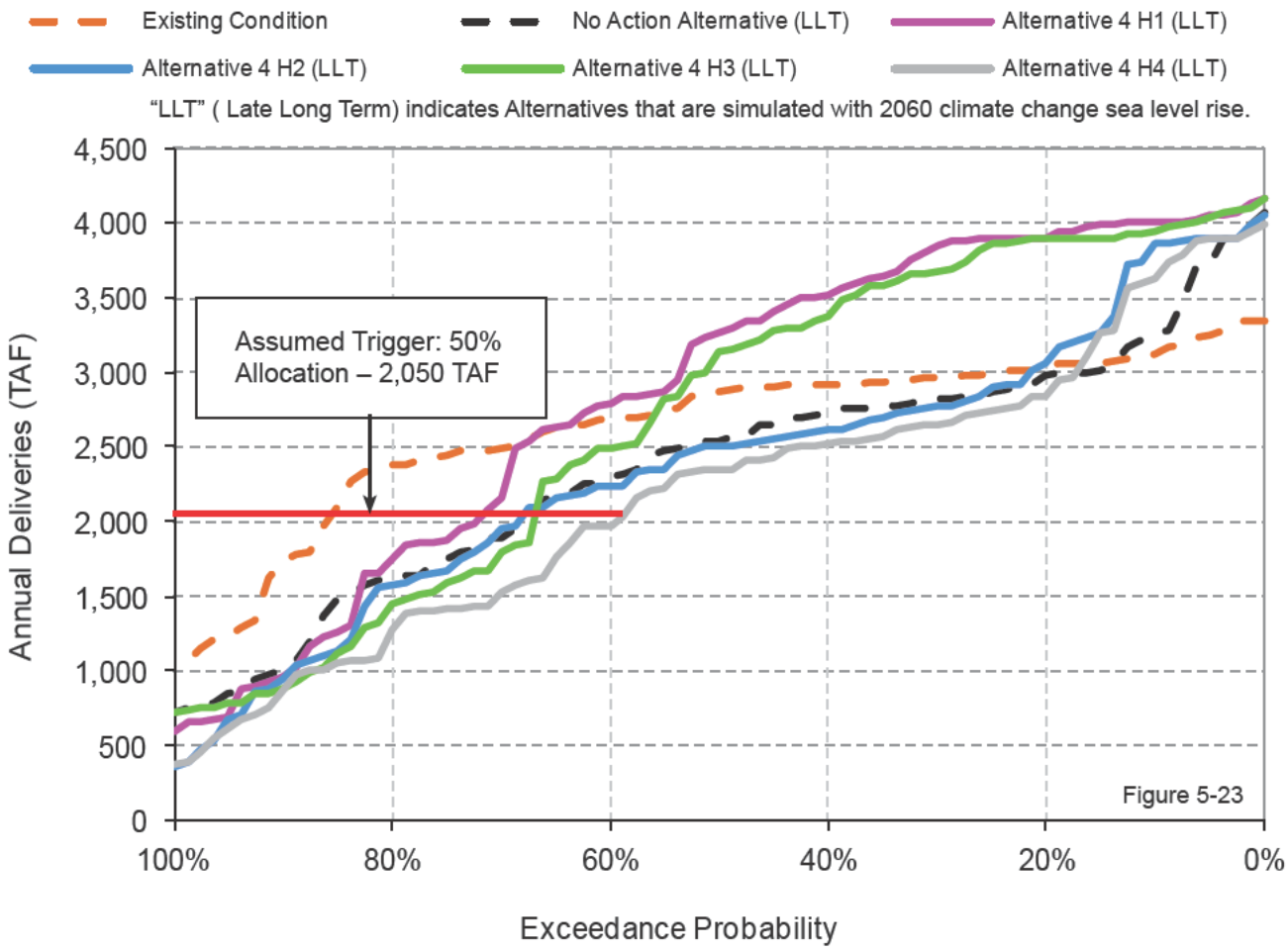

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Figure 5D-1
SWP Trigger Assumptions for Supplemental Supply Demand

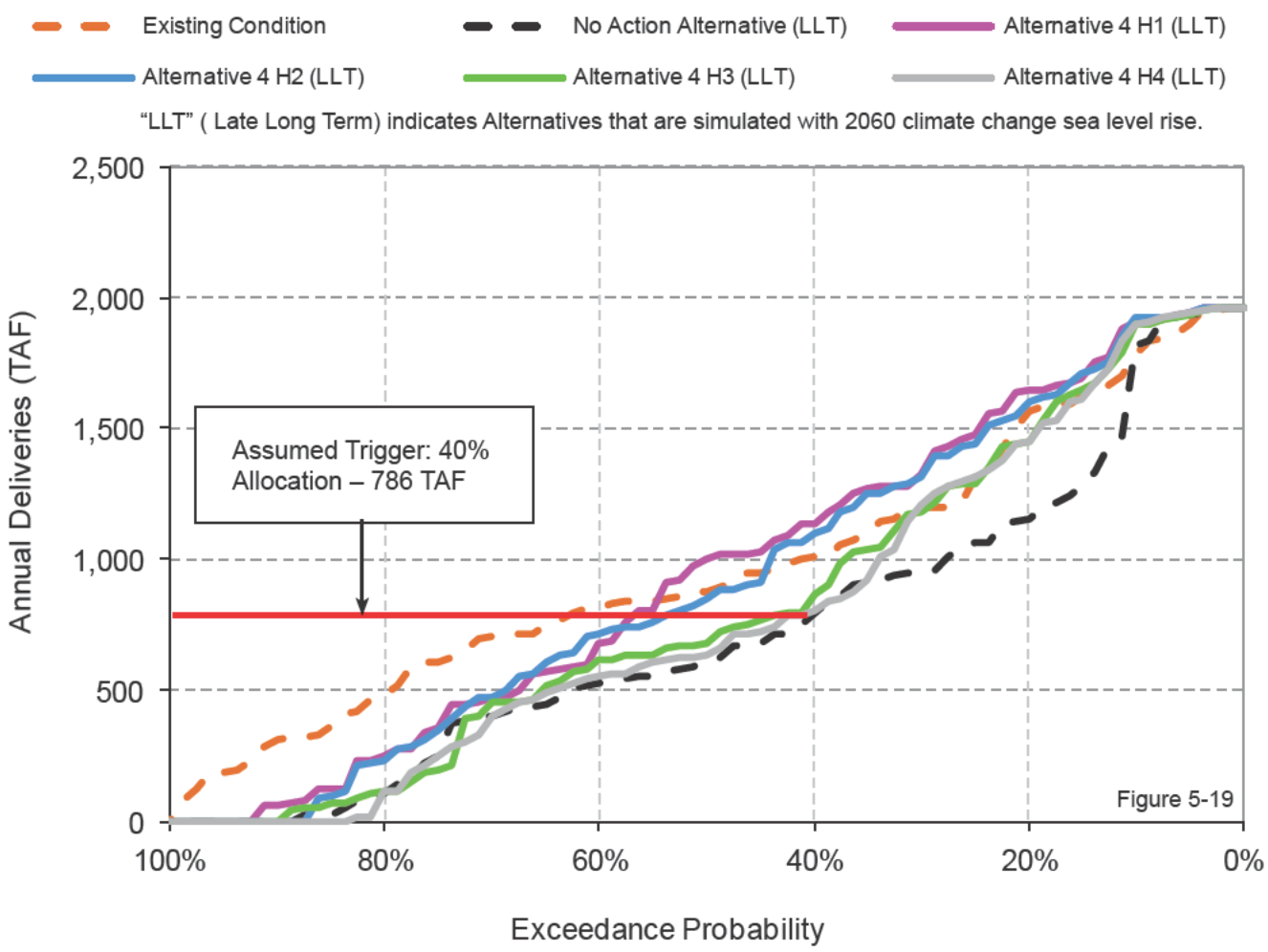

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Figure 5D-2
CVP Trigger Assumptions for Supplemental Supply Demand

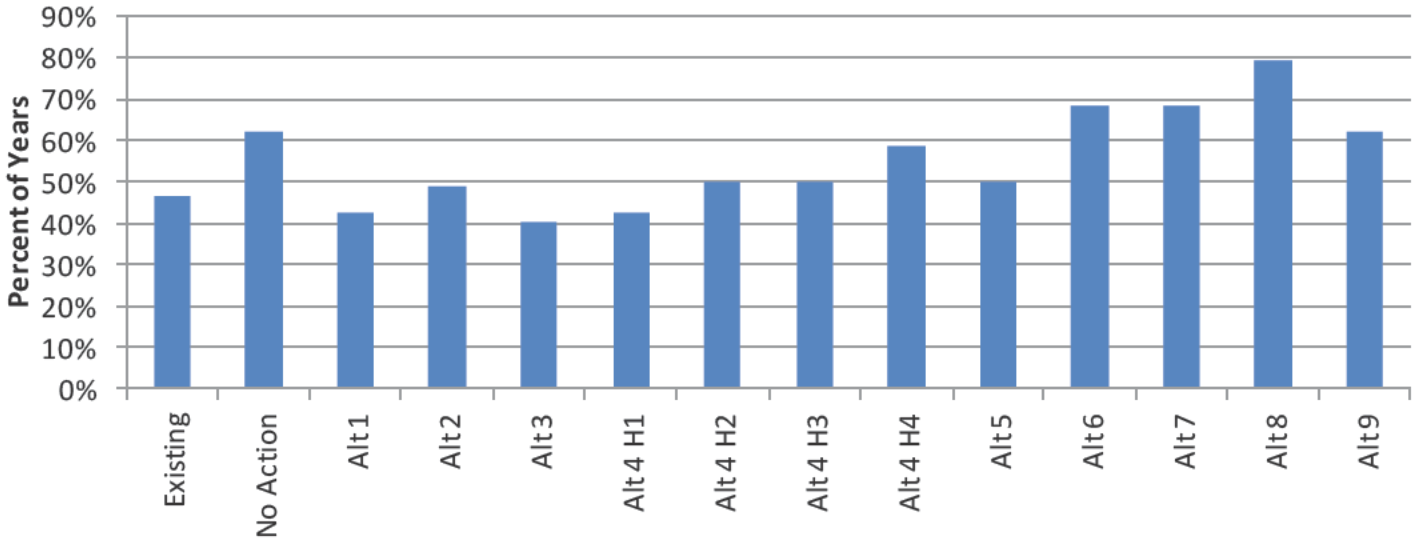

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Figure 5D-3
Average Percent of Years of Supplemental Demand By Alternative, SWP and CVP Combined

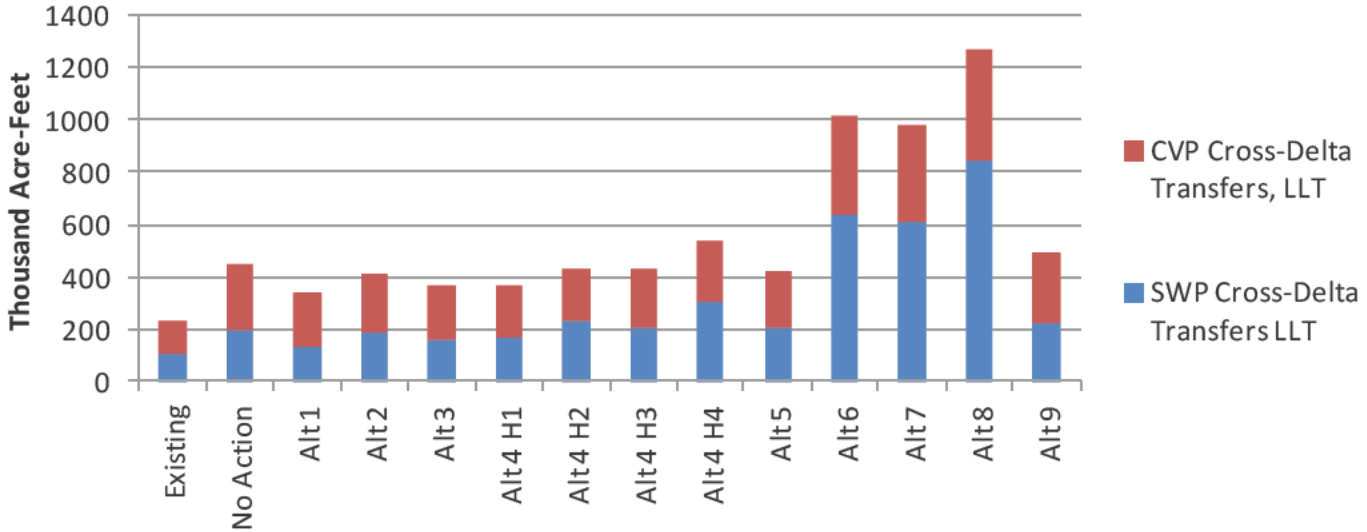

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Figure 5D-4
Average Annual Supplemental Demand By Alternative, by SWP and CVP

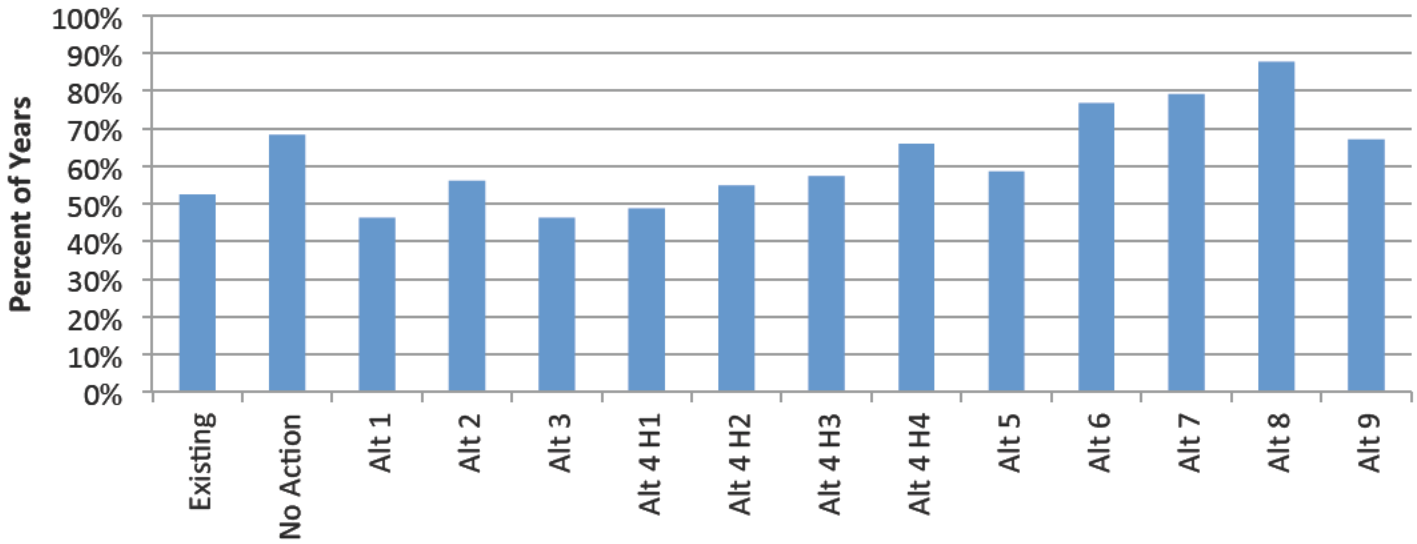

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Figure 5D-5
Average Percent of Years of Cross-Delta Transfers
SWP and CVP Combined, 600,000 AF Supply

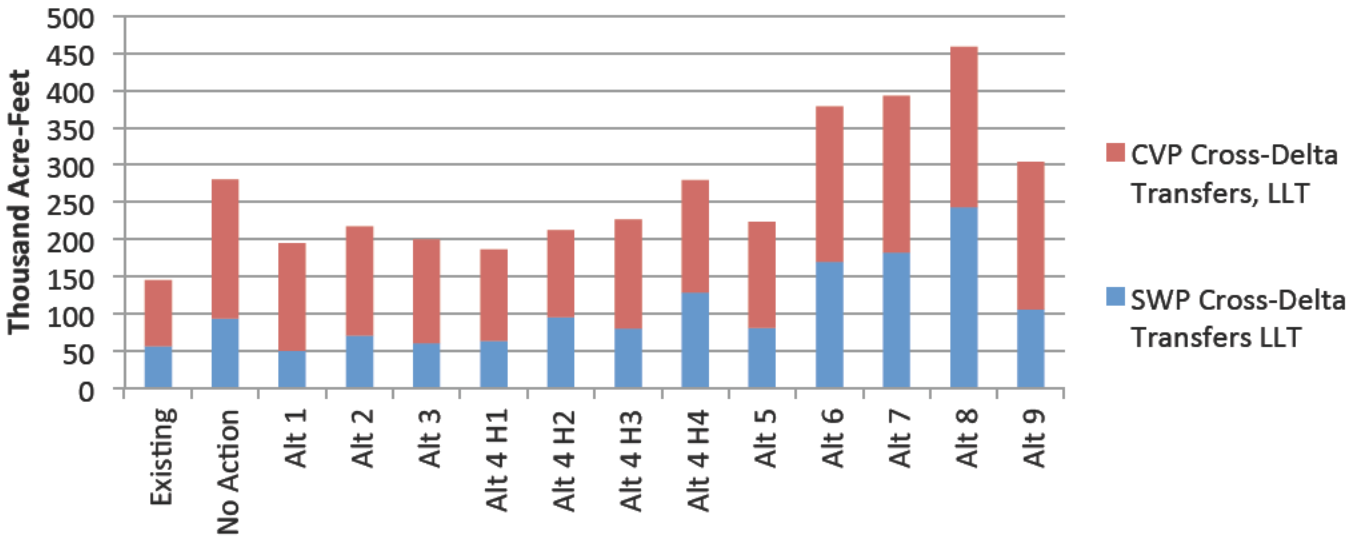

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Figure 5D-6
Average Annual Cross-Delta Transfers By Alternative, by SWP and CVP, 600,000 AF Supply

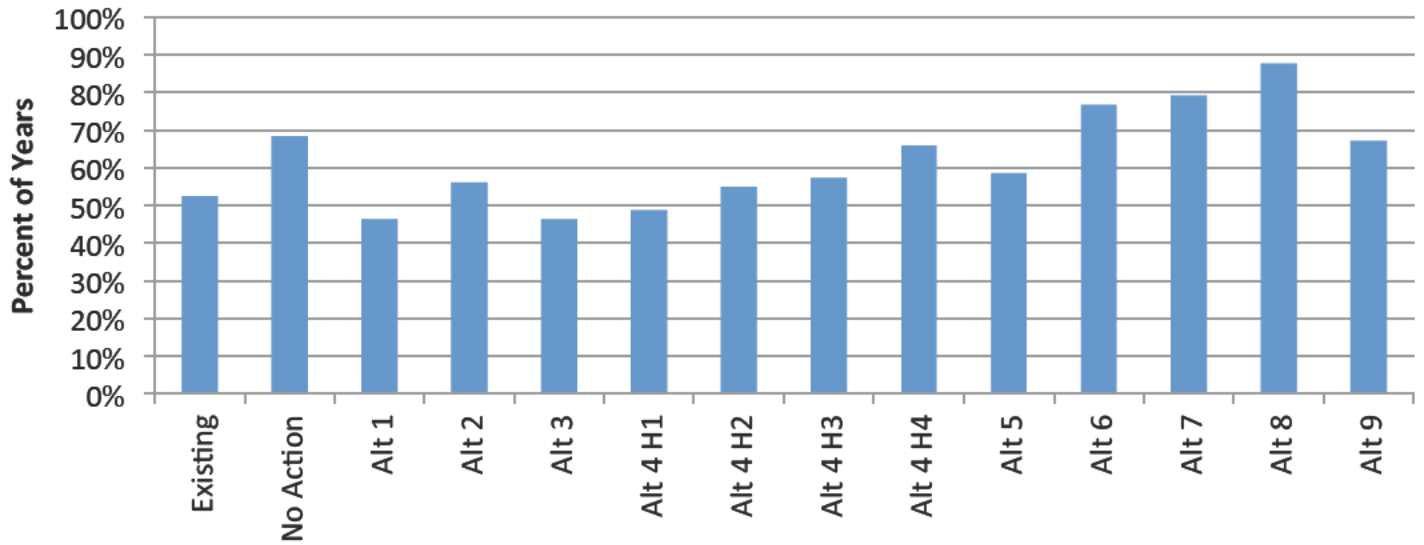

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Figure 5D-7
Average Percent of Years of Cross-Delta Transfer
SWP and CVP Combined, 1,000,000 AF Supply

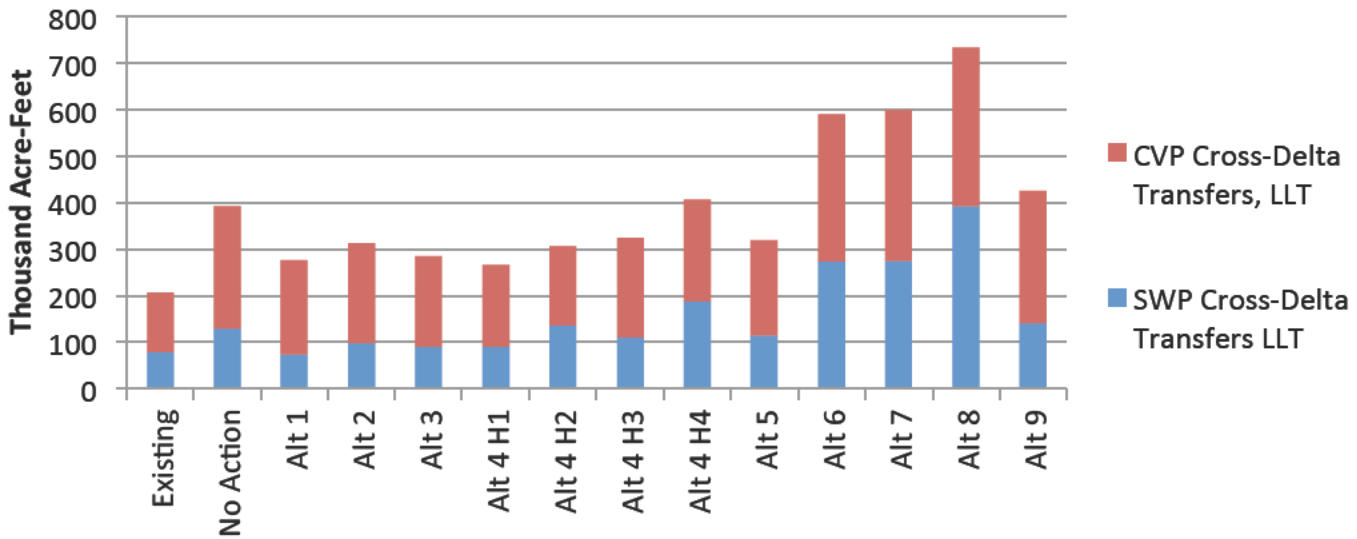

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Figure 5D-8
Average Annual Cross-Delta Transfers By Alternative, by SWP and CVP, 1,000,000 AF Supply