CHAPTER V. WATER SUPPLY IMPACTS OF THE FLOW ALTERNATIVES

The purpose of this chapter is to evaluate the water supply impacts of the seven alternatives for implementing the flow objectives in the 1995 Bay/Delta Plan. The seven alternatives are described in detail in Chapter II, section E.1. A number of parameters have water supply implications among the alternatives being evaluated. The principal parameters are delivery changes, export reductions, carry-over storage changes, and water transfer export capacity in the Delta.

In addition to evaluating impacts to the quantities of water available under the seven alternatives, this chapter contains an analysis of the time of year and frequency that diversions are curtailed for individual water rights holders in the Central Valley under Alternatives 3 and 4. These two alternatives require surface water diversion curtailments, based on the water rights priority system, when the SWP and CVP are releasing supplemental water to meet inbasin entitlements. Implementation of Alternatives 3 and 4 will affect the exercise of water rights and the water supply available to individual water right holders in the Central Valley.

Where applicable, impacts are determined by subtracting the value of a water supply parameter for the base case from that of the alternatives. Because hydrologic conditions vary considerably from year to year in the project area, the water supply impacts are calculated for two different hydrology scenarios: (1) the average annual impacts based on the historic 73-year period hydrology of 1922 through 1994, and (2) the average annual impacts based on the critically dry period hydrology of May 1928 through October 1934 (called the critical period).

This chapter is divided into the following sections: (A) water deliveries, (B) carryover storage in Central Valley reservoirs, (C) Delta exports, (D) capacity for water transfers, (E) diversion curtailments under Alternatives 3 and 4, and (F) summary and conclusions.

A. WATER DELIVERIES

The amount of water delivered for beneficial consumptive use under each alternative was determined using results from DWRSIM, EBMUDSIM and HEC 3. Chapter IV of this EIR discusses the assumptions and operating criteria used in the DWRSIM modeling studies for each of the flow alternatives. EBMUD provided results from its planning model, EBMUDSIM, for the base case and Alternatives 3, 4 and 5. EBMUD reservoir operations under Alternatives 2, 6, 7, and 8 are identical to the base case; thus, these alternatives were not modeled. For Alternative 5, the HEC 3 model of the Yuba and Bear river systems, which provides input to DWRSIM, was run. The HEC 3 model results provide information on delivery impacts on the Yuba and Bear rivers for Alternative 5. The HEC 3 analysis shows substantial reductions in diversions through the Bear River Canal. However, these diversion reductions are not included in the delivery reduction analysis. DWRSIM output shows full deliveries to the Bear River Canal vicinity because the model attempts to make full deliveries

from other available sources, including groundwater, when one of the available sources has deficient supplies. This feature of the model causes upstream delivery reductions to be translated into export reductions. The HEC 3 model was not rerun for Alternatives 3 and 4, because, although those alternatives could affect deliveries on the Bear and Yuba rivers, the impact would be small. Additional information regarding the modeling of the Bear and Yuba River systems is located in Chapter IV, section H.

The delivery reduction calculations for Alternatives 3 and 4 are affected by assumptions included in the modeling. When a direct diversion is curtailed under these alternatives, the water right holder can either contract for a substitute water supply, as other prior right water users have in the past, or pump groundwater. For modeling purposes, the assumption is made that a water right holder in the Sacramento Basin will contract for a substitute water supply while a water right holder in the San Joaquin Basin will pump groundwater. Consequently, the model results show no impact on Sacramento Basin direct diverters under these alternatives, but do show an impact on the San Joaquin Basin direct diverters. The Sacramento Basin impact is translated into an export area delivery impact because the SWP and the CVP are supplying stored water to the water right holders required to curtail direct diversions. Because of these assumptions, the results of this section and section E of this chapter should be considered together to understand the delivery impacts of Alternatives 3 and 4. Section E evaluates the time of year and frequency that individual water right holders in the Central Valley must curtail diversions to meet the flow objectives.

As formulated, Alternative 5 significantly exceeds the Delta flow objectives and results in the largest average water delivery reductions for the 73-year period. Further refinement of this alternative would result in modeled water supply impacts closer to those of the other alternatives. The model results for Alternative 5 are still useful indicators of trends in water supply impacts.

A large part of the demand in the study area is met through delivery of water stored in reservoirs. The amount of water delivered versus the amount retained in a reservoir as carryover storage is an operations decision that can change from year to year. For modeling purposes, reservoir operation assumptions regarding deliveries versus carryover storage are programmed into the models. Thus, actual reservoir operations may vary from modeled operations resulting in different deliveries and carryover storage amounts than those calculated here. Nonetheless, the model results are a good tool for comparing the alternatives for relative impacts.

Table V-1 shows the annual average reductions, or in one case, increase, in deliveries for the different alternatives compared to the base case for the 73-year period. Table V-2 presents the information for the critical period. Delivery impacts are broken out by service area or supplier where possible. The total delivery reductions are shown at the bottom of both tables.

Table V-1

Base Case Water Deliveries and Delivery Changes, 73-Year Period Annual Average (TAF)

	Delivery	Delivery Change from the Base Case						
	Base Case	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
Non-CVP/SWP Supplies								
Yuba River System	403	0	0	0	-45	0	0	0
Bear River System	290	0	0	0	-57	0	0	0
East Bay MUD	238	0	-3	-4	-22	0	0	0
San Joaquin River System Direct Diversions	857	0	-73	-65	0	0	0	0
City of San Francisco	243	0	0	0	0	0	0	0
Modesto ID/Turlock ID	1,138	0	0	0	-6	0	0	0
Merced Irrigation District	1,343	0	0	0	0	0	0	0
Eastman Lake (Chowchilla WD)	292	0	-14	-13	-10	0	0	0
Hensley Lake (Madera ID)	384	0	0	0	-7	0	0	0
Subtotal	**5,188**	**0**	**-90**	**-82**	**-147**	**0**	**0**	**0**
Selected SWP Supplies								
North Bay	42	-2	-2	-2	-1	-2	-2	-2
South Bay	167	-7	-5	-5	-2	-6	-8	-7
Tulare Basin	1,117	-45	-36	-36	-5	-44	-53	-45
Southern California	1,532	-61	-54	-54	-22	-59	-67	-60
Subtotal	**2,858**	**-115**	**-97**	**-97**	**-30**	**-111**	**-130**	**-114**
Selected CVP Supplies								
Contra Costa Canal	143	0	0	0	0	0	0	0
Stockton-East WD/Central San Joaquin WCD	107	-37	-22	-24	-9	-4	-84	-47
San Felipe Service Area	175	-9	-7	-7	-6	-8	-10	-10
Exchange Contractors	894	-20	-15	-16	-7	-21	-24	-18
Other CVP and DMC Ag Diversions	406	-44	-39	-39	-32	-25	-49	-55
Cross Valley Canal Ag Diversions	96	-10	-9	-9	-7	-6	-11	-12
Total Refuge Diversions	288	-3	-2	-2	-1	-4	-3	-3
San Luis Unit	913	-98	-86	-86	-71	-55	-107	-125
Friant Project	1,343	0	0	0	-423	0	0	0
Subtotal	**4,365**	**-221**	**-180**	**-183**	**-556**	**-123**	**-288**	**-270**
Total	**12,411**	**-336**	**-367**	**-362**	**-733**	**-234**	**-418**	**-384**

Table V-2

Base Case Water Deliveries and Delivery Changes, Critical Period Annual Average (TAF)

	Delivery	Delivery Change from the Base Case						
	Base Case	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
Non-CVP/SWP Supplies								
Yuba River System	412	0	0	0	-90	0	0	0
Bear River System	224	0	0	0	-108	0	0	0
East Bay MUD	233	0	-15	-15	-37	0	0	0
San Joaquin River System Direct Diversions	853	0	-99	-82	0	0	0	0
City of San Francisco	260	0	0	0	0	0	0	0
Modesto ID/Turlock ID	1,171	0	0	0	-61	0	0	0
Merced Irrigation District	1,408	0	0	0	1	0	0	0
Eastman Lake (Chowchilla WD)	304	0	-19	-17	-8	0	0	0
Hensley Lake (Madera ID)	401	0	0	0	-6	0	0	0
Subtotal	**5,266**	**0**	**-133**	**-114**	**-309**	**0**	**0**	**0**
Selected SWP Supplies								
North Bay	31	-9	-8	-9	-4	-8	-9	-9
South Bay	125	-22	-21	-21	-6	-20	-22	-20
Tulare Basin	876	-152	-149	-149	-47	-145	-160	-146
Southern California	1,475	-307	-295	-294	-112	-292	-298	-293
Subtotal	**2,507**	**-490**	**-473**	**-473**	**-169**	**-465**	**-489**	**-468**
Selected CVP Supplies								
Contra Costa Canal	154	0	0	0	0	0	0	0
Stockton-East WD/Central San Joaquin WCD	38	-38	-38	-38	-17	-17	-30	-23
San Felipe Service Area	153	-17	-10	-10	-3	-20	-18	-16
Exchange Contractors	875	-64	-46	-45	-18	-76	-69	-63
Other CVP and DMC Ag Diversions	262	-56	-33	-33	-4	-60	-56	-52
Cross Valley Canal Ag Diversions	61	-13	-8	-8	-1	-13	-12	-11
Total Refuge Diversions	298	-5	-2	-2	-1	-7	-4	-5
San Luis Unit	578	-120	-72	-71	-9	-131	-121	-110
Friant Project	959	0	0	0	-327	0	0	0
Subtotal	**3,378**	**-313**	**-209**	**-207**	**-380**	**-324**	**-310**	**-280**
Total	**11,151**	**-803**	**-815**	**-794**	**-858**	**-789**	**-799**	**-748**

Alternative 6 results in the lowest total reduction in average deliveries for the 73-year period, but this result should be viewed with caution. Alternative 6 is the only flow alternative that includes unlimited combined use of SWP and CVP points of diversion in the Delta. The other alternatives would have smaller 73-year period average delivery reductions, when compared to Alternative 6, if they also included unlimited combined use of points of diversion. Combined use of points of diversion could be authorized as part of the implementation of the 1995 Bay/Delta Plan for any of the alternatives, as described in Chapter XIII of this report.

For the critical period, Alternative 8 reduces total deliveries the least. Alternative 5 has the largest delivery reductions for both the 73-year and critical period principally due to reductions in non-project deliveries and Friant Project deliveries.

B. CARRYOVER STORAGE IN CENTRAL VALLEY RESERVOIRS

Carryover storage is the amount of water retained in a reservoir at the end of September of each year. Carryover storage helps meet future demand in the event that the next year is dry. The amount of water dedicated to carryover storage is balanced against the amount needed to meet immediate delivery needs, hydropower generation needs, and instream flow requirements of a project, according to operation rules that differ for each reservoir. For the SWP and CVP reservoirs, the operation rules have been determined through optimization studies. Reservoir functions are modeled in DWRSIM according to these rules.

To determine the impacts of implementing the 1995 Bay/Delta Plan flow objectives on carryover storage, average September end-of-month storage amounts for each flow alternative are compared to those of the base case. Reservoirs in this analysis include, from north to south, Trinity Lake, Lake Shasta, Lake Oroville, Folsom Lake, Camanche Reservoir, Pardee Reservoir, New Melones Reservoir, New Don Pedro Reservoir, Lake McClure, Eastman Lake, Hensley Lake, and Millerton Lake. Tables V-3 and V-4 show carryover storage volumes in these reservoirs for the 73-year period and the critical period for the alternatives and the base case. Bar charts for each reservoir (Figures V-1 through V-11) show the increase or decrease in carryover storage for each alternative compared to the base case for the two scenarios. Trinity Lake carryover storage was not charted because there is no difference among the alternatives.

The charts show that Alternative 5 generally has more favorable carryover storage in the SWP and CVP reservoirs in the Sacramento Valley than the other alternatives. With the exception of New Melones Reservoir, Alternative 5 is the least favorable alternative for the Delta east-side and San Joaquin Valley reservoirs. This relationship is true for both the long-term average and the critical period average. For the San Joaquin Valley reservoirs (except New Melones), Alternatives 2, 6 and 7, which have little effect relative to the base case, are the most favorable alternatives. An anomalous result is apparent for Alternative 7 in New Don Pedro Reservoir where carryover storage is shown to increase although demands on the reservoir are higher in this alternative. This anomaly is caused because the FERC instream flow requirements for New Don Pedro Reservoir were modeled slightly differently under

Table V-3
Carryover Storage in Central Valley Reservoirs (TAF)
73-Year Period Annual Average

		Sacramento Valley			Delta Eastside Area		San Joaquin Valley					
Alternative	Trinity	Shasta	Oroville	Folsom	Pardee	Camanche	New Melones	N. Don Pedro	McClure	Eastman	Hensley	Millerton
Alt. 1	1329	2,910	2,310	481	163	238	1,543	1,365	657	27	23	186
Alt. 2	1330	2,886	2,195	444	163	238	1,238	1,365	657	27	23	186
Alt. 3	1330	2,929	2,204	458	168	210	1,457	1,275	602	40	21	186
Alt. 4	1330	2,929	2,203	457	168	208	1,358	1,292	631	39	22	186
Alt. 5	1330	3,015	2,328	482	134	162	1,554	1,124	522	18	12	175
Alt. 6	1329	2,805	2,181	408	163	238	1,560	1,365	657	27	23	186
Alt. 7	1329	2,819	2,141	426	163	238	1,788	1,377	654	27	23	186
Alt. 8	1330	2,896	2,165	448	163	238	1,392	1,346	612	27	23	186

Table V-4
Carryover Storage in Central Valley Reservoirs (TAF)
Critical Period Annual Average

		Sacramento Valley			Delta Eastside Area		San Joaquin Valley					
Alternative	Trinity	Shasta	Oroville	Folsom	Pardee	Camanche	New Melones	N. Don Pedro	McClure	Eastman	Hensley	Millerton
Alt. 1	775	1,944	1,608	261	155	205	1,104	1,101	644	12	14	156
Alt. 2	775	1,827	1,454	174	155	205	511	1,101	644	12	14	156
Alt. 3	775	1,956	1,418	206	159	161	996	776	598	21	10	156
Alt. 4	775	1,955	1,420	207	159	161	706	854	625	23	11	156
Alt. 5	775	2,079	1,646	266	95	57	1,228	410	433	9	6	149
Alt. 6	775	1,762	1,430	160	155	205	1,180	1,101	644	12	14	156
Alt. 7	775	1,857	1,453	187	155	205	1,531	1,133	642	12	14	156
Alt. 8	775	1,904	1,439	204	155	205	748	1,064	574	12	14	156

this alternative than under the other alternatives. In any event, the effect of Alternative 7 on New Don Pedro Reservoir is small. For New Melones Reservoir, Alternative 7 is the most favorable alternative for carry-over storage, due to modeling assumptions made for this alternative. Alternative 2 results in the lowest carry-over storage in New Melones Reservoir.

For Alternatives 3 and 4, the modeling assumption that water right holders in the Sacramento Valley will seek contracts from the DWR and USBR when their diversions are curtailed affects the carryover storage calculations for SWP and CVP reservoirs. If water right holders do not seek substitute water supply contracts when their diversions are curtailed, carryover storage in Sacramento Valley SWP and CVP reservoirs could increase over the amounts calculated in this analysis.

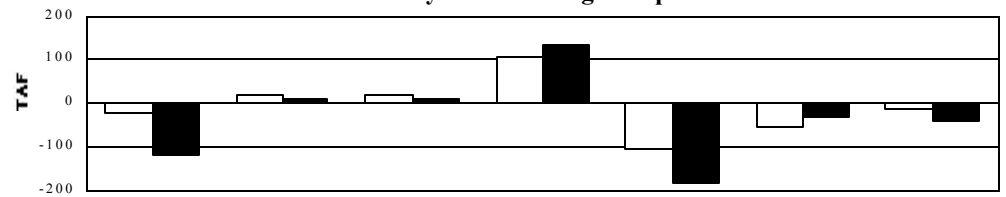
C. DELTA EXPORTS

The 1995 Bay/Delta Plan limits the rate of Delta export pumping to a percent of Delta inflow.[1] Total exports evaluated in this section include SWP Banks Pumping Plant exports,

[1] The method for calculating the percent of Delta inflow diverted is described on page 25 of the 1995 Bay/Delta Plan.

Figure V-1

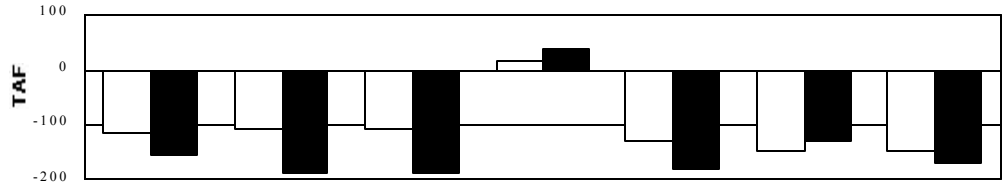
Shasta Lake Carryover Storage Impacts



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	-24	19	19	105	-105	-54	-14
Critical Period Avg	-117	11	11	135	-182	-30	-40

Figure V-2

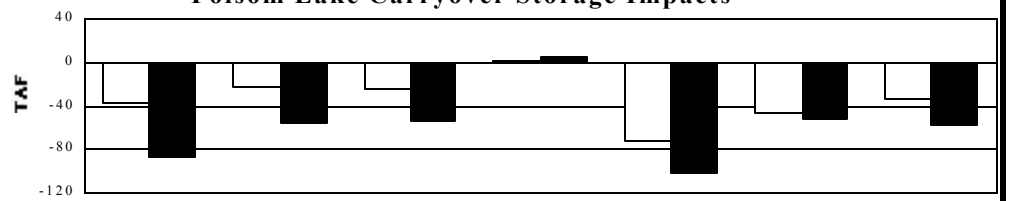
Lake Oroville Carryover Storage Impacts



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	-115	-106	-107	18	-129	-147	-145
Critical Period Avg	-154	-190	-188	38	-178	-129	-169

Figure V-3

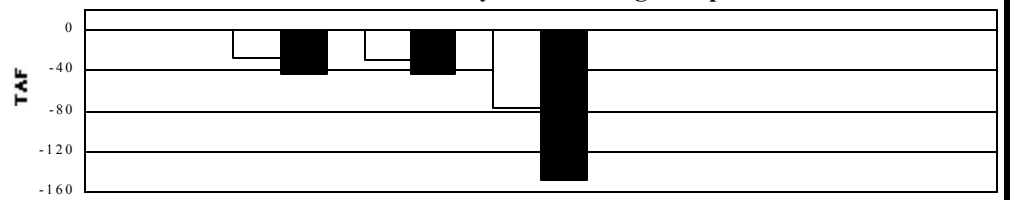
Folsom Lake Carryover Storage Impacts



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	-37	-23	-24	1	-73	-46	-33
Critical Period Avg	-87	-55	-54	5	-101	-52	-57

Figure V-4

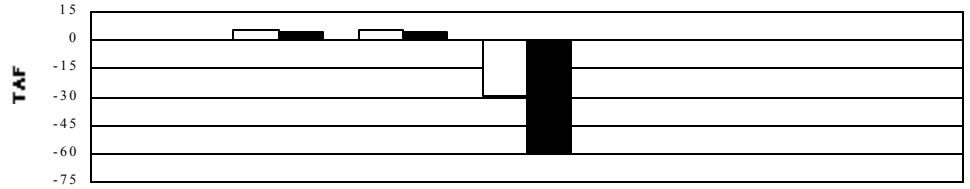
Camanche Reservoir Carryover Storage Impacts



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	0	-28	-30	-76	0	0	0
Critical Period Avg	0	-44	-44	-148	0	0	0

Figure V-5

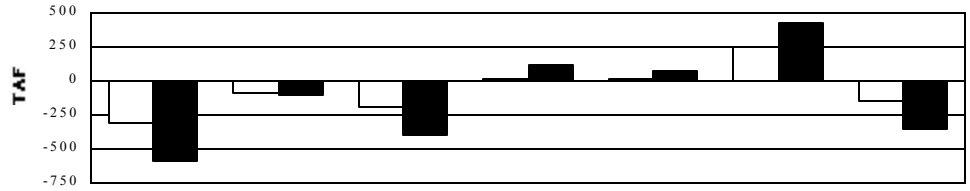
Pardee Reservoir Carryover Storage Impacts



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	0	5	5	-29	0	0	0
Critical Period Avg	0	4	4	-60	0	0	0

Figure V-6

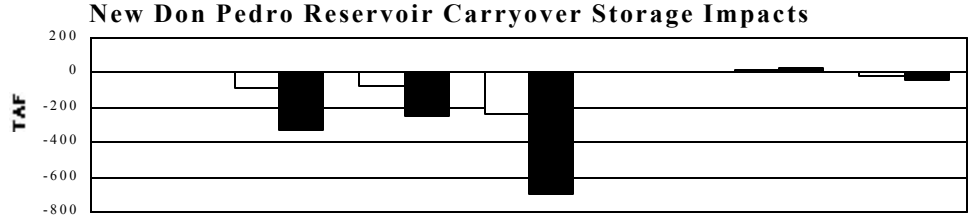
New Melones Reservoir Carryover Storage Impacts



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	-305	-86	-185	11	17	245	-151
Critical Period Avg	-593	-107	-397	124	77	427	-356

Figure V-7

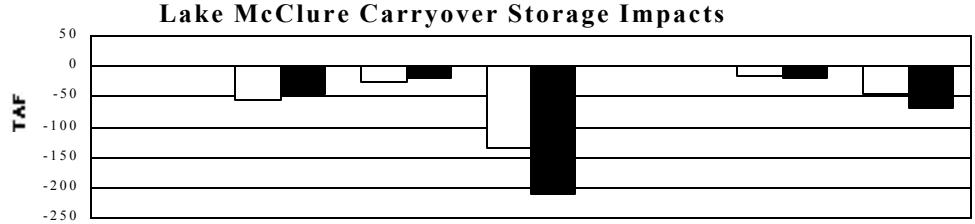
New Don Pedro Reservoir Carryover Storage Impacts



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	0	-90	-73	-241	0	12	-19
Critical Period Avg	0	-325	-247	-691	0	31	-37

Figure V-8

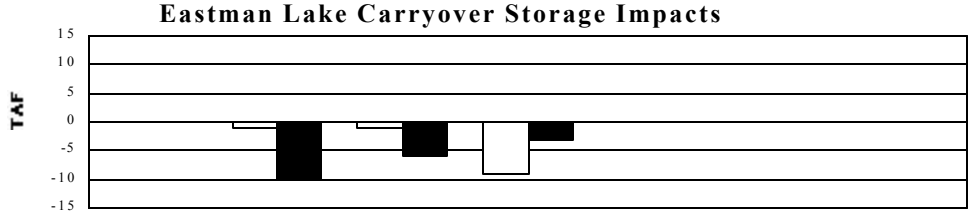
Lake McClure Carryover Storage Impacts



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	0	-55	-26	-135	0	-17	-45
Critical Period Avg	0	-47	-20	-211	0	-18	-70

Figure V-9

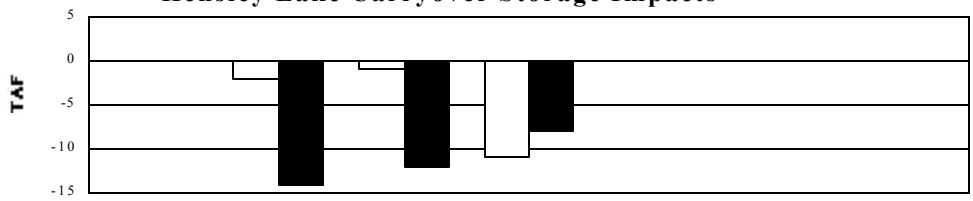
Eastman Lake Carryover Storage Impacts



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	0	-1	-1	-9	0	0	0
Critical Period Avg	0	-10	-6	-3	0	0	0

Figure V-10

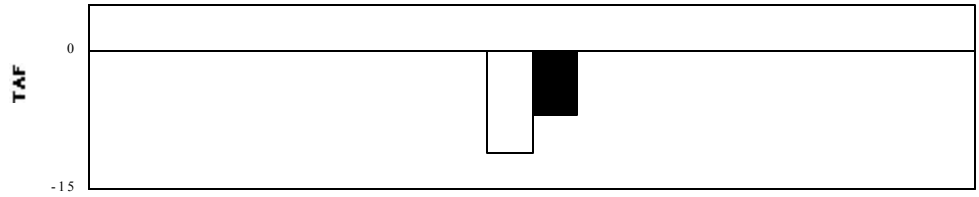
Hensley Lake Carryover Storage Impacts



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	0	-2	-1	-11	0	0	0
Critical Period Avg	0	-14	-12	-8	0	0	0

Figure V-11

Millerton Lake Carryover Storage Impacts



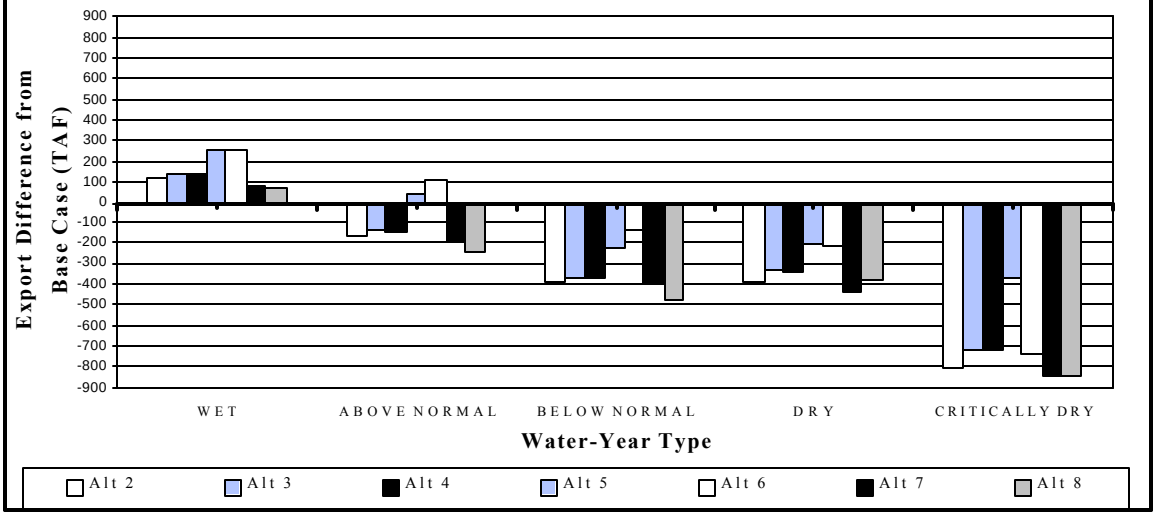
	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	0	0	0	-11	0	0	0
Critical Period Avg	0	0	0	-7	0	0	0

CVP Tracy Pumping Plant exports, Contra Costa Canal exports and North Bay Aqueduct exports. Figure V-12 shows the yearly average Delta exports by water year type. The 1995 Bay/Delta Plan allows an increase in export during wet years when compared to D-1485. Exports are reduced progressively as conditions become drier. Figure V-13 shows the average annual exports under the base case and alternatives for the 73-year hydrology and critical period hydrology. Figure V-14 shows the average annual export impact. The impacts to exports were calculated by subtracting the base case exports from the exports under each alternative. Figure V-14 shows that exports are reduced under all alternatives, but the

reduction is least under Alternative 5, making it the favorable alternative with respect to exports. The largest export reductions occur under Alternative 8 for the 73-year period and Alternative 7 for the critical period.

Figure V-12

Average Annual Delta Export by Water-Year Type



Like carryover storage, exports under Alternatives 3 and 4 are affected by the assumption that water right holders in the Sacramento Valley will seek substitute water supply contracts from the DWR and USBR when their diversions are curtailed. More water may be available for export from the SWP and CVP than indicated by this analysis if water right holders do not seek contracts to replace curtailed diversions. Chapter VI discusses the potential effects if water right holders use groundwater instead of seeking substitute water supply contracts.

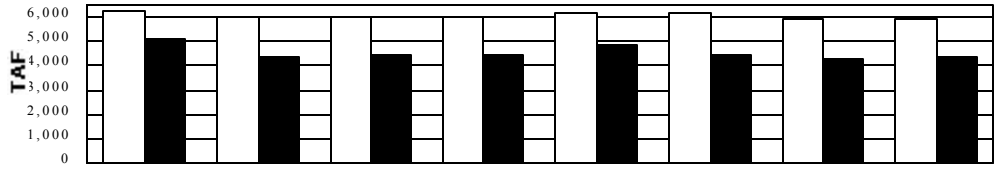
D. CAPACITY FOR WATER TRANSFERS

Water transfers using the SWP and the CVP export facilities are an important tool for meeting the water supply needs of the state. The capacity of export facilities to accommodate transfers has water supply implications for the different alternatives. The purpose of this analysis is to identify the maximum amounts of water that could be transferred under the flow alternatives, under optimal conditions. The actual transfer capacity may be less in many years. Nonetheless, the analysis provides valuable information about the relative impacts of the alternatives on transfer capacity. The analysis also provides a basis for determining the maximum environmental impacts that could occur.

For this evaluation, July through October is assumed to be the most likely period for water transfers to occur. This assumption is based on historical operations, the objectives in the 1995 Bay/Delta Plan, which are more restrictive in February through June, and the increased

Figure V-13

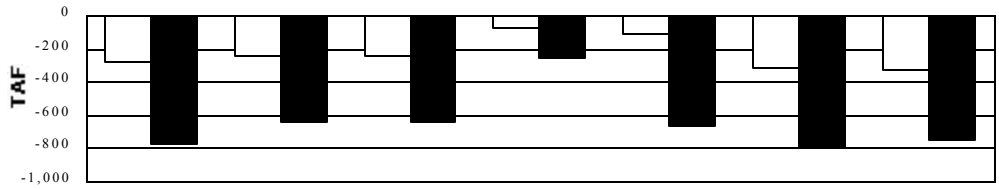
Average Annual Exports



	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	6,256	5,974	6,016	6,015	6,187	6,153	5,941	5,927
Critical Period Avg	5,102	4,329	4,462	4,466	4,843	4,438	4,310	4,357

Figure V-14

Average Annual Export Impacts



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	-282	-240	-241	-69	-103	-315	-329
Critical Period Avg	-773	-640	-636	-259	-664	-792	-745

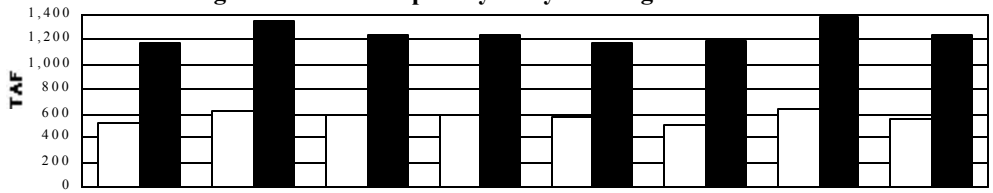
possibility of fishery impacts in other periods. The ability of the projects to accommodate water transfers during the July through October period depends on two factors: (1) unused pumping capacity at the Banks and Tracy pumping plants and (2) limits on exports in the 1995 Bay/Delta Plan.

The following method was used to analyze the capacity for water transfers during July through October for each of the seven alternatives. Using DWRSIM study results, the unused Delta pumping capacity was determined for each flow alternative by subtracting the monthly exports at the Banks and Tracy pumping plants from their respective physical and authorized maximum pumping capacities. The portion of the unused capacity that could be transferred through the Delta without exceeding the export ratio limit of 65 percent of Delta inflow was then determined. An iterative process was used because as the volume of transferred water increases, the Delta inflow increases allowing increased exports within the 65 percent limit. Transfer capacity could be increased beyond the quantities calculated in this analysis if the parties to the transfer provide supplemental Delta inflow to keep exports within the 65 percent limit. This analysis does not consider other possible operational restrictions such as storage or conveyance capacity south of the Delta. In this analysis, a 72-year hydrologic period was used instead of a 73-year period because data were not available for October of the 1995 water year.

The transfer capacity of the base case and alternatives and the impacts of the alternatives are shown in Figures V-15 and V-16. The only scenario in which transfer capacity is less than the base case is the Alternative 6 critical period. Alternative 7 has the greatest transfer capacity and is the favorable alternative with respect to this parameter.

Figure V-15

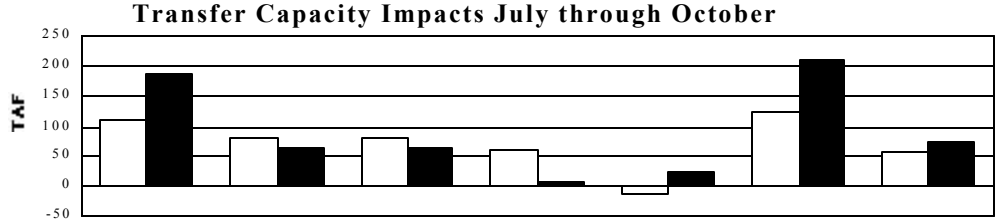
Average Transfer Capacity July through October



	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	513	623	595	594	573	499	637	568
Critical Period Avg	1,171	1,359	1,232	1,232	1,178	1,194	1,380	1,246

Figure V-16

Transfer Capacity Impacts July through October



	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
73-Year Period Avg.	110	82	81	60	-14	124	55
Critical Period Avg	188	61	61	7	23	209	75

E. DIVERSION CURTAILMENTS UNDER FLOW ALTERNATIVES 3 AND 4

In Alternatives 3 and 4, the availability of water for appropriation by water right holders in the Bay/Delta watershed is determined by using the orders of priority described for these alternatives in Chapter II. This section evaluates the frequency and time of year that individual water right holders must curtail diversions under Alternatives 3 and 4. The method for calculating the frequency and time of year of curtailments is described in Chapter IV of this report. The method uses a modified Term 91 approach, which can be applied to all post-1914 appropriative water right permits and licenses; but for the purposes of this report is only applied to larger water right holders, as described in Chapter II.

Alternatives 3 and 4 are the only alternatives that curtail diversions under individual water rights using an order of priority and a modification of the Term 91 process. The other flow alternatives will continue to apply the existing Term 91 process. Term 91 currently is included in the relatively small group of appropriative water rights issued by the SWRCB (and its predecessor) after 1965 for diversion of more than one cfs or 100 acre-feet annually in the Central Valley. Implementation of any of the alternatives could affect the date on

which the existing Term 91 water right holders are required to curtail diversions. The effect on these diverters will not be substantial because they already have arranged for fill-in supplies.

The analysis in this section identifies when different groups of post-1914 appropriative water right holders (post-1914 rights) would be required to curtail diversions. The analysis does not identify pre-1914 rights for curtailment because many pre-1914 appropriative right claims are neither documented nor quantified. Thus, the relative priorities of most pre-1914 rights are unknown.

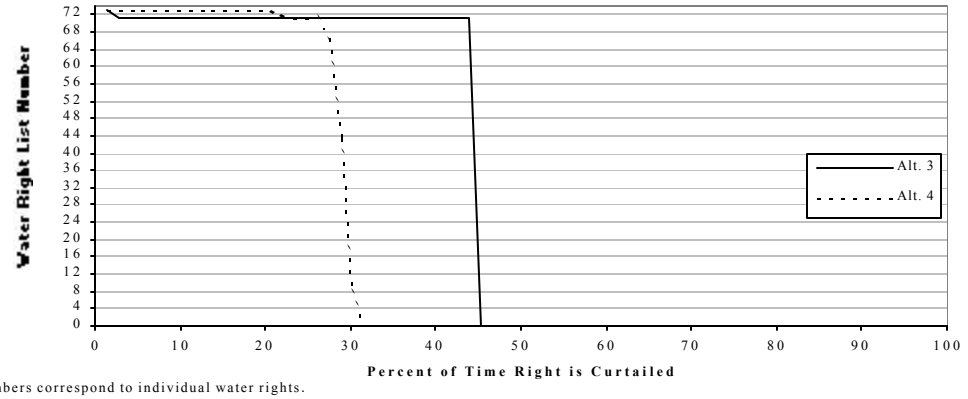
In this analysis, there are 72 post-1914 appropriative diverters in the San Joaquin Basin whose water rights are affected by implementing the Vernalis objectives. These diverters were assigned water right priority numbers from 1 to 72 as shown in Chapter II, Table II-6. Figures V-17 through V-22 show the frequency that diversions under these water rights must be curtailed in October, and February through June to meet the Vernalis objectives. The results of both Alternatives 3 and 4 are shown on each figure.

The graph for October shows frequent diversion curtailments for almost all water rights. Alternative 3 will result in curtailment of all post-1914 diversions in 45 percent of the years. Alternative 4 is less drastic with curtailment of most rights in about 30 percent of the years. February and March are not nearly as severe. In February, diversions under the eight lowest priority rights are curtailed in less than ten percent of the years while in March diversions are curtailed in about twelve percent of the years. However, occasionally under both alternatives, the curtailments include the 36 most junior rights for Alternative 3 and the 48 most junior rights for Alternative 4.

Availability of water in the remaining spring months is a problem for the 16 lowest priority rights under Alternative 3. Curtailment of diversion under the eight lowest priority rights occurs in April in almost 60 percent of the years, in May in almost 80 percent of the years, and in June in almost 45 percent of the years. Diversions pursuant to water rights 9 through 16 in the priority ranking are curtailed in April in about 50 percent of the years, in May in about 55 percent of the years, and in June in over 35 percent of the years. This situation is significantly better in Alternative 4 where none of the 16 lowest priority rights are curtailed in more than 40 percent of the years for any of the spring months. For rights with a priority above 16, the most severe curtailments occur in April and June at a frequency of 30 percent of the years.

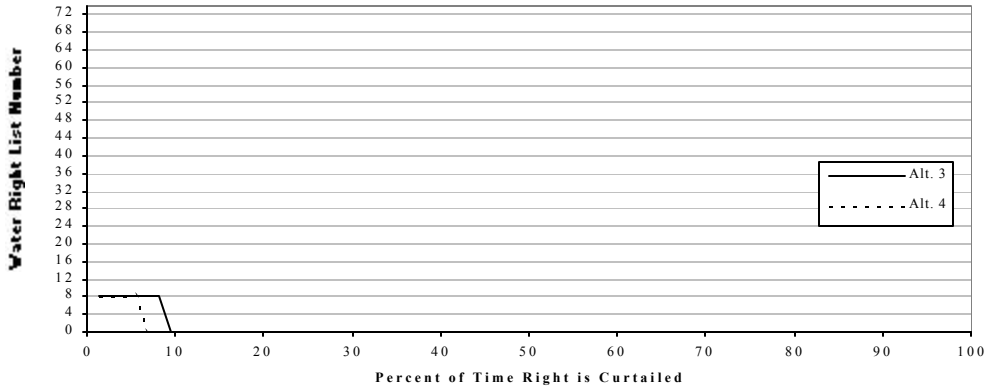
Under Alternatives 3 and 4, the satisfaction of in-basin entitlements is the responsibility of all water right holders in both the Sacramento and San Joaquin Basin. For ease of administration of these alternatives, the post-1914 water right holders are placed into eight groups depending on priority. Table II-5 lists Central Valley water rights in groups 1 through 8.

Figure V-17
Frequency of Curtailing Diversions To Meet
Vernalis Objective in October



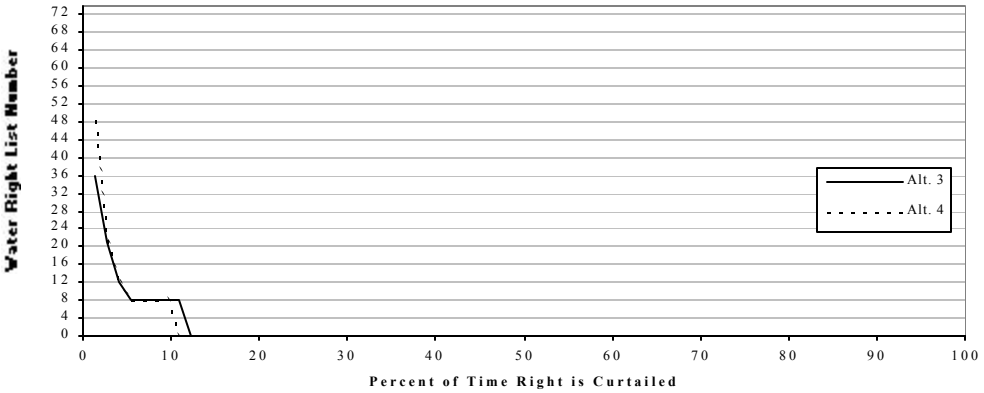
List numbers correspond to individual water rights.

Figure V-18
Frequency of Curtailing Diversions To Meet
Vernalis Objective in February



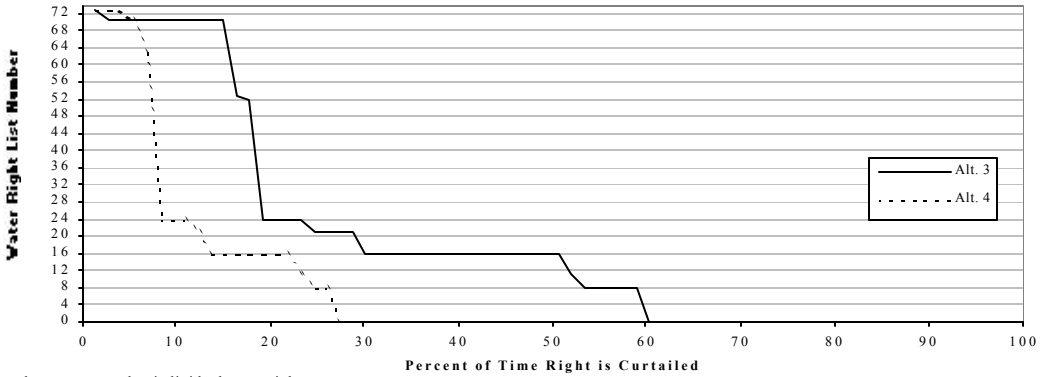
List numbers correspond to individual water rights.

Figure V-19
Frequency of Curtailing Diversions To Meet
Vernalis Objective in March



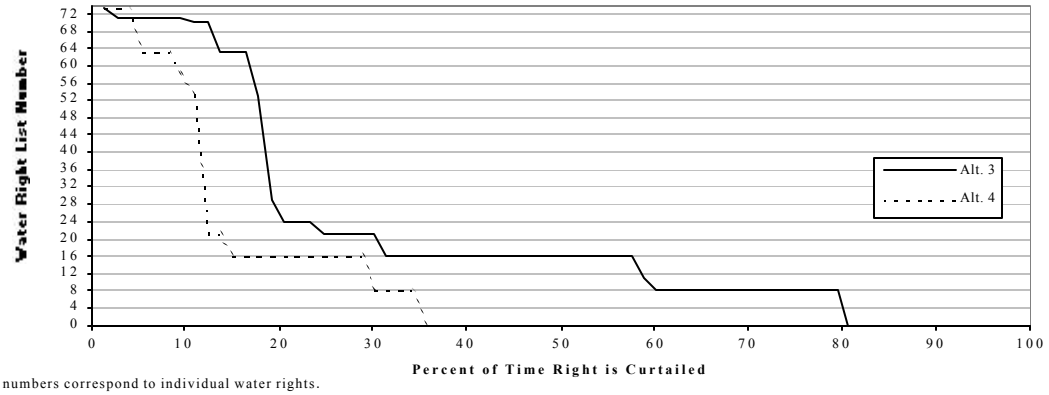
List numbers correspond to individual water rights.

Figure V-20
Frequency of Curtailing Diversions To Meet
Vernalis Objective in April



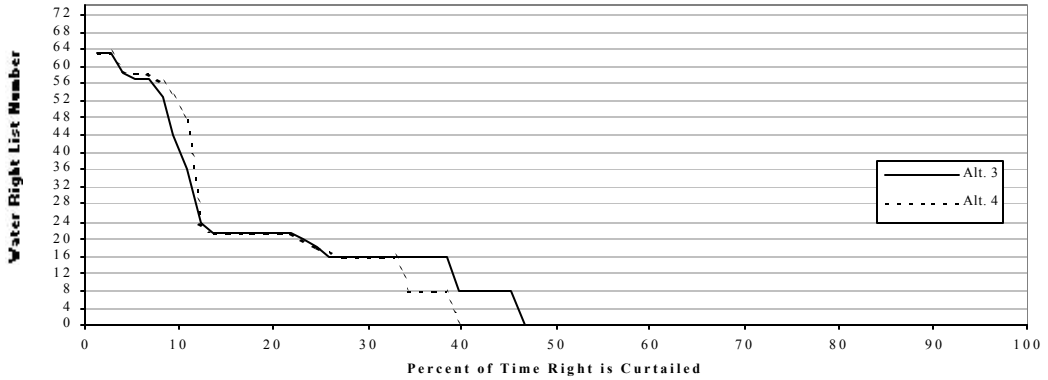
List numbers correspond to individual water rights.

Figure V-21
Frequency of Curtailing Diversions To Meet
Vernalis Objective in May



List numbers correspond to individual water rights.

Figure V-22
Frequency of Curtailing Diversions To Meet
Vernalis Objective in June



List numbers correspond to individual water rights.

Figures V-23 through V-31 show the frequency that diversions in the water rights groups are curtailed for each month. Post-1914 appropriators can use these graphs to determine how frequently their diversions would be curtailed under Alternatives 3 and 4.

These figures show that June, July and August require the most frequent curtailments for all groups under both Alternatives 3 and 4. With few exceptions, Alternative 4 requires greater frequency of curtailment for all groups than Alternative 3. Curtailments also occur in October, February, March, April, and May for some or all of the different groups, but never at a frequency greater than about 10 percent.

Alternatives 3 and 4 have similar curtailment frequencies for June and July. However, August curtailments are more severe for all groups under Alternative 4 than Alternative 3. The figures also show that for Alternative 3, all of the post-1914 diversions (groups 1 through 8) would be curtailed for the month of June in about 25 percent of the years, for July in 50 percent of the years and for August in less than 5 percent of the years. For Alternative 4, all of the post-1914 diversions would be curtailed for the month of June in about 35 percent of the years, for July in about 70 percent of the years, and for August in about 25 percent of the years. For groups 1 through 5, representing the majority of post-1914 rights, water is unavailable for appropriation in June in over half of the years and in July in 80 percent of the years.

Although infrequent in occurrence, there are years in which curtailment of all post-1914 diversions provides insufficient flow to meet the supplemental water requirement needed to meet Delta flow objectives. This occurs in February, April, June, and July at a frequency of less than 5 percent of the years. Using a strict priority approach, this additional increment of flow would become the obligation of the junior-most pre-1914 appropriative diverters. However, the relative priorities of the pre-1914 diverters are not established. In addition, many pre-1914 diverters hold settlement contracts with the USBR. If these contractors' diversions were curtailed, they would become an in-basin obligation of the USBR. Thus, any additional increment of flow needed to meet the supplemental water requirement after all of the post-1914 appropriative diversions have been curtailed becomes the obligation of the USBR and the DWR under Flow Alternatives 3 and 4.

F. SUMMARY AND CONCLUSIONS

Following is a summary description of the seven flow alternatives and the water supply impacts associated with each alternative. Conclusions explaining why the impacts occur also are provided.

Alternative 2: The SWP and the CVP are responsible for meeting the flow objectives under this alternative. Therefore, carryover storage at SWP and CVP reservoirs declines in relation to the other alternatives and exports also decline because stored water is not available for export. The more restrictive export requirements from the base case also limit export opportunities. Transfer capacity increases in comparison with other alternatives because export capacity is not used by the projects. Carryover storage in New Melones Reservoir is depleted because it is the only reservoir in the San Joaquin Basin required to release water to meet the Vernalis objectives.

Figure V-23

Group 1 Frequency of Diversion Curtailment

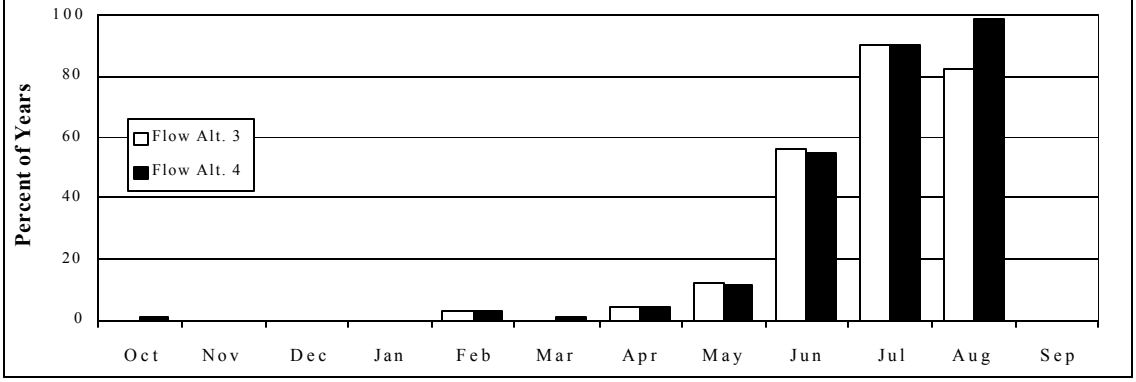


Figure V-24

Group 2 Frequency of Diversion Curtailment

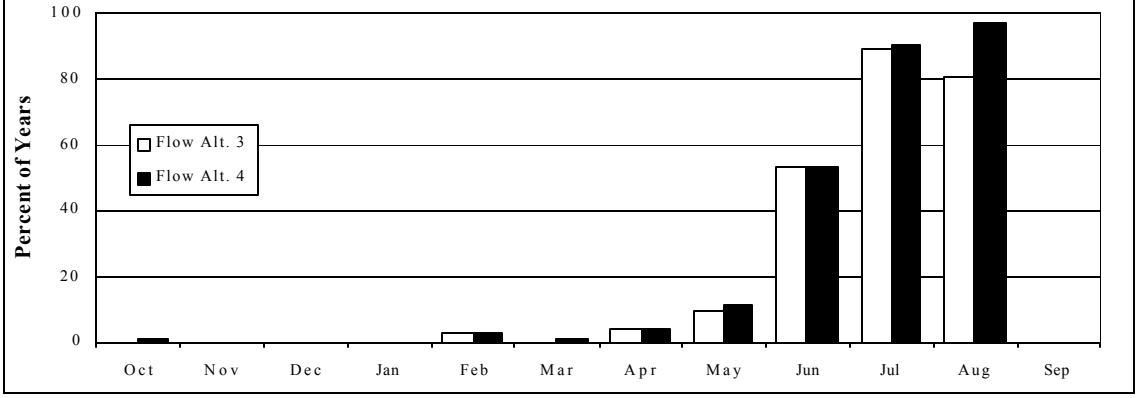


Figure V-25

Group 3 Frequency of Diversion Curtailment

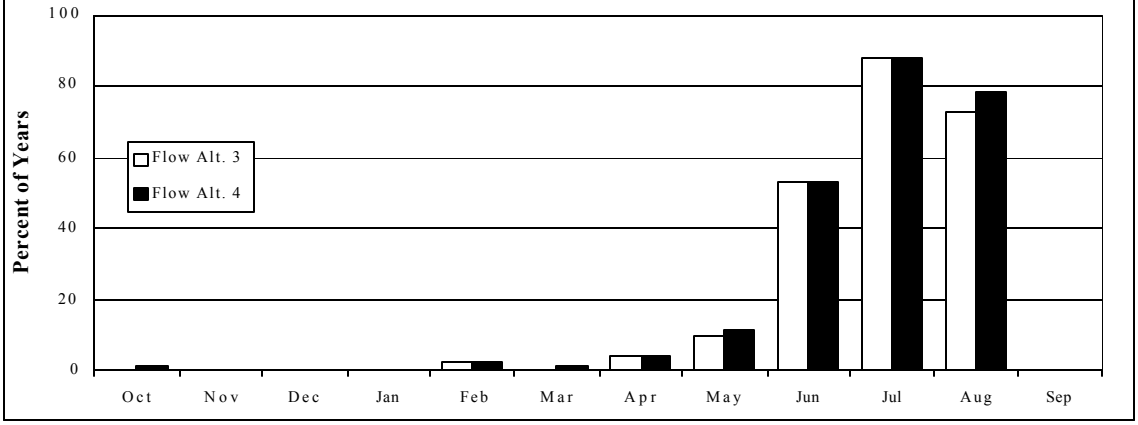


Figure V-26

Group 4 Frequency of Diversion Curtailment

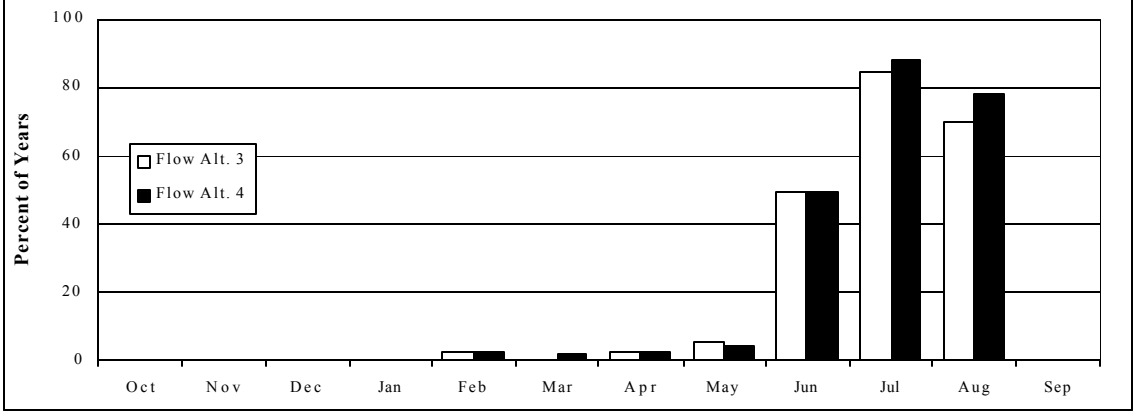


Figure V-27

Group 5 Frequency of Diversion Curtailment

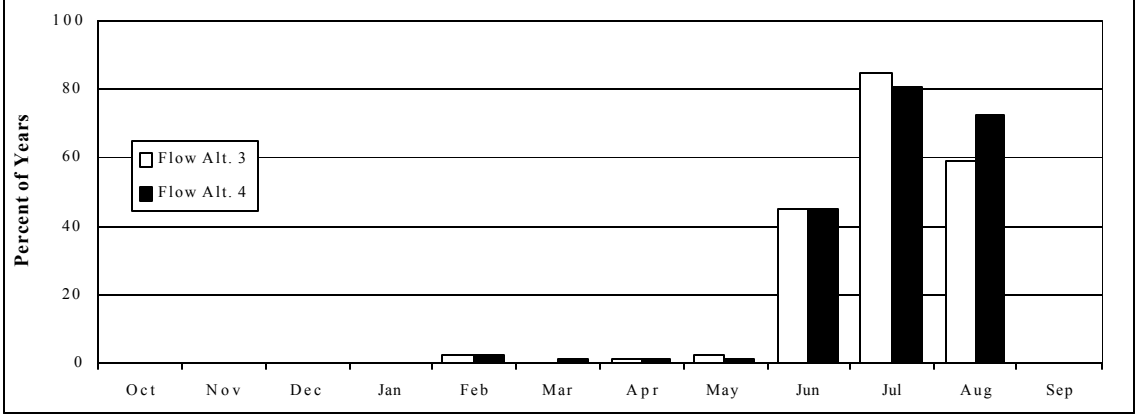


Figure V-28

Group 6 Frequency of Diversion Curtailment

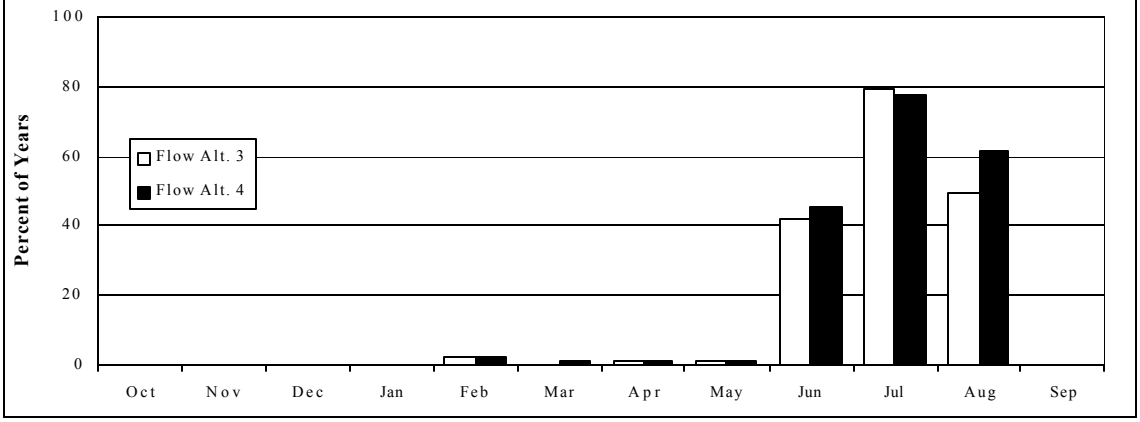


Figure V-29

Group 7 Frequency of Diversion Curtailment

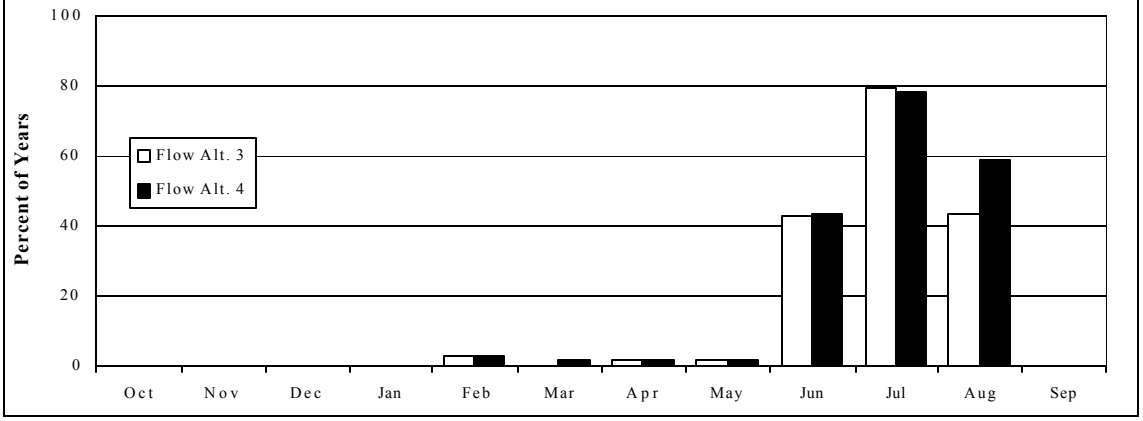


Figure V-30

Group 8 Frequency of Diversion Curtailment

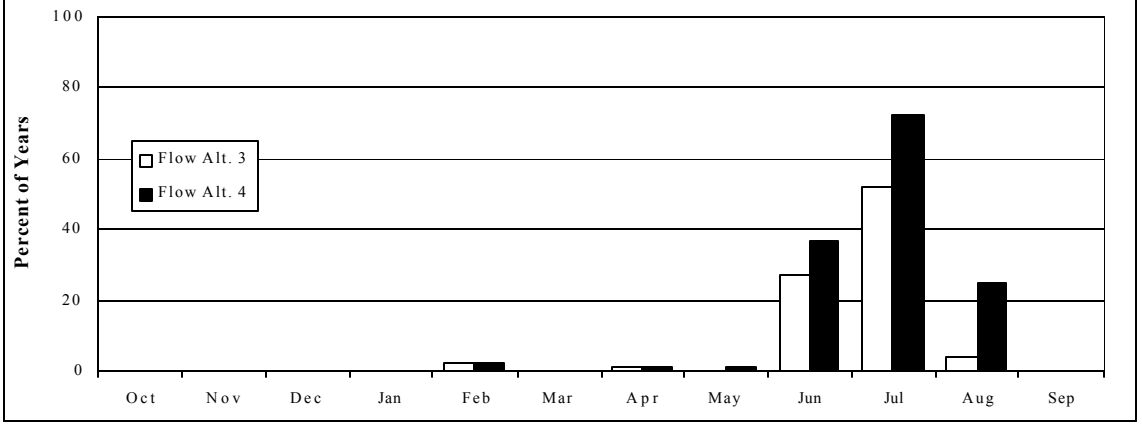
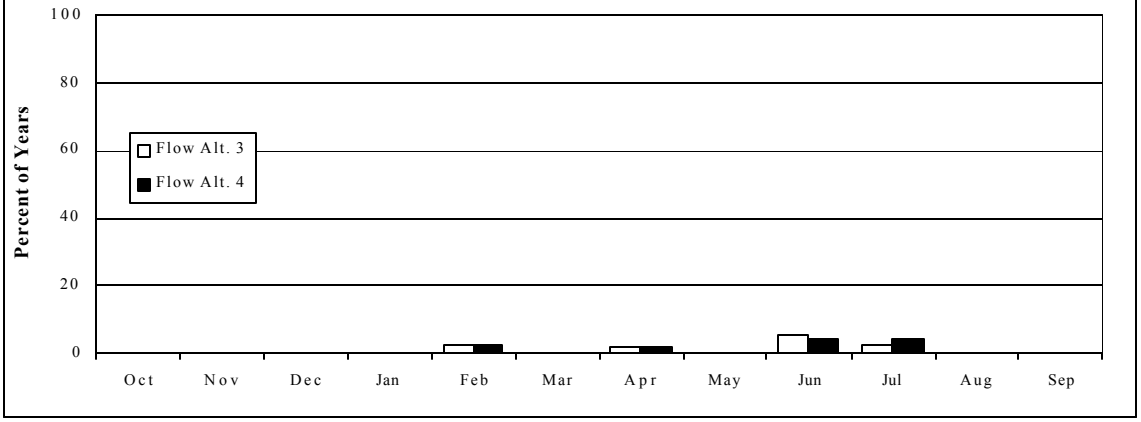


Figure V-31

Frequency When Additional Supplemental Water is required of the SWP and the CVP



Alternative 3: Post-1914 appropriators are responsible for meeting the objectives under this alternative based on an order of priority. The SWP and the CVP in connection with their exports meet the bulk of the responsibility to achieve the objectives because the exports are junior in water right priority. The Friant Project and the New Melones Project are assumed to be in-basin projects, not exports, and the New Melones Project meets all flow responsibility incurred by the Friant Project.

Overall carryover storage in SWP and CVP reservoirs in the Sacramento Basin increases in comparison to Alternative 2 because other parties are sharing responsibility to meet inbasin entitlements. Additional increases in carryover storage could be realized if, contrary to the modeling assumption, water rights holders do not seek contracts when their diversions are curtailed under this alternative. Carryover storage in New Melones Reservoir improves substantially because other parties in the San Joaquin Basin are bypassing flows that would otherwise be diverted. Carryover storage in other reservoirs declines because of bypass requirements.

Deliveries to SWP and CVP export areas increase because of the shared responsibility. However, San Joaquin River direct diverters are required to cease diversion at some times which reduces their deliveries. San Joaquin water right holders with storage rights in New Don Pedro and Lake McClure do not have any delivery reductions because, through reservoir reoperations, they have adequate storage to meet the flow obligations plus full deliveries. Export transfer capacity declines in comparison to Alternative 2 because the SWP and the CVP are making more use of their export facilities.

Alternative 4: The difference between Alternative 3 and Alternative 4 is that the Friant Project is considered to be an export project in Alternative 4. Therefore, the part of the water delivered by the Friant Project to the export area shifts from being treated as a comparatively senior water right to a junior water right compared to inbasin users. The principal effect of this change is that carryover storage in New Melones Reservoir declines because this reservoir makes releases to meet the Friant Project obligations.

Alternative 5: Under this alternative, flow requirements are established for the principal tributaries to the Bay/Delta watershed to meet the 1995 Bay/Delta Plan Vernalis and outflow objectives based on the unimpaired flow contribution of the tributaries to the watershed. The Friant Project is required to make releases to meet the flow requirements assigned to the upper San Joaquin River. Compared with the other alternatives, this alternative shifts more responsibility to meet the flow objectives onto water right holders other than the SWP and CVP export facilities. Alternative 5 also has a very substantial effect on Friant Project deliveries.

Carryover storage in Sacramento Basin SWP and CVP reservoirs and in New Melones Reservoir increases slightly. Carryover storage in Millerton Lake declines slightly while in the other modeled reservoirs declines are substantial.

Total 73-year period average deliveries under this alternative decline more than any other alternative, but the Friant Project accounts for 58 percent of the total delivery reductions.

Deliveries to the Yuba and Bear river system and the EBMUD service area decline substantially because of increased flow obligations from these watersheds. Modest reductions occur in the Madera ID and Chowchilla WD. Deliveries to Modesto, Turlock, and Merced irrigation districts do not decline substantially because these districts have adequate storage to meet the new flow requirements plus make deliveries. Deliveries to SWP and CVP export areas improve substantially because water from other sources is entering the Delta and can be exported. Also, the reduced responsibility to meet the flow objectives leaves more water in storage upstream, which can be exported as the need arises. The increase in transfer capacity under Alternative 5 is less than the increases in the other alternatives because the SWP and the CVP are making more use of their export facilities.

Alternative 6: This alternative is similar to Alternative 2, but the Vernalis flow objectives are met by the CVP by using the export facilities to meet the Vernalis flow objectives through recirculation rather than by making releases from New Melones Reservoir. Additional flow requirements at Vernalis are also established under this alternative to meet the consumptive use in the southern Delta, and these requirements are also met through recirculation. Combined use of SWP and CVP points of diversion are incorporated in this alternative.

This alternative places a substantial new demand on the CVP storage in the Sacramento Basin and on the SWP and the CVP export facilities. Other facilities have no responsibility to meet the objectives. Consequently, CVP carryover storage in Shasta and Folsom lakes declines. Carryover storage in New Melones Reservoir increases because this reservoir is not responsible for meeting the Vernalis flow objectives.

Exports increase under this alternative compared to most of the other alternatives. Even though much of this increase is used to meet the Vernalis requirements, CVP deliveries to export areas also increase because of the combined use of SWP and CVP points of diversion in the Delta. Transfer capacity at the export facilities substantially declines because of the other demands on the facilities. However, transfer requirements should also decline.

Alternative 7: Under this alternative, the minimum flows required at Vernalis are reduced from the Bay/Delta Plan objectives based on the Letter of Intent. The SWP and the CVP facilities in the Sacramento Basin are responsible for meeting the Delta outflow objectives. The San Joaquin tributaries group guarantees flow releases to meet the minimum flows on the San Joaquin River at Vernalis identified in the Letter of Intent. Carryover storage in Sacramento Basin SWP and CVP facilities is similar to Alternative 2, but New Melones carryover storage improves because of the new operating rules for New Melones Reservoir, including a 70 TAF cap on releases for salinity control at Vernalis. Minor carryover storage changes occur in New Don Pedro Reservoir and Lake McClure because of the new demands on these reservoirs.

Deliveries by the SWP and CVP to export areas decline compared to Alternative 2 because there is less water available to export in the April-May period due to the reduced Vernalis flow requirements and the export restrictions during this period. Deliveries to all other water right holders in the Central Valley are unaffected by this alternative. Transfer capacity is similar to the capacity under Alternative 2.

Alternative 8: Under Alternative 8, the Vernalis pulse flows and the export levels during the pulse flows are replaced with target values in the San Joaquin River Agreement. The SWP and the CVP facilities in the Sacramento Basin are responsible for meeting the Delta outflow objective. New Melones Reservoir is operated according to the New Melones Interim Plan of Operation (Interim Plan). If additional water is needed to meet the Vernalis target flows, the San Joaquin tributaries group provides up to 110 TAF.

Carryover storage in Sacramento Basin SWP and CVP reservoirs is similar to Alternative 2, but New Melones Reservoir carryover storage improves because of the Interim Plan. A decline in carryover storage occurs in New Don Pedro Reservoir and in Lake McClure compared to Alternative 2 due to releases from these reservoirs to meet the target flows.

Deliveries by the SWP and CVP to export areas decline slightly compared to Alternative 2 for the 73-year period because of the export restrictions during the Vernalis pulse flow. Transfer capacity is improved over the base case but declines in comparison to Alternative 2.