DWR/USBR
2020 Level-of-Development Benchmark Study
Version BST_2020D09D_ANNBENCHMARK_2_2
(ANN)

Release Date: September 30, 2002

California Department of Water Resources,
Bay Delta Office
And
United States Bureau of Reclamation, Mid Pacific Region
Division of Planning

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I Introduction

This document summarizes the DWR/USBR jointly developed 2020 Level-of-Development Benchmark Study, BST_2020D09D_ANNBENCHMARK_2_2, using The California Department of Water Resources ANN Salinity Model for representing Delta flow-salinity relationships.

The model applied in developing this study is the joint DWR/USBR operations planning model, CALSIM II. The CALSIM Water Resources Simulation Model application 1.2.4 was used to run this study. The latest model application is available for downloading at http://modeling.water.ca.gov/branch/computer_models.html.

This study has been developed under the oversight of the CALFED/DWR/USBR Technical Coordination Team.

CALSIM II is a general-purpose planning simulation model developed by DWR and USBR for simulating the operation of California's water resources system, specifically the CVP and SWP. On a monthly time-step, CALSIM II utilizes optimization techniques to route water through a network. A linear programming (LP)/mixed integer linear programming (MILP) solver determines an optimal set of decisions for each time period given a set of weights and system constraints. A key component for specification of the physical and operational constraints is the WRESL language. The model user describes the physical system (dams, reservoirs, channels, pumping plants, etc.), operational rules (flood-control diagrams, minimum flows, delivery requirements, etc.), and priorities for allocating water to different uses in WRESL statements.

It is intended that CALSIM II be used in a comparative mode. The results from a "With Project" alternative simulation are compared to the results of a Benchmark simulation to determine the incremental effects of a project. The results from a single simulation may not necessarily represent the exact operations for a specific month or year, but should reflect long-term trends. The model should be used with extreme caution to prescribe seasonal or to guide real-time operations, predict flows or water deliveries for any real-time operations.

II Key Model Results for Benchmark Study Version BST_2020D09D_ANNBENCHMARK_2_2 (ANN)

This section presents key results regarding project water supply capabilities, project operations as well as CVPIA (b)(2) and EWA operations as simulated by the model.

II.1. Water Supply

Table II.1.1
Water Supply
(taf/year)

Delivery	(May 1928 - Oct. 1934) Dry Period Average	(1922-1994) 73-Year Period Average
SWP South-of-Delta Firm Delivery	1932	3179
SWP Interruptible Delivery	72	95
CVP North-of-Delta Delivery	2100	2264
CVP South-of-Delta Delivery **	1673	2520
CVP South-of-Delta Ag Delivery **	331	1068
Total Delivery	5777	8058

** Note: Cross Valley Canal Users included in calculation

Table II.1.1 shows the average annual deliveries for the SWP and CVP for the historical dry period of 1928 through 1934 and 73-year long-term. The average annual SWP south-of-Delta firm delivery in the dry period of 1928 through 1934 is 1932 taf and 3179 taf long-term. The average annual SWP interruptible delivery in the dry period of 1928 through 1934 is 72 taf and 95 taf long-term. The average annual for CVP north-of-Delta delivery in the dry period of 1928 through 1934 is 2100 taf and 2264 taf long-term. The average annual CVP south-of-Delta delivery in the dry period of 1928 through 1934 is 1673 taf and 2520 taf long-term. The average annual CVP south-of-Delta agricultural delivery in the dry period of 1928 through 1934 is 331 taf and 1068 taf long-term.

Table II.1.2. Percent Allocation Summary

	Water Year Type	SWP NOD		SWP SOD			CVP NOD				CVP SOD			
Water Year	Sac 40-30-30 Index	FRSA	MI	MWD	AG	Other MI	AG	SC	MI	RF	AG	MI	EX	RF
1922	AN	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	100%	100%	100%
1923	BN	100%	90%	90%	90%	90%	72%	100%	97%	100%	72%	97%	100%	100%
1924	C	50%	25%	27%	25%	25%	0%	75%	50%	75%	0%	50%	77%	75%
1925	D	100%	38%	40%	38%	38%	37%	100%	75%	100%	37%	75%	100%	100%
1926	D	100%	75%	81%	75%	75%	10%	100%	60%	100%	10%	60%	100%	100%
1927	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	100%	100%	100%
1928	AN	100%	80%	82%	81%	80%	62%	100%	87%	100%	62%	87%	100%	100%
1929	C	100%	27%	30%	27%	27%	10%	100%	60%	100%	10%	60%	100%	100%
1930	D	100%	76%	81%	75%	76%	21%	100%	71%	100%	21%	71%	100%	100%
1931	C	50%	28%	29%	29%	28%	0%	75%	50%	75%	0%	50%	77%	75%
1932	D	100%	42%	43%	42%	42%	15%	75%	65%	75%	15%	65%	77%	75%
1933	C	100%	39%	41%	40%	39%	0%	75%	50%	75%	0%	50%	77%	75%
1934	C	50%	42%	43%	42%	42%	10%	75%	60%	75%	10%	60%	77%	75%
1935	BN	100%	100%	100%	100%	100%	37%	100%	75%	100%	37%	75%	100%	100%
1936	BN	100%	97%	100%	96%	97%	40%	100%	75%	100%	40%	75%	100%	100%
1937	BN	100%	89%	97%	87%	89%	34%	100%	75%	100%	34%	75%	100%	100%
1938	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	71%	96%	100%	100%
1939	D	100%	84%	93%	84%	84%	48%	100%	75%	100%	48%	75%	100%	100%
1940	AN	100%	100%	100%	100%	100%	95%	100%	100%	100%	64%	89%	100%	100%
1941	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	85%	100%	100%	100%
1942	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	100%	100%	100%
1943	W	100%	87%	88%	87%	87%	100%	100%	100%	100%	77%	100%	100%	100%
1944	D	100%	100%	100%	100%	100%	46%	100%	75%	100%	46%	75%	100%	100%
1945	BN	100%	100%	100%	100%	100%	86%	100%	100%	100%	60%	85%	100%	100%
1946	BN	100%	91%	99%	91%	91%	100%	100%	100%	100%	77%	100%	100%	100%
1947	D	100%	75%	87%	73%	75%	50%	100%	75%	100%	50%	75%	100%	100%
1948	BN	100%	89%	99%	84%	89%	80%	100%	100%	100%	68%	93%	100%	100%
1949	D	100%	59%	67%	57%	59%	56%	100%	81%	100%	56%	81%	100%	100%
1950	BN	100%	89%	95%	86%	89%	26%	100%	75%	100%	26%	75%	100%	100%
1951	AN	100%	100%	100%	100%	100%	100%	100%	100%	100%	72%	97%	100%	100%
1952	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	82%	100%	100%	100%
1953	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	85%	100%	100%	100%
1954	AN	100%	100%	100%	100%	100%	100%	100%	100%	100%	78%	100%	100%	100%
1955	D	100%	37%	40%	36%	37%	43%	100%	75%	100%	43%	75%	100%	100%
1956	C	100%	100%	100%	100%	100%	100%	100%	100%	100%	88%	100%	100%	100%
1957	AN	100%	80%	84%	79%	80%	100%	100%	100%	100%	81%	100%	100%	100%
1958	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	78%	100%	100%	100%
1959	BN	100%	87%	87%	87%	87%	100%	100%	100%	100%	82%	100%	100%	100%
1960	D	100%	56%	60%	54%	56%	15%	100%	65%	100%	15%	65%	100%	100%
1961	D	100%	73%	77%	70%	73%	60%	100%	85%	100%	60%	85%	100%	100%
1962	BN	100%	90%	100%	87%	90%	93%	100%	100%	100%	76%	100%	100%	100%
1963	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	72%	97%	100%	100%
1964	D	100%	75%	79%	75%	75%	42%	100%	75%	100%	42%	75%	100%	100%
1965	W	100%	80%	87%	80%	80%	90%	100%	100%	100%	90%	100%	100%	100%
1966	BN	100%	95%	100%	95%	95%	100%	100%	100%	100%	70%	95%	100%	100%
1967	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	53%	78%	100%	100%
1968	BN	100%	87%	88%	87%	87%	97%	100%	100%	100%	84%	100%	100%	100%
1969	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	79%	100%	100%	100%
1970	W	100%	100%	100%	100%	100%	75%	100%	100%	100%	72%	97%	100%	100%
1971	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	83%	100%	100%	100%
1972	BN	100%	65%	65%	65%	65%	63%	100%	88%	100%	63%	88%	100%	100%
1973	AN	100%	93%	95%	93%	93%	100%	100%	100%	100%	89%	100%	100%	100%
1974	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	86%	100%	100%	100%
1975	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	100%	100%	100%
1976	C	100%	70%	74%	70%	70%	18%	100%	68%	100%	18%	68%	100%	100%
1977	C	50%	18%	18%	18%	18%	2%	75%	52%	75%	2%	52%	77%	75%
1978	AN	100%	100%	100%	100%	100%	100%	100%	100%	100%	78%	100%	100%	100%
1979	BN	100%	92%	95%	91%	92%	73%	100%	98%	100%	73%	98%	100%	100%
1980	AN	100%	90%	99%	100%	90%	100%	100%	100%	100%	78%	100%	100%	100%
1981	D	100%	89%	91%	89%	89%	100%	100%	100%	100%	83%	100%	100%	100%
1982	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	70%	95%	100%	100%
1983	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	67%	92%	100%	100%
1984	W	100%	100%	100%	100%	100%	100%	100%	100%	100%	79%	100%	100%	100%
1985	D	100%	89%	100%	89%	89%	88%	100%	100%	100%	59%	84%	100%	100%
1986	W	100%	81%	86%	100%	81%	59%	100%	84%	100%	59%	84%	100%	100%
1987	D	100%	79%	91%	79%	79%	23%	100%	73%	100%	23%	73%	100%	100%
1988	C	50%	23%	24%	23%	23%	16%	100%	66%	100%	16%	66%	100%	100%
1989	D	100%	88%	97%	86%	88%	45%	100%	75%	100%	45%	75%	100%	100%
1990	C	100%	25%	25%	25%	25%	0%	100%	50%	100%	0%	50%	100%	100%
1991	C	50%	20%	20%	20%	20%	9%	75%	59%	75%	9%	59%	77%	75%
1992	C	100%	31%	32%	31%	31%	40%	75%	75%	75%	40%	75%	77%	75%
1993	AN	100%	100%	100%	100%	100%	100%	100%	100%	100%	50%	75%	100%	100%
1994	C	100%	71%	71%	71%	71%	83%	75%	100%	75%	83%	100%	77%	75%

Table II.1.2 shows the percent annual water year allocation for SWP and CVP. SWP north-of-Delta includes Feather River (FRSA) and municipal and industrial (MI) allocations. SWP south-of-Delta includes Metropolitan Water District (MWD), agriculture (AG) and other municipal and industrial (MI) allocations. CVP north-of-Delta includes agriculture (AG), Settlement Contractors (SC), municipal and industrial (MI) and refuge (RF) allocations. CVP south-of-Delta includes agriculture (AG), municipal and industrial (MI), exchange contractors (EX) and refuge (RF) allocations.

Figure II.1.1
Frequency of Total SWP south-of-Delta Deliveries Reliability

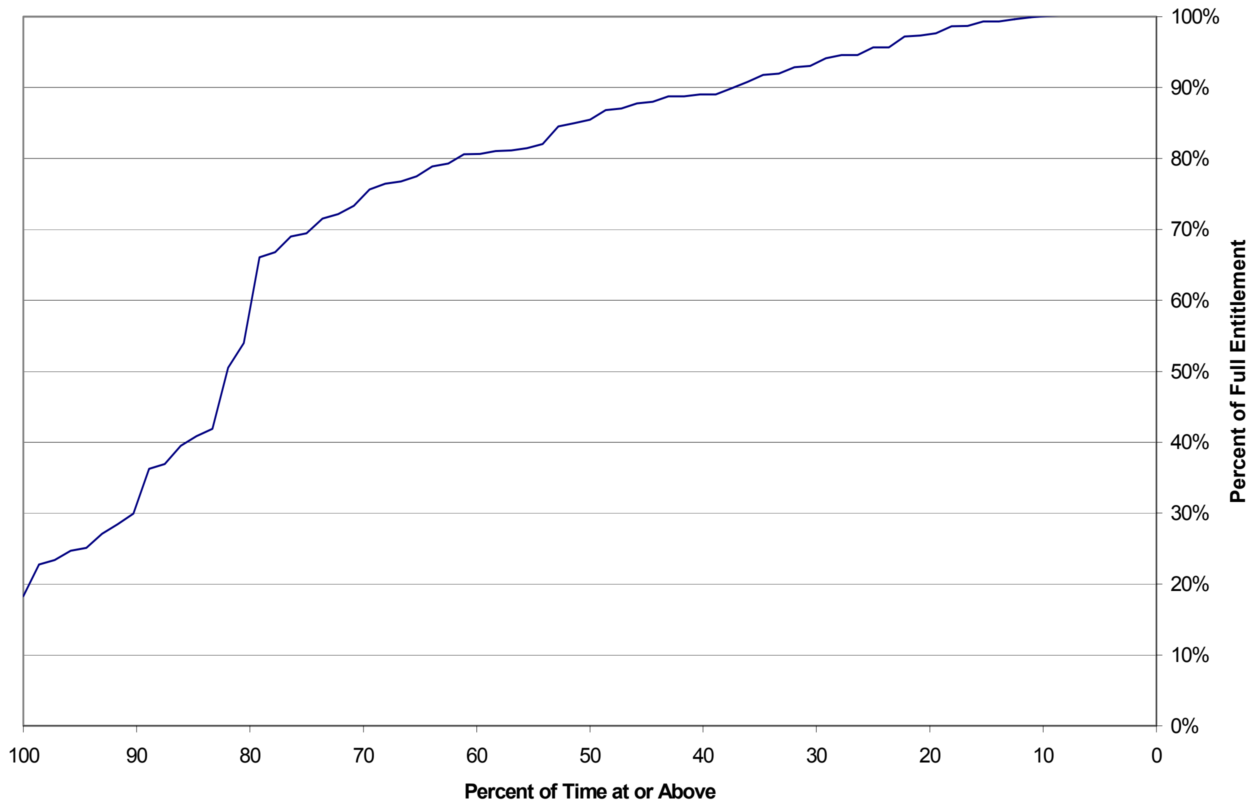

Figure II.1.1 shows the frequency of total annual SWP south-of-Delta full entitlement reliability. In 50 percent of the years, at least 85% of the SWP south-of-Delta full entitlement is met.

Figure II.1.2
Frequency of SWP Interruptible Delivery

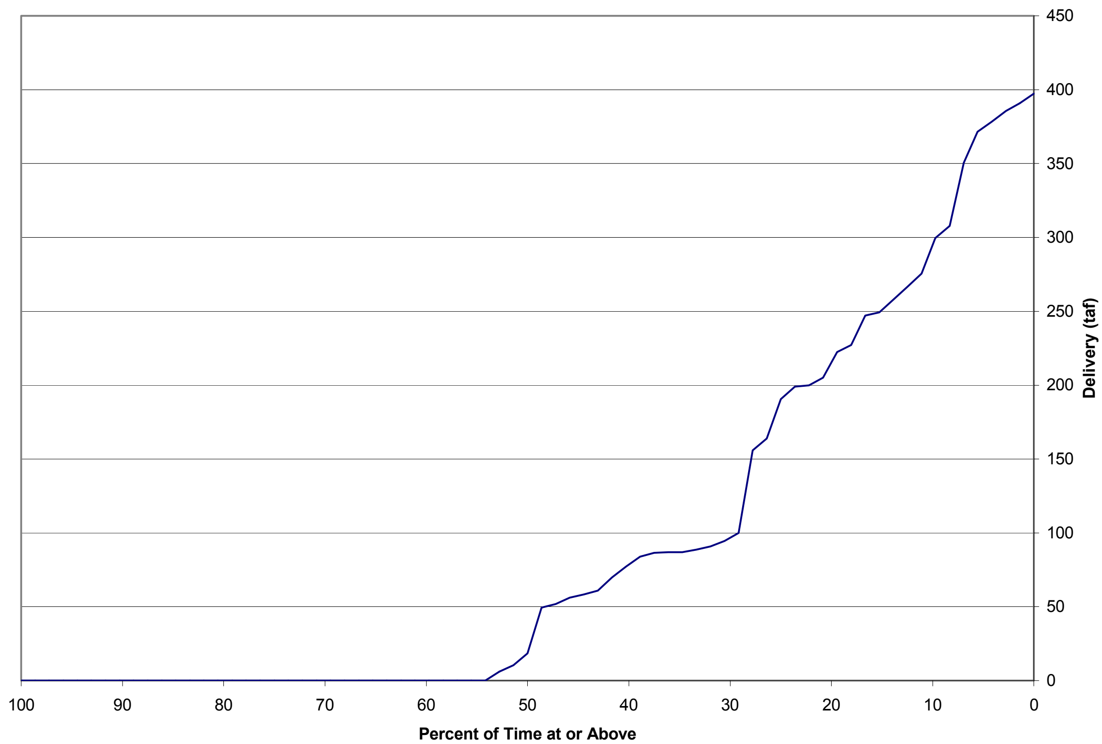

Figure II.1.2 shows the frequency of total annual SWP interruptible delivery. In about 50% of the years, the total annual interruptible delivery is at least 19 taf. The average annual interruptible delivery is 95 taf.

Figure II.1.3
Frequency of Total CVP SOD Delivery

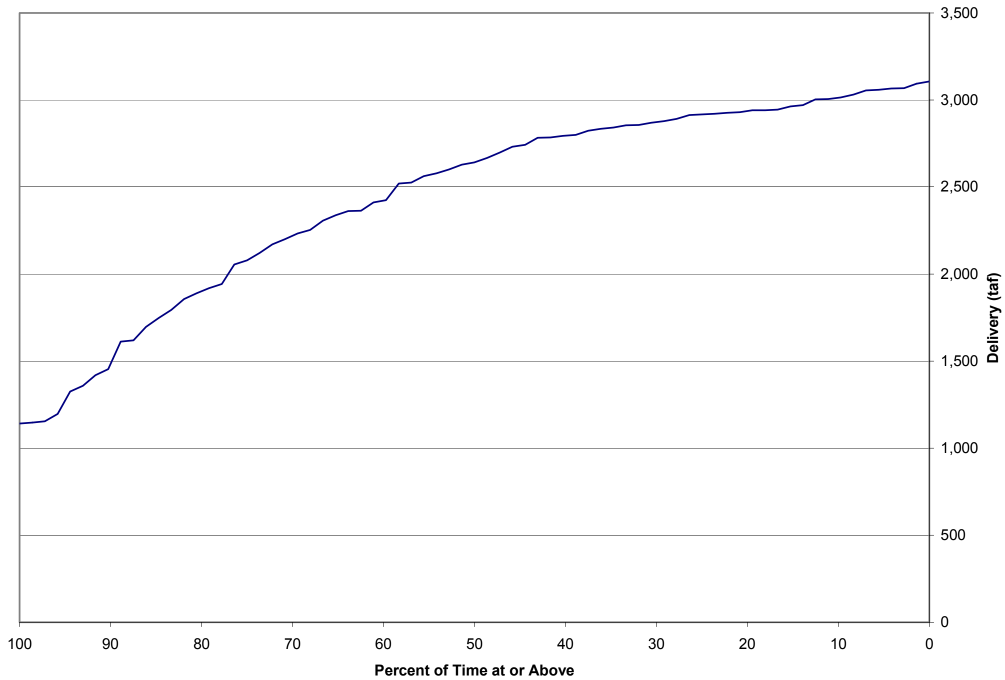

Figure II.1.3 shows the frequency of total annual CVP south-of-Delta delivery. In 50 percent of the years, the total annual CVP south-of-Delta delivery is at least 2,640 taf. The average annual CVP south-of-Delta delivery is 2,443 taf.

Figure II.1.4
Frequency of Total CVP SOD Ag Delivery

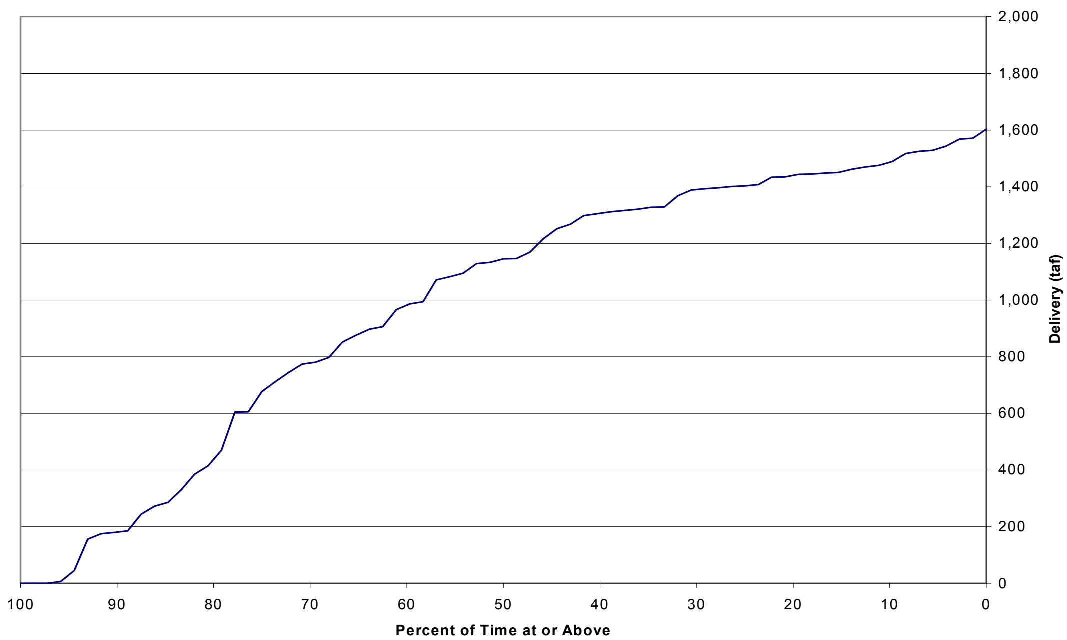

Figure II.1.4 shows the frequency of total CVP south-of-Delta delivery to agricultural contractors. In 50% of the years, the total annual CVP south-of-Delta delivery to agricultural contractors is at least 1,146 taf. The average annual CVP south-of-Delta delivery to agricultural contractors is 992 taf.

Figure II.1.5
Frequency of Total CVP NOD Delivery

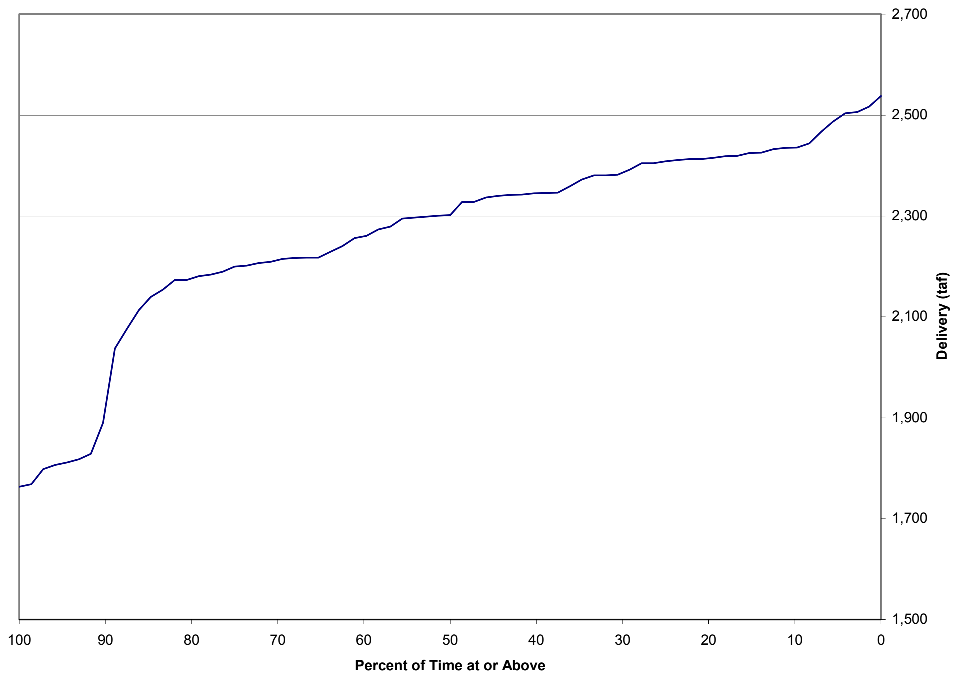

Figure II.1.5 shows the frequency of total CVP north-of-Delta delivery. In 50% of the years, the total annual CVP north-of-Delta delivery is at least 2,302 taf. The average annual CVP north-of-Delta delivery to agricultural contractors is 2,264 taf.

II.2. CVPIA (b)(2) Operations

Figure II.2.1
Total End of Year (b)(2) Costs

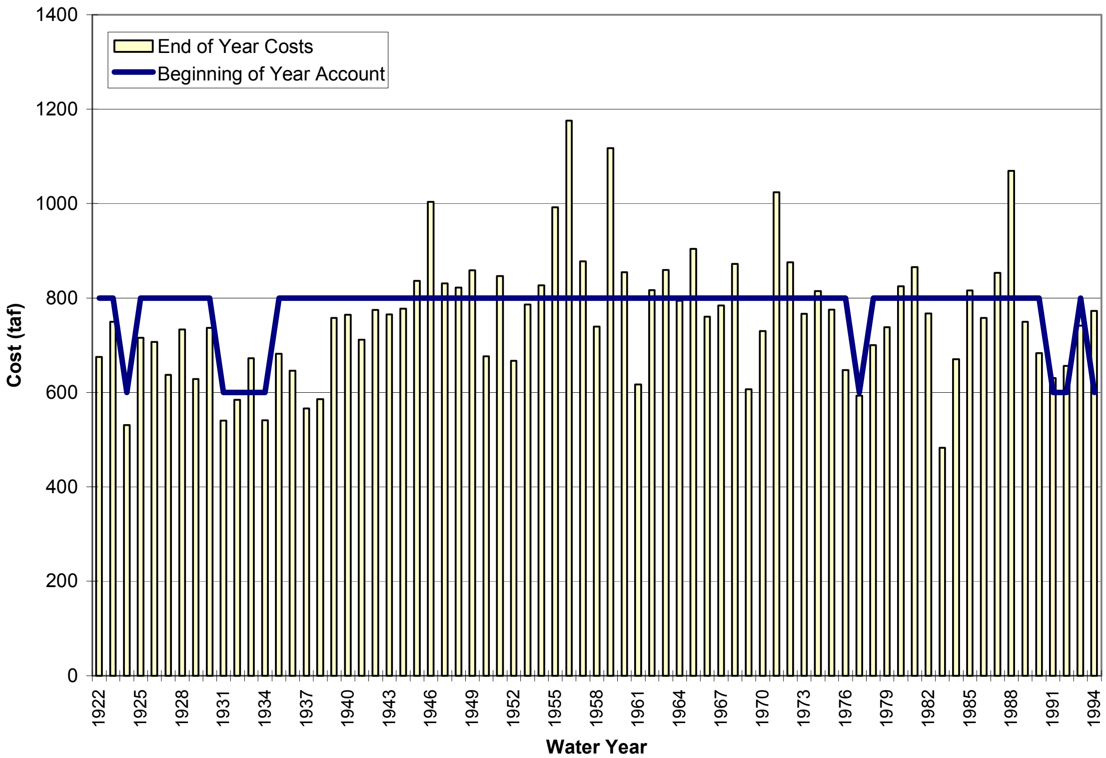

Figure II.2.1 shows the total end of year (b)(2) costs and the beginning of year (b)(2) account. The cost is computed from the (b)(2) study with D1485 as the baseline. The heavy line shows the total (b)(2) account limit at the beginning of each year (800 taf in normal years, 600 taf in Shasta critical years). The bars show the actual total end of year (b)(2) costs for each year. There are several years throughout the 73-year study period in which the total (b)(2) cost exceeded the (b)(2) account. This can happen for several reasons: 1. CVP costs, as measured through (b)(2) metrics, of satisfying WQCP standards exceed the allocated (b)(2) account. This is the primary cause for account over-expenditures. 2. CALSIM is a monthly time-step model and will impose a (b)(2) action as long as there is a balance in the (b)(2) account at the beginning of the month and reserve criteria are satisfied. When a (b)(2) action is imposed, it is imposed for the entire month, and the action taken resulted in a cost more than the remaining (b)(2) account balance.

There are also years when the total (b)(2) cost is less than the (b)(2) account limit as shown in the chart. In those years, all of the (b)(2) actions are taken, but the total cost of those actions is less than 800 taf or 600 taf (b)(2) account.

Figure II.2.2
Percent of Time (b)(2) Actions Taken

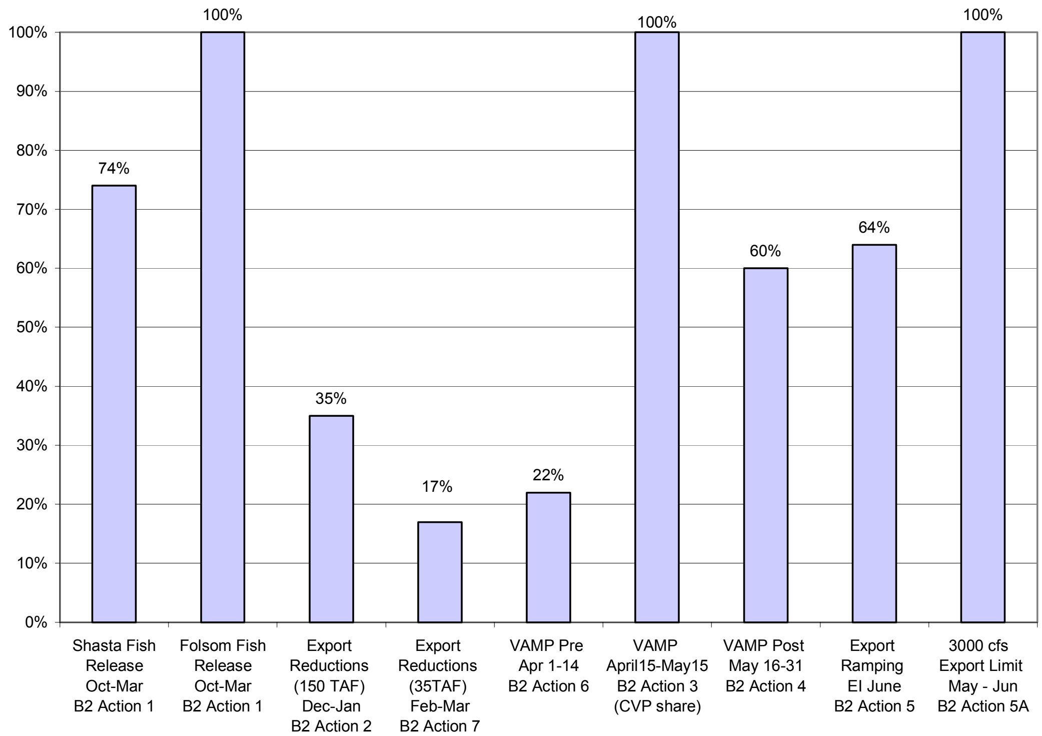

Figure II.2.2 shows the percent of time (b)(2) actions are taken during the 73-year study period. The (b)(2) actions are imposed on the CVP system only.

II.3. EWA Operations

Figure II.3.1
Percent of Time EWA Actions Taken

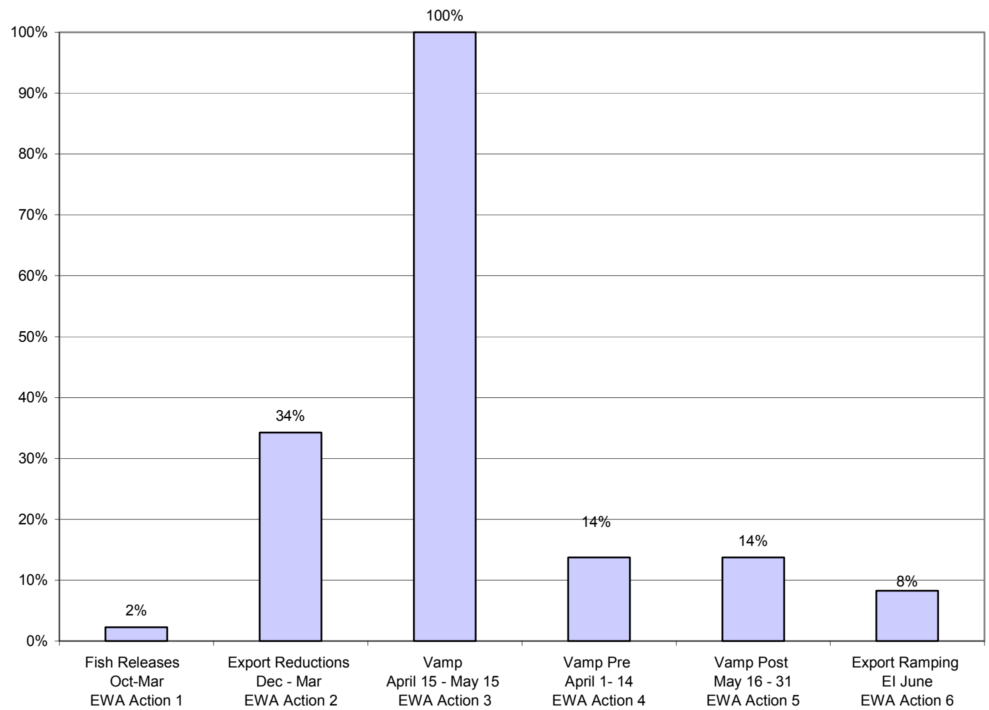

Figure II.3.1 shows the percent of time EWA actions are taken. While the (b)(2) actions are imposed only on the CVP system, EWA actions are imposed on both the SWP and CVP systems. Four of the EWA actions are the same as the (b)(2) actions. The EWA would impose actions only on the SWP if (b)(2) actions were imposed on the CVP. However, if (b)(2) actions were not imposed on the CVP because the (b)(2) account is exhausted, then the EWA will impose actions on both the CVP and SWP as long as the EWA has sufficient collateral to repay the debt to the projects.

Figure II.3.2
Percent of Times (b)(2) and EWA Actions Taken

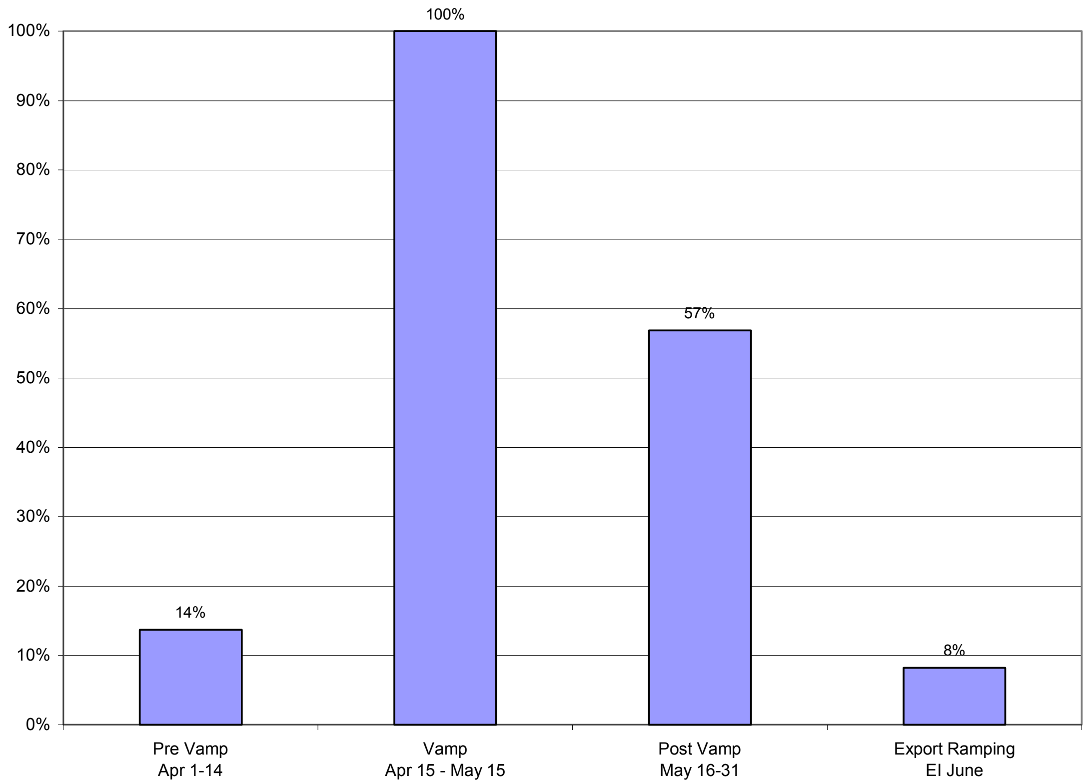

Figure II.3.2 shows the percent of time (b)(2) and EWA actions are taken. The actions are common to (b)(2) and EWA. These are percent of times when:

- (b)(2) actions are taken on the CVP, and EWA actions are taken on the SWP (this qualifies as one full action taken)
- no (b)(2) action is taken on the CVP, but EWA actions are taken on both the SWP and CVP (this qualifies as one full action taken)
- or (b)(2) actions are taken on the CVP, and EWA does not take actions (this qualifies as one half action taken)

Figure II.3.3
Frequency of Joint Point Use for EWA
(Includes 500 cfs July through September)

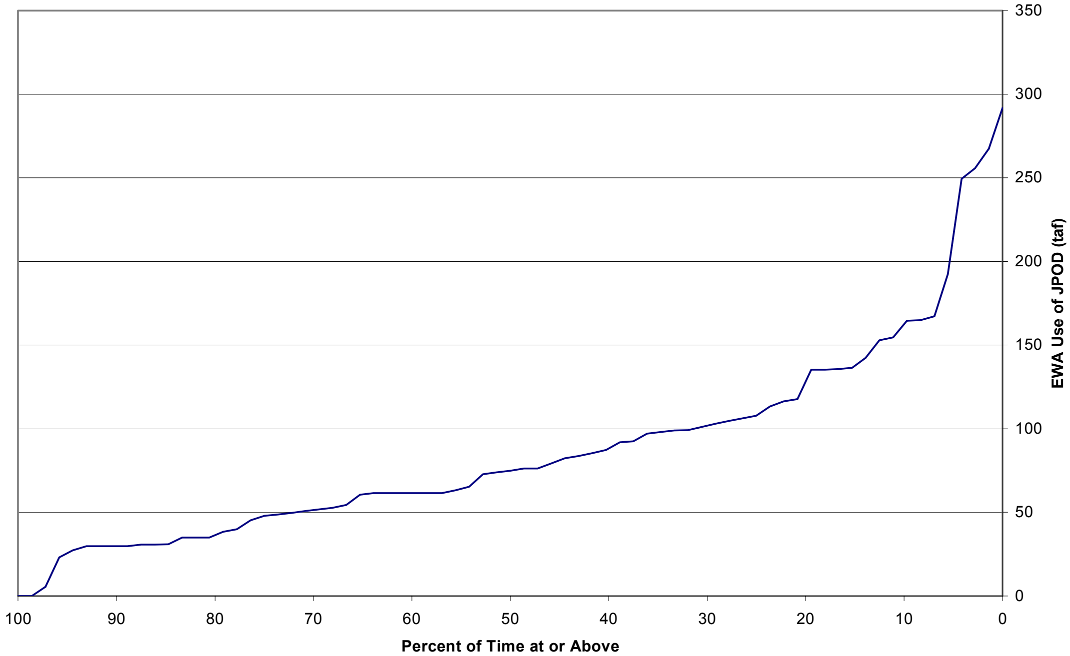

Figure II.3.3 shows the frequency of total annual use of joint-point-of-diversion for the EWA. This represents the total use of joint-point-of-diversion at Banks Pumping Plant to export water for the EWA, including a north-of-Delta purchase, EWA water stored in north-of-Delta project reservoirs, and surplus water. The average annual total use of joint-point-of-diversion for the EWA is 88 taf.

Figure II.3.4
EWA Use of JPOD and Dedicated 500 cfs Banks Capacity to Transfer NOD Purchase

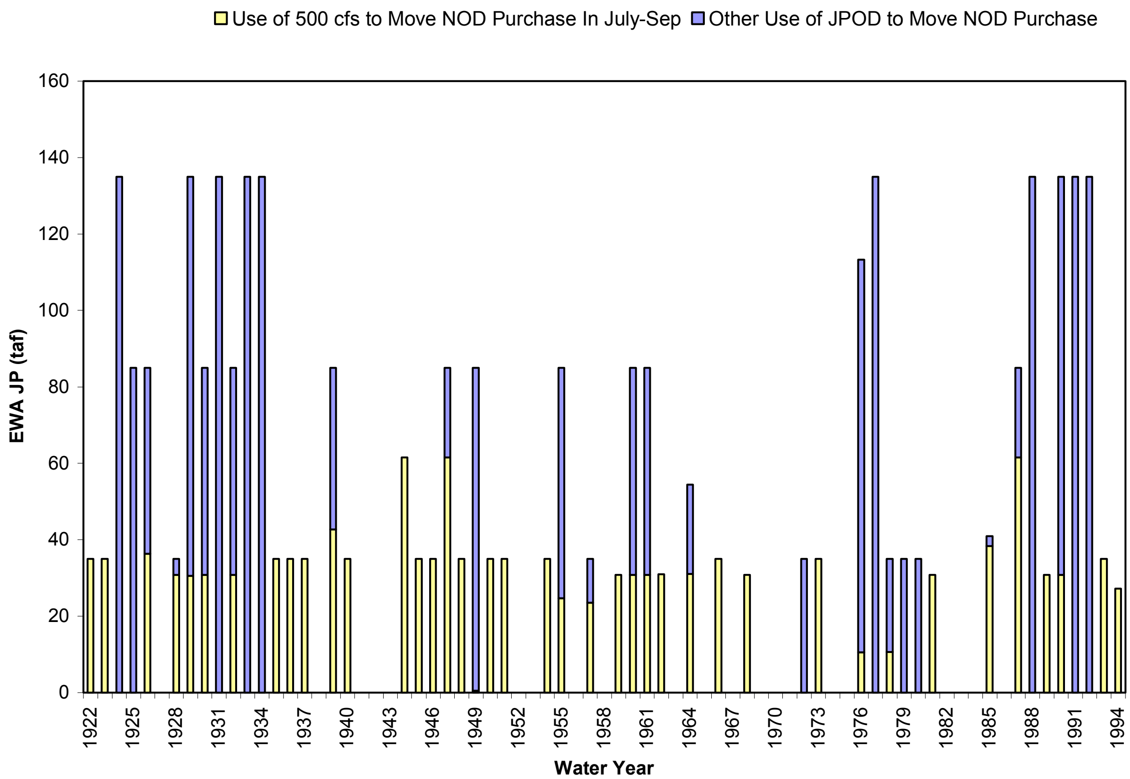

Figure II.3.4 shows the use of JPOD and dedicated 500 cfs to transfer the north-of-Delta EWA purchase. EWA north of Delta purchased water is moved through Banks Pumping Plant during Jul-Sep at the earliest possible opportunity. The purchased water is transferred through the EWA dedicated additional 500 cfs capacity at Banks in July through September if existing JPOD capacity is limiting. Average annual EWA usage of the additional 500 cfs Banks capacity is 18 taf.

Figure II.3.5
EWA Use of JPOD and Dedicated 500 cfs Banks Capacity to Transfer NOD Storage and Delta Surplus

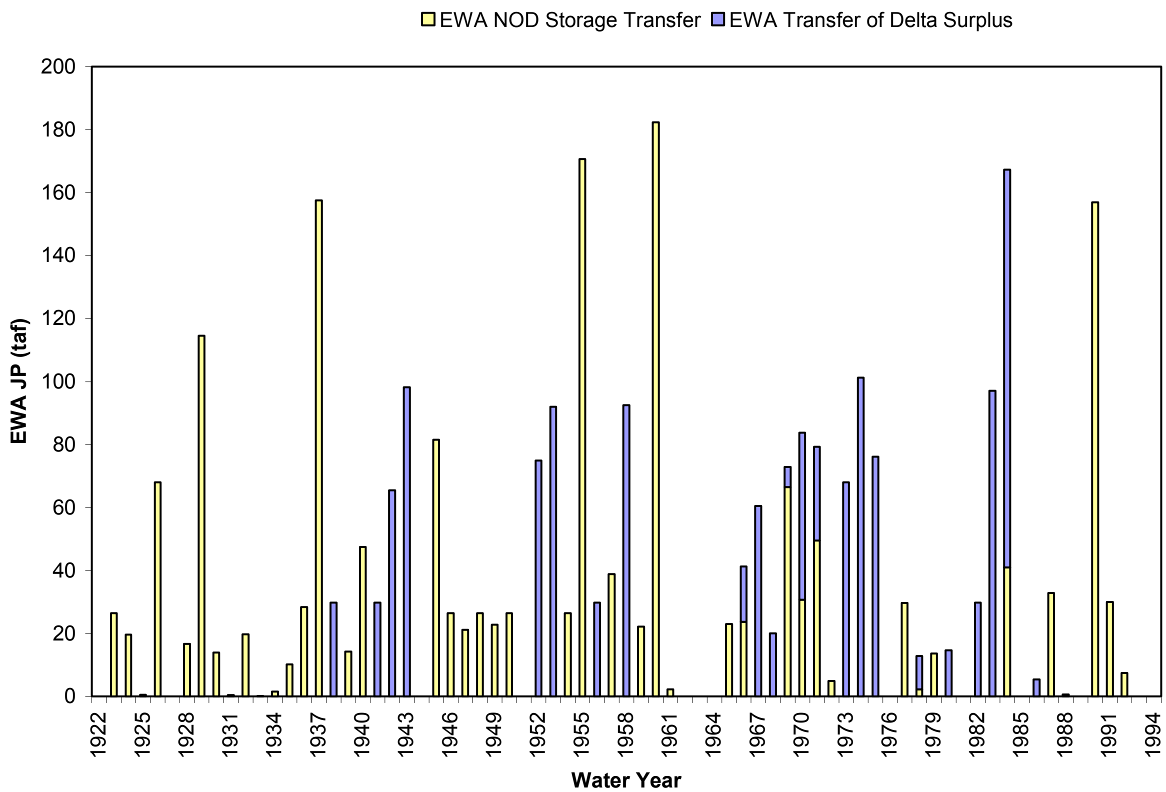

Figure II.3.5 shows total annual transfer of EWA water from north-of-Delta EWA storage and Delta Surplus into San Luis Reservoir through the use of joint-point-of-diversion and dedicated 500 cfs capacity through Banks Pumping Plant. When the EWA takes an action to reduce exports, the amount of storage backed up in Lake Oroville, Shasta Lake, or Folsom Lake as a result of EWA imposed export reduction is credited to the EWA account in those reservoirs. The transfer of EWA water from the northern reservoirs is prevalent in dry years because

- EWA storage in northern reservoirs is usually higher in dry years where EWA is less likely to lose its storage account due to flood control spills.
- There is sufficient joint-point-of-diversion capacity available at Banks Pumping Plant to transfer EWA water in dry years

EWA NOD stored water, when available, is moved to EWA SOD storage when EWA has capacity at Banks – first with the 50% of JPOD capacity and then using the 500 cfs additional Banks capacity (July-Sept) if not used by north-of-Delta purchase. This typically occurs during Jun-Aug, but can occur in any month.

The average annual transfer of EWA water from north-of-Delta reservoirs to San Luis reservoir is 23 taf.

Figure II.3.6
EWA Assets Utilized

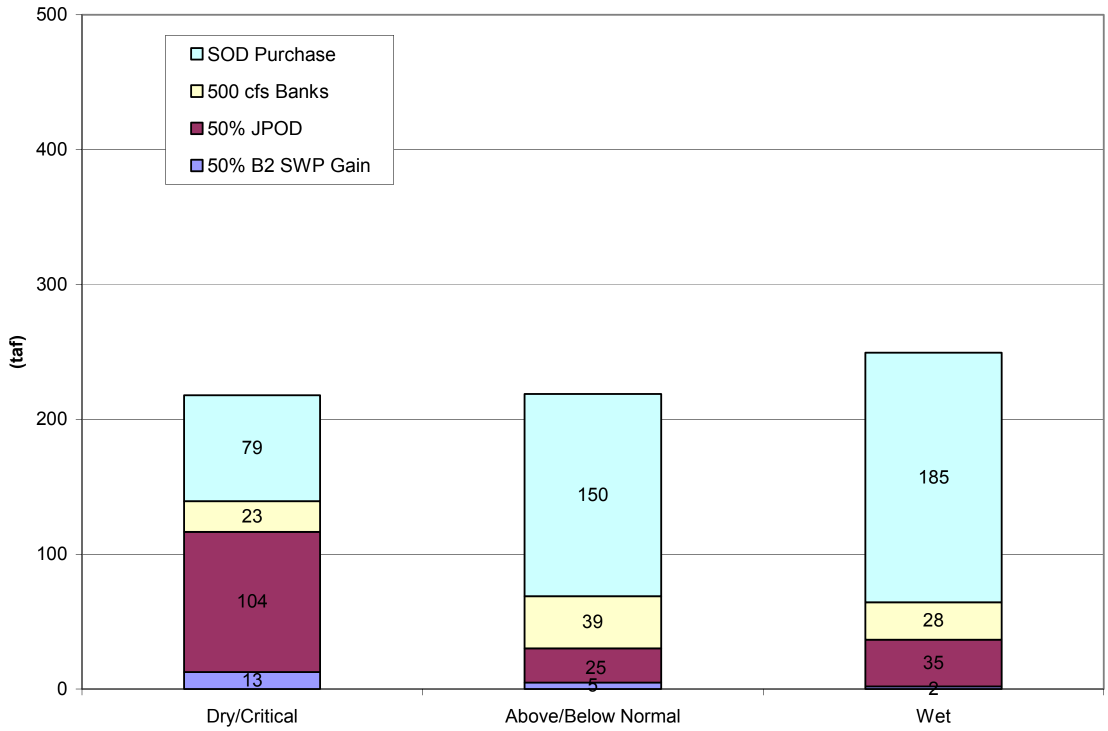

Figure II.3.6 shows EWA assets utilized by water-year type. The assets shown include south-of-Delta purchase, 500 cfs additional Banks Pumping Plant capacity, the remainder of the 50% of joint-point-of-diversion capability, and 50% of (b)(2) SWP gain. The average asset from south-of-Delta purchase is 79 taf/year in dry and critical years, 150 taf/year in above and below normal years, and 185 taf/year in wet years. The average asset from 500 cfs additional Banks Pumping Plant capacity is 23 taf/year in dry and critical years, 39 taf/year in above and below normal years, and 28 taf/year in wet years. The average remaining asset from 50% of joint point of diversion capability is 104 taf/year in dry and critical years, 25 taf/year in above and below normal years, and 35 taf/year in wet years. The average asset from 50% of (b)(2) SWP gain is 13 taf/year in dry and critical years, 5 taf/year in above and below normal years, and 2 taf/year in wet years. These are the major assets that the EWA utilizes to accumulate collateral south-of-Delta so that it can repay debt to the projects when it imposes an EWA action.

Figure II.3.7
SOD EWA Unpaid Debt

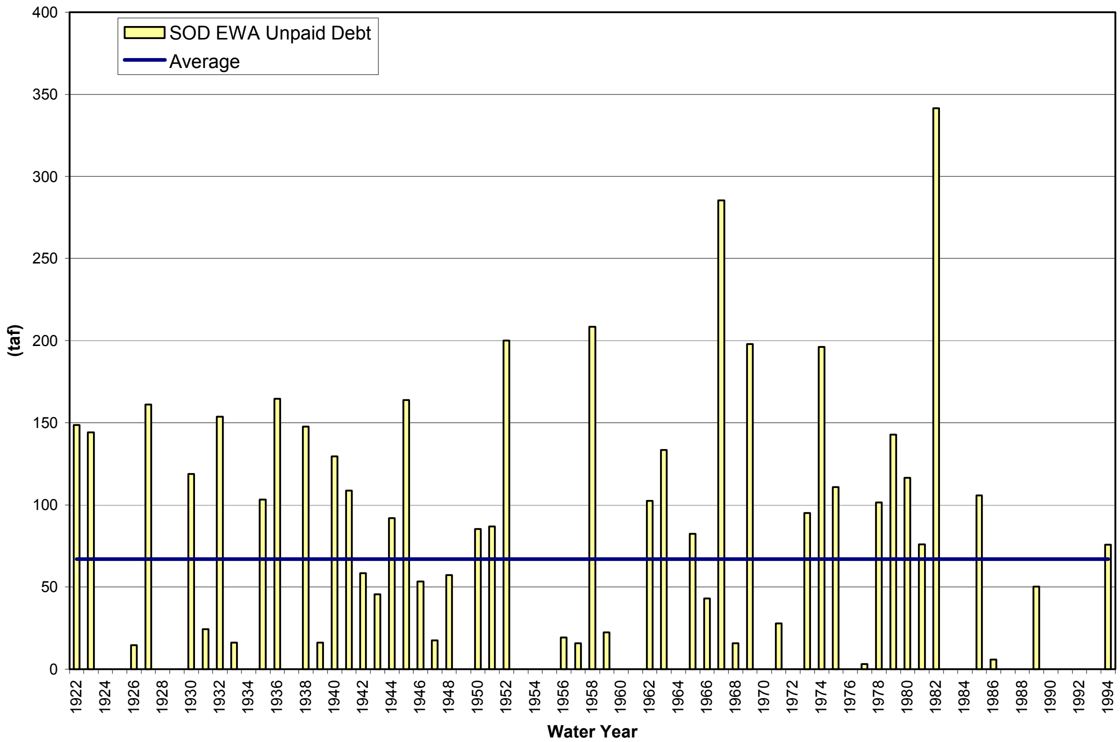

Figure II.3.7 shows the south of Delta EWA unpaid debts for each water year. The south of Delta EWA unpaid debt ranges from 0 to 342 taf. The average south of Delta EWA unpaid debt is 67 taf/year. SOD unpaid debts occur when EWA SOD assets are not sufficient to repay delivery or storage debt to the projects. Some causes for unpaid debts are that the prescriptive implementation of VAMP export restrictions may result in higher costs to EWA than exist in assets; and that actual implementation of any action may cost more than estimated and the monthly model does not implement partial actions.

Figure II.3.8
EWA north-of-Delta and south-of-Delta Purchase

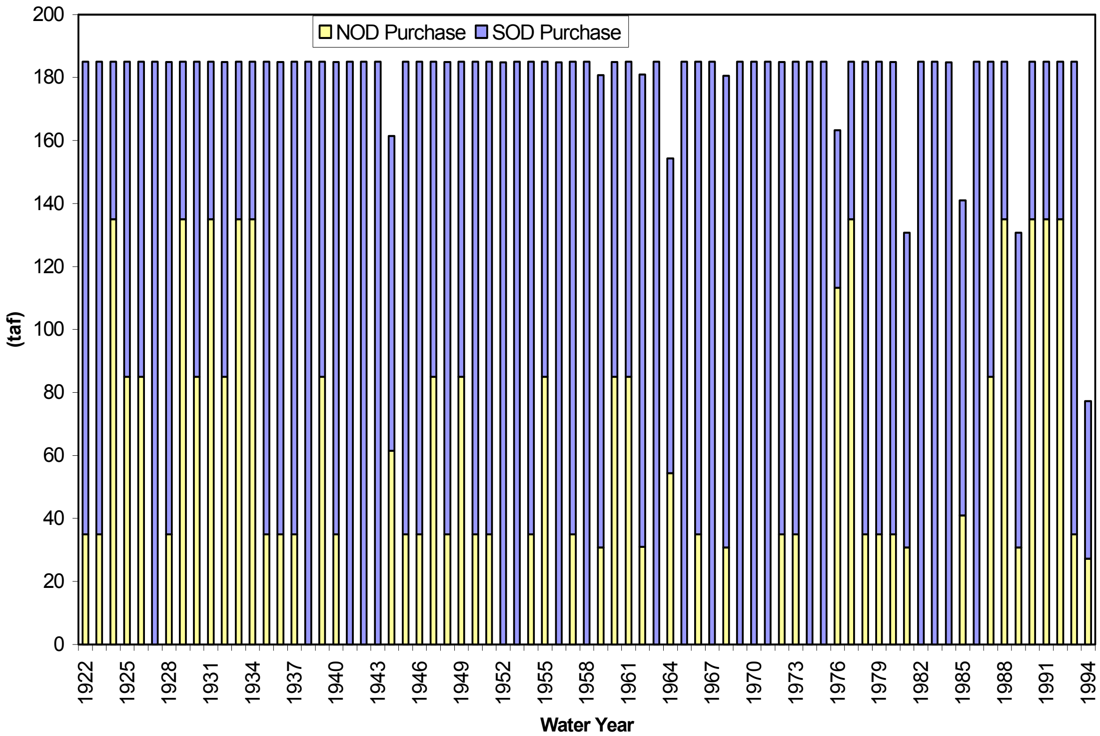

Figure II.3.8 shows EWA south-of-Delta and north-of-Delta purchase. The south-of-Delta purchase amounts are 50 taf/year in critical years, 100 taf/year in dry years, 150 taf/year in above and below normal years, and 185 taf/year in wet years. The north-of-Delta purchase amounts are 135 taf/year in critical years, 85 taf/year in dry years, 35 taf/year in above and below normal years, and 0 taf/year in wet years. The EWA uses the purchase water to repay debts to the projects. EWA purchases may be less than 185 taf in years in which available storage for the EWA in San Luis or south-of-delta groundwater is limited or when available capacity for the EWA at Banks is limited.

Figure II.3.9
EWA Storage in San Luis Reservoir

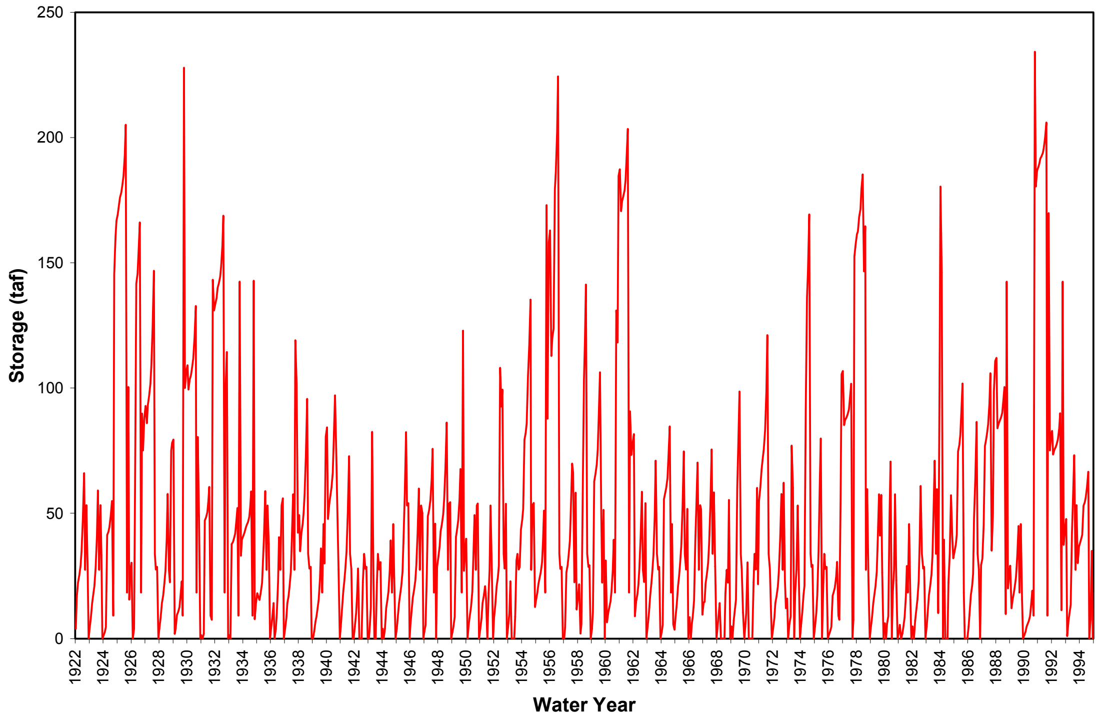

Figure II.3.9 shows EWA San Luis storage. This is EWA's storage account in San Luis Reservoir. This is a part of the south-of-Delta EWA collateral that the EWA accumulates from the various assets. The collateral is used to repay EWA debts to the projects when EWA incurs a debt on the projects by taking an EWA action. EWA will lose its storage in San Luis reservoir if storage is filled. EWA storage is usually high in dry years because:

- During dry years, EWA actions do not cost as much water because baseline deliveries are low. Therefore, EWA does not have much debt to repay to the projects.
- San Luis reservoir has storage capacity available for EWA to store its water. EWA San Luis reservoir does not spill for several consecutive years.
- In dry years, EWA has more opportunity to back up water in Lake Oroville, Shasta Lake, and Folsom Lake because there is less chance of losing that water due to flood control spills from the reservoirs.
- There is sufficient joint-point-of-diversion capacity available at Banks Pumping Plant.

Figure II.3.10
NOD SWP EWA Unpaid debt

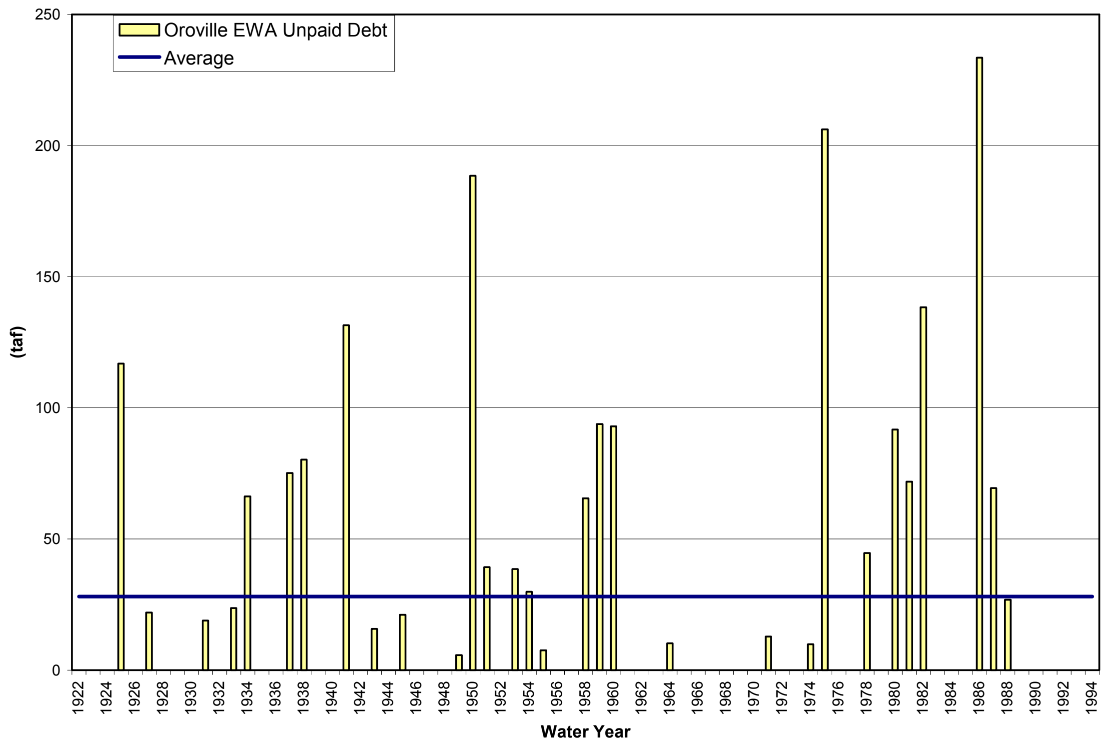

Figure II.3.10 shows the north of Delta SWP EWA unpaid debts for each water year. The north of Delta SWP EWA unpaid debt ranges from 0 to 234 taf. The average north of Delta SWP EWA unpaid debt is 28 taf/year. This debt is paid to Oroville as SWP add-water. Much of this debt may come from flood release water lost due to export curtailments. This loss leads to a lower San Luis level in the EWA versus the WQCP run and thus more water to be pulled out of Oroville Reservoir in the EWA run to meet rule curve. Also the 100% activation of VAMP may contribute to the NOD SWP EWA unpaid debt. Further review of north of Delta EWA unpaid debt may be needed. NOD unpaid debts result from changed operations of upstream reservoirs. Potential causes of unpaid NOD debts are changes in required outflows for salinity control and changes in timing of project exports from surplus to storage releases periods. Further refinement of operations under the EWA step are likely to reduce these unpaid depts.

Figure II.3.11
NOD CVP EWA Unpaid Debt

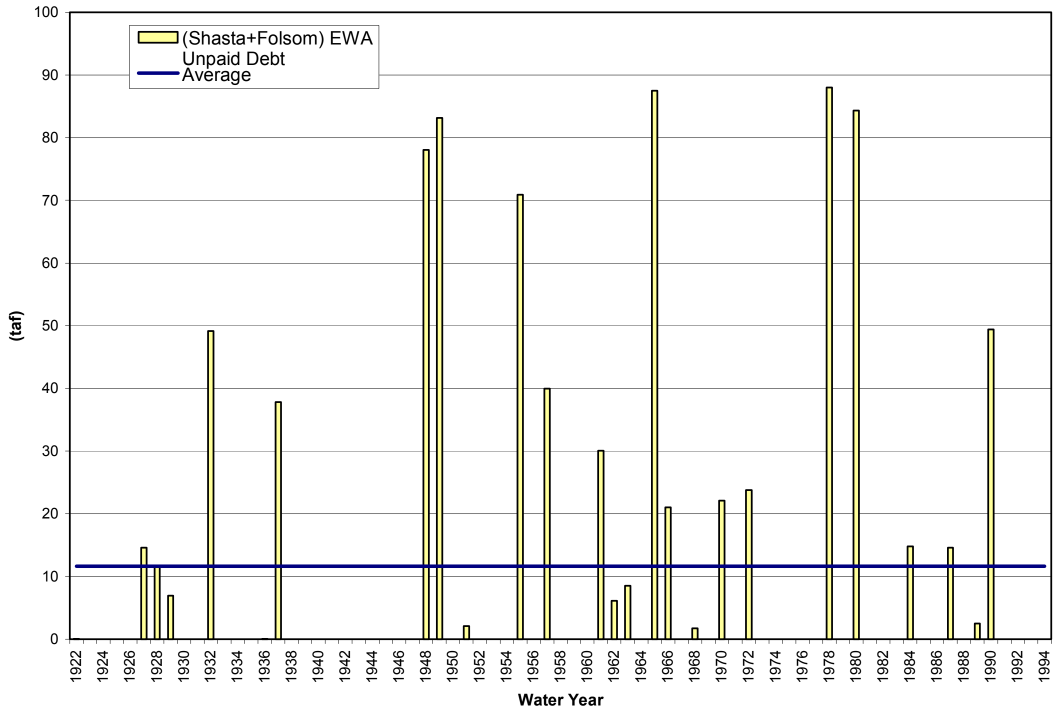

Figure II.3.11 shows the north of Delta CVP EWA unpaid debts for each water year. The north of Delta CVP EWA unpaid debt ranges from 0 to 88 taf. The average north of Delta CVP EWA unpaid debt is 12 taf/year. NOD unpaid debts result from changed operations of upstream reservoirs. Potential causes of unpaid NOD debts are changes in required outflows for salinity control and changes in timing of project exports from surplus to storage releases periods. Further refinement of operations under the EWA step are likely to reduce these unpaid depts.

II.4. Trinity River

Figure II.4.1
Trinity Lake Storage

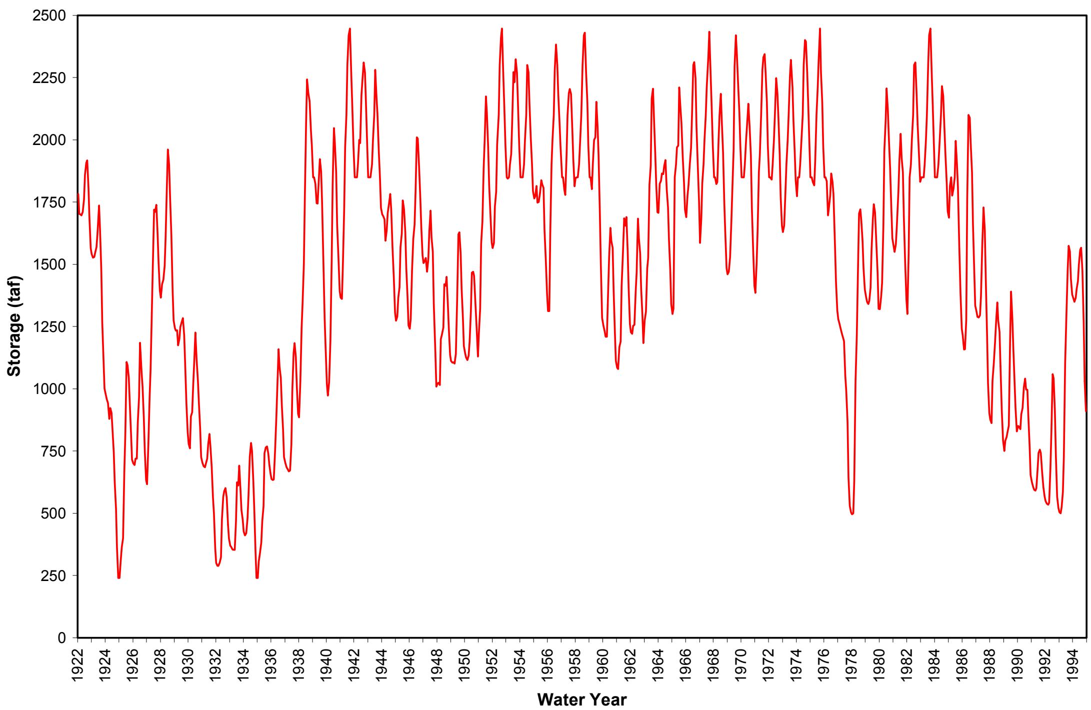

Figure II.4.1 shows Trinity Lake storage. The reservoir is operated to meet the Trinity River minimum required flow and export of water to the Sacramento River system.

Figure II.4.2
Total Annual Trinity River Minimum Instream Flow

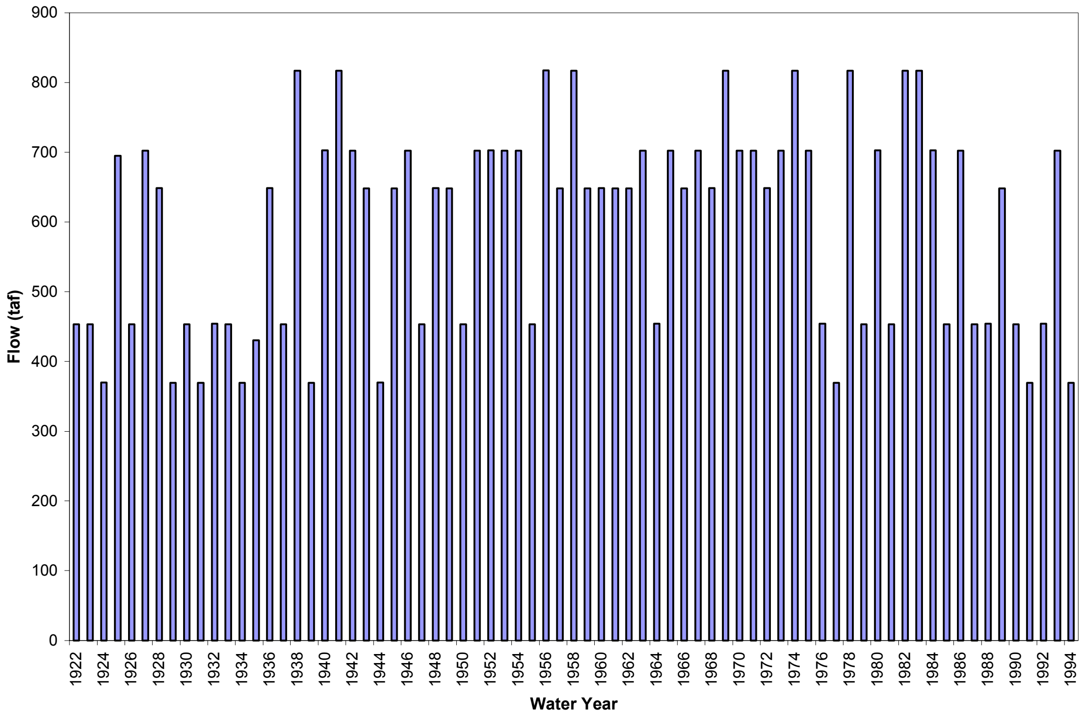

Figure II.4.2 shows the total annual Trinity River minimum instream flow for all years. The flows varied from 369 taf/year in dry years to 817 taf/year in wet years, based on the Trinity River index.

Figure II.4.3
Total Annual Trinity River Export

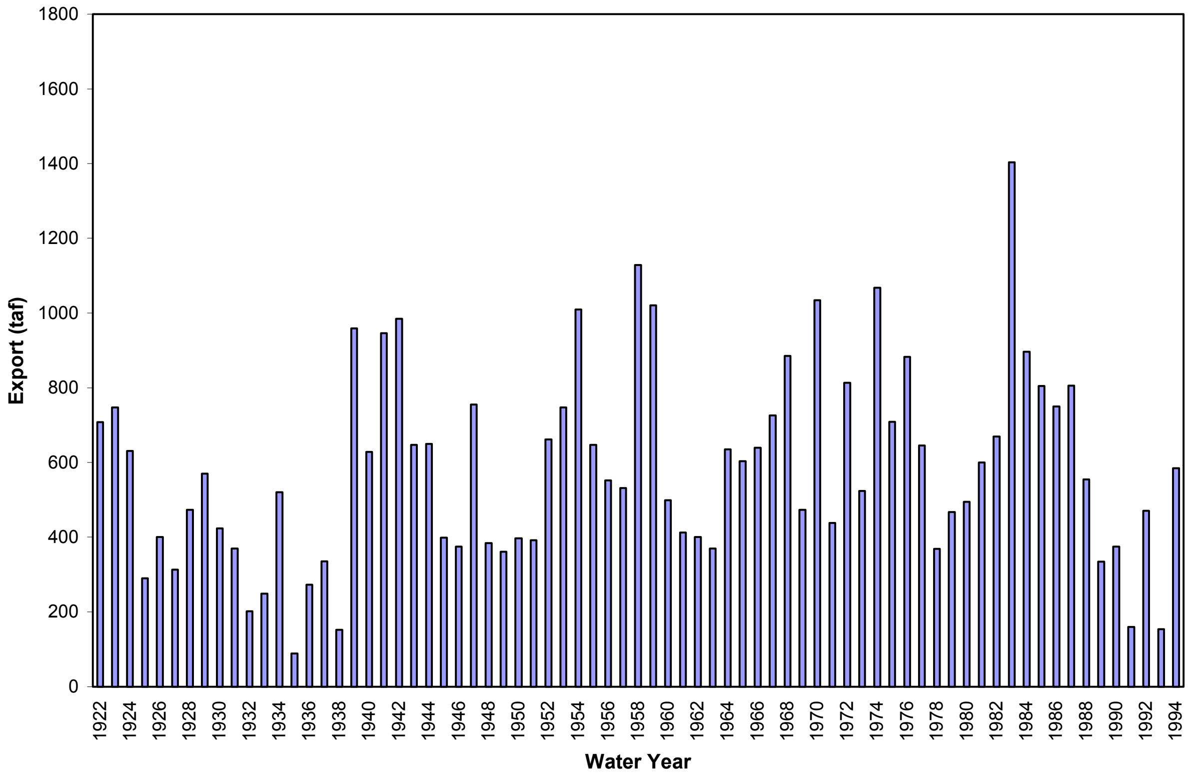

Figure II.4.3 shows the total Trinity River water exported annually to the Sacramento River system. The average annual export is 583 taf.

II.5. Sacramento River

Figure II.5.1
Shasta Lake Storage

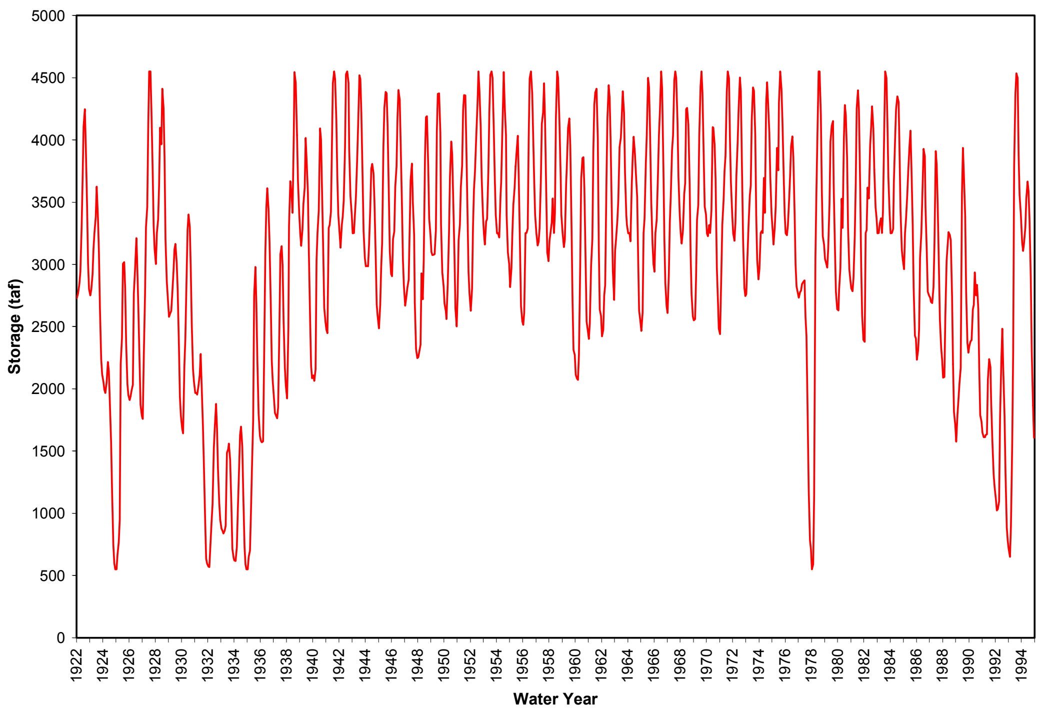

Figure II.5.1 shows Shasta Lake storage. There are 14 years in which the Shasta Lake carryover storage is lower than 1.9 maf. In 7 of those years, the carryover storage is between 1,000 and 1,900 taf, and in 7 of those years, the carryover storage is between 550 and 1000 taf. Most of the low carryover storage occurs in dry years including 1924, the 1928 through 1934 dry period, 1977, and the 1986 through 1992 dry period. In those dry years, Shasta reservoir is operated mostly to meet fish releases or temperature control flows at Keswick Dam or navigational control flow requirements. The CVP Settlement Contractors (full allocation 2.2 maf/year) are assumed to use their entire yearly allocation, whether full or 25% deficiency. This is a conservative approach that aggravates the low Shasta carryover problem in this simulation. While it is likely that NMFS and Reclamation would develop extraordinary measures to avoid carryover as low as is shown here in dry years, it is not possible to simulate this adaptive management approach with this version of CALSIM.

Table II.5.1
Shasta Lake Release Control

WYEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Carryover Storage, taf
1922	--	--	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	NCP	NCP	NCP	NCP	2,803
1923	Keswick	--	Keswick	Keswick	Keswick	Keswick	Keswick	NCP	NCP	--	NCP	Keswick	2,119
1924	NCP	NCP	NCP	Keswick	Keswick	--	NCP	NCP	--	--	NCP	NCP	550
1925	Keswick	Keswick	Keswick	Keswick	Keswick	--	Keswick	Keswick	--	--	NCP	Keswick	1,949
1926	Keswick	NCP	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	NCP	--	NCP	NCP	1,785
1927	Keswick	Keswick	Keswick	Keswick	Flood	Keswick	Flood	Flood	NCP	--	NCP	NCP	3,120
1928	--	--	Flood	Keswick	Keswick	Flood	Keswick	--	NCP	--	--	NCP	2,698
1929	NCP	--	Keswick	Keswick	Keswick	Keswick	NCP	NCP	--	--	--	NCP	1,787
1930	--	--	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	NCP	--	NCP	Keswick	2,056
1931	Keswick	NCP	Keswick	Keswick	Keswick	Keswick	--	NCP	--	--	NCP	NCP	596
1932	NCP	Keswick	Keswick	Keswick	Keswick	Keswick	NCP	NCP	NCP	NCP	NCP	--	947
1933	NCP	Keswick	Keswick	Keswick	Keswick	Keswick	--	NCP	--	--	--	NCP	640
1934	NCP	Keswick	Keswick	Keswick	Keswick	Keswick	NCP	NCP	--	--	NCP	NCP	550
1935	NCP	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	--	NCP	NCP	--	NCP	1,622
1936	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	--	NCP	NCP	2,067
1937	NCP	NCP	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	--	Keswick	Keswick	2,027
1938	Keswick	Keswick	Flood	Flood	Flood	Flood	Flood	Keswick	Keswick	NCP	NCP	Flood	3,400
1939	Flood	--	Keswick	Keswick	Keswick	Keswick	--	NCP	--	--	--	Keswick	2,084
1940	--	--	Keswick	Keswick	Flood	Flood	Keswick	Keswick	NCP	--	NCP	NCP	2,534
1941	Keswick	--	Flood	Flood	Flood	Flood	Flood	Flood	Keswick	Flood	Flood	Flood	3,400
1942	Flood	--	Flood	Flood	Flood	Keswick	Keswick	Flood	Keswick	--	NCP	Flood	3,400
1943	Flood	Flood	Flood	Flood	Flood	Flood	Keswick	Keswick	NCP	--	NCP	--	3,053
1944	--	NCP	Keswick	Keswick	Keswick	Keswick	NCP	Keswick	--	--	NCP	--	2,583
1945	--	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	NCP	--	NCP	NCP	2,924
1946	--	Keswick	Flood	Flood	--	Keswick	NCP	NCP	NCP	--	NCP	--	2,827
1947	--	--	Keswick	NCP	Keswick	Keswick	Keswick	NCP	--	--	--	NCP	2,246
1948	--	Keswick	Keswick	Keswick	--	Keswick	Keswick	Keswick	Keswick	NCP	NCP	--	3,240
1949	--	--	Keswick	Keswick	Keswick	Flood	Keswick	Keswick	NCP	--	--	Keswick	2,830
1950	--	--	Keswick	Keswick	Keswick	Keswick	Keswick	NCP	NCP	NCP	NCP	NCP	2,500
1951	Keswick	Keswick	Flood	Flood	Flood	Keswick	NCP	Keswick	NCP	--	NCP	--	2,763
1952	--	Keswick	Flood	Flood	Flood	Flood	Flood	Flood	Keswick	--	Flood	Flood	3,400
1953	Flood	--	Flood	Flood	Keswick	Keswick	Keswick	Flood	Flood	--	Flood	Flood	3,400
1954	Flood	Flood	--	Flood	Flood	Flood	Flood	--	NCP	--	--	--	3,003
1955	--	--	Keswick	Keswick	--	Keswick	--	Keswick	--	--	--	--	2,544
1956	Keswick	Keswick	Flood	Flood	Flood	Flood	Keswick	Flood	NCP	NCP	NCP	Flood	3,400
1957	Flood	--	--	Keswick	Flood	Flood	--	Keswick	--	--	--	--	3,026
1958	Keswick	--	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	3,400
1959	Flood	--	--	Flood	Flood	--	NCP	NCP	--	--	--	--	2,274
1960	--	--	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	NCP	--	--	NCP	2,463
1961	--	Keswick	Keswick	Keswick	Flood	Flood	--	Keswick	--	--	--	--	2,584
1962	--	--	Keswick	--	Flood	Keswick	Keswick	NCP	NCP	--	NCP	--	2,716
1963	Keswick	--	Flood	Keswick	Flood	--	Flood	Keswick	NCP	--	NCP	Keswick	3,316
1964	Flood	Flood	--	Keswick	--	Keswick	NCP	NCP	NCP	--	--	--	2,544
1965	--	Keswick	Flood	Flood	Keswick	--	Flood	--	NCP	--	--	--	2,999
1966	Keswick	Flood	Flood	Flood	Flood	Flood	Flood	NCP	--	--	--	--	2,661
1967	--	--	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	3,400
1968	Flood	--	Keswick	Keswick	Flood	Flood	--	Keswick	--	--	--	--	2,581
1969	Keswick	--	Keswick	Flood	Flood	Flood	Flood	Flood	NCP	--	NCP	Flood	3,400
1970	Flood	--	Flood	Flood	Flood	Keswick	--	NCP	NCP	--	--	--	2,485
1971	--	Keswick	Flood	Flood	--	Flood	Keswick	Flood	NCP	--	NCP	Flood	3,400
1972	Flood	--	Keswick	Flood	Flood	Flood	NCP	NCP	--	--	--	Keswick	2,744
1973	Keswick	Keswick	Keswick	Flood	Flood	Flood	Keswick	Keswick	NCP	--	NCP	--	2,879
1974	--	Flood	Flood	Flood	Flood	Flood	Flood	Keswick	NCP	Keswick	Flood	Flood	3,400
1975	Flood	--	Keswick	Keswick	Flood	Flood	Keswick	Flood	NCP	NCP	Flood	Flood	3,400
1976	Flood	--	Keswick	Keswick	Keswick	Keswick	NCP	NCP	--	--	Keswick	Keswick	2,771
1977	--	Keswick	NCP	Keswick	--	--	--	NCP	--	--	--	--	712
1978	--	--	Keswick	--	Flood	Flood	Flood	Flood	NCP	--	NCP	Keswick	3,158
1979	--	--	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	--	--	Keswick	--	2,641
1980	--	Keswick	Keswick	Flood	Flood	Keswick	Keswick	Keswick	NCP	--	NCP	Keswick	2,879
1981	Keswick	NCP	Keswick	Keswick	Keswick	Keswick	Keswick	NCP	--	--	--	--	2,394
1982	--	Flood	Flood	Flood	Flood	Flood	Flood	Keswick	Keswick	Keswick	Keswick	Keswick	3,377
1983	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	3,400
1984	Flood	Flood	Flood	Flood	Flood	Flood	--	NCP	NCP	--	--	Keswick	3,040
1985	--	Flood	Flood	Keswick	Keswick	Keswick	Keswick	NCP	--	--	--	Keswick	2,403
1986	--	Keswick	Keswick	Keswick	Flood	Flood	Keswick	NCP	NCP	--	NCP	Keswick	2,752
1987	Keswick	NCP	Keswick	Keswick	Keswick	Keswick	--	--	--	--	--	--	2,231
1988	--	NCP	Keswick	Keswick	--	--	NCP	Keswick	--	--	--	NCP	1,710
1989	--	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	--	NCP	--	--	Keswick	2,291
1990	Keswick	--	Keswick	Keswick	--	Keswick	NCP	Keswick	--	--	--	--	1,738
1991	--	--	Keswick	Keswick	--	Keswick	Keswick	NCP	NCP	NCP	--	NCP	1,210
1992	--	--	Keswick	Keswick	Keswick	Keswick	Keswick	--	--	--	--	--	779
1993	--	--	Keswick	Keswick	Keswick	Keswick	Keswick	Keswick	Flood	--	Keswick	Keswick	3,400
1994	--	--	Keswick	Keswick	Keswick	--	NCP	NCP	--	--	--	--	1,606

Table II.5.1 shows the factors controlling Shasta releases. In the May 1928 to October 1934 dry period, there are 31 months when Keswick (Fish releases or temperature flows) controls, 27 months when NCP (Navigational Control Point) controls, 0 months when T. Min (Minimum Tracy Pumping) controls, and 0 months when flood control release controls. The "—" symbol indicates a condition when the project is controlling.

Figure II.5.2
Sacramento River Flow Below Keswick Dam

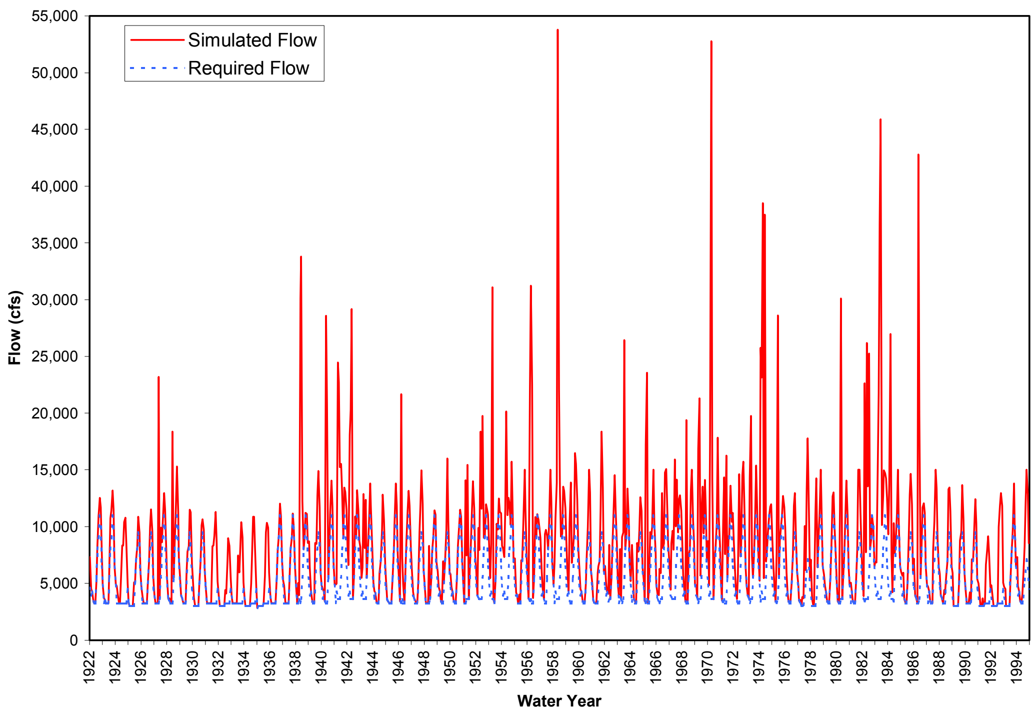

Figure II.5.2 shows the simulated and minimum instream required flows in the Sacramento River below Keswick Dam. The minimum required flows (Fish releases and temperature control flows) tend to control the releases from Keswick Dam in the dry years.

II.6. American River

Figure II.6.1
Folsom Lake Storage

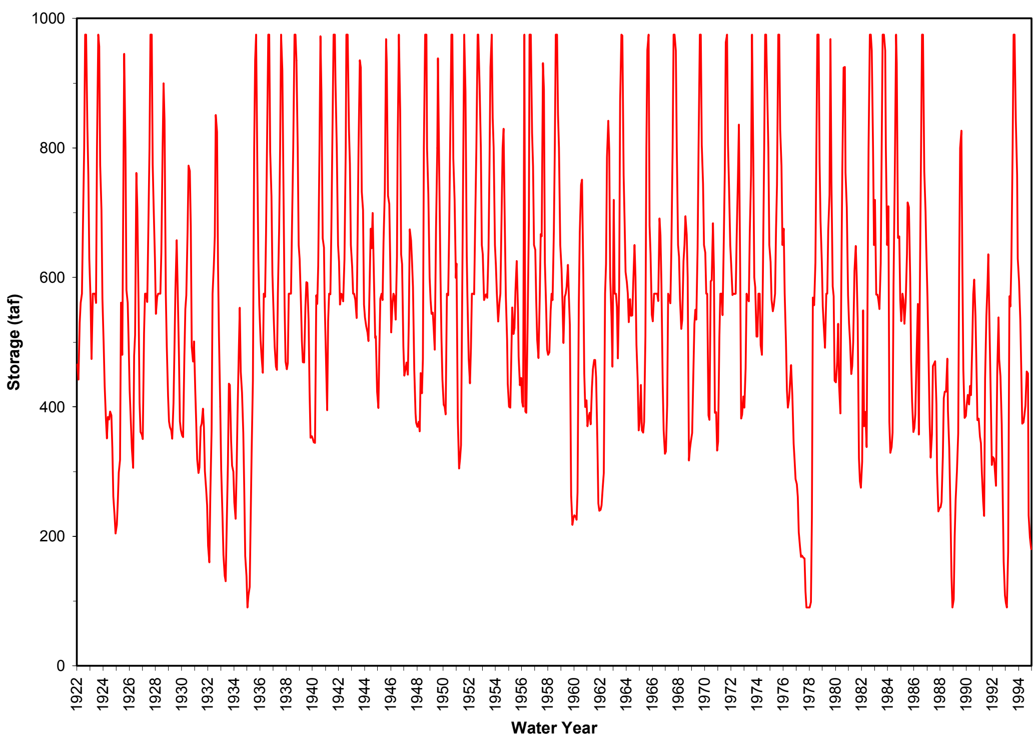

Figure II.6.1 shows Folsom Lake storage. In most months in dry years, Folsom Lake release is controlled by the fish release flows at Nimbus.

Table II.6.1
Folsom Lake Release Control

WYEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Carryover Storage, taf
1922	--	Nimbus	Nimbus	Nimbus	Flood	Flood	Flood	Flood	Flood	--	Nimbus	--	629
1923	--	--	Flood	Flood	Flood	Nimbus	Flood	Flood	Nimbus	--	Nimbus	--	567
1924	--	Nimbus	Nimbus	Nimbus	Nimbus	--	Nimbus	Nimbus	Nimbus	Nimbus	--	Nimbus	204
1925	Nimbus	Nimbus	Nimbus	Nimbus	Flood	--	Nimbus	Nimbus	--	--	Nimbus	Nimbus	497
1926	--	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	--	--	--	Nimbus	357
1927	--	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	Flood	--	Nimbus	--	629
1928	--	Nimbus	Flood	Flood	Flood	Flood	Flood	--	--	--	--	Nimbus	417
1929	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	--	--	--	--	364
1930	--	Nimbus	Nimbus	Nimbus	Flood	Flood	Nimbus	Nimbus	--	--	--	Nimbus	501
1931	--	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	--	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	248
1932	--	Nimbus	Nimbus	Nimbus	Flood	Nimbus	Nimbus	Nimbus	--	--	--	--	400
1933	--	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	--	--	--	--	300
1934	--	--	Nimbus	Nimbus	Nimbus	Nimbus	--	--	--	Nimbus	--	--	138
1935	--	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Flood	--	Flood	--	--	--	557
1936	--	Nimbus	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	--	--	--	604
1937	--	Nimbus	Nimbus	Nimbus	Flood	Flood	Flood	Flood	Nimbus	--	--	--	470
1938	Nimbus	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	Flood	--	Flood	Flood	650
1939	Nimbus	--	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	--	--	--	--	Nimbus	355
1940	--	--	Nimbus	Flood	Flood	Flood	Flood	Nimbus	--	--	--	--	567
1941	--	--	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	Nimbus	Flood	Flood	650
1942	Nimbus	--	Flood	Flood	Flood	Nimbus	Flood	Flood	Flood	--	Nimbus	Flood	650
1943	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	Nimbus	Nimbus	--	Nimbus	--	558
1944	--	Nimbus	Nimbus	Nimbus	Flood	Flood	Nimbus	Nimbus	--	--	Nimbus	--	424
1945	Nimbus	Nimbus	Nimbus	Flood	Flood	Nimbus	Nimbus	Nimbus	--	--	--	--	624
1946	--	Nimbus	Flood	Flood	--	Nimbus	Nimbus	Flood	--	--	--	--	493
1947	--	--	Nimbus	Nimbus	Nimbus	Flood	Nimbus	Nimbus	Nimbus	--	--	--	376
1948	--	Nimbus	Nimbus	Nimbus	--	Nimbus	Flood	Flood	Flood	--	--	--	600
1949	Nimbus	--	Nimbus	Nimbus	--	Flood	Flood	Nimbus	--	--	--	Nimbus	442
1950	Nimbus	Nimbus	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	--	Nimbus	--	599
1951	Nimbus	Flood	Flood	Flood	Flood	Flood	Nimbus	Flood	Nimbus	--	Nimbus	--	475
1952	--	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	Flood	--	Flood	Flood	650
1953	Nimbus	--	Nimbus	Flood	Flood	Nimbus	Nimbus	Nimbus	Flood	--	Flood	Flood	650
1954	Nimbus	Flood	Nimbus	Nimbus	Flood	Flood	Flood	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	436
1955	Nimbus	Nimbus	Nimbus	Nimbus	--	Nimbus	Nimbus	Nimbus	Nimbus	--	--	Nimbus	445
1956	Nimbus	Nimbus	--	Flood	Flood	Nimbus	Nimbus	Flood	Flood	--	Nimbus	Flood	650
1957	Nimbus	--	Nimbus	Nimbus	Flood	Flood	Nimbus	Nimbus	--	--	--	Nimbus	488
1958	Nimbus	Nimbus	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	--	Flood	Flood	650
1959	Nimbus	--	Nimbus	Nimbus	Flood	Nimbus	Nimbus	Nimbus	Nimbus	--	Nimbus	Nimbus	228
1960	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Flood	--	Nimbus	--	--	--	--	410
1961	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	240
1962	Nimbus	Nimbus	Nimbus	Nimbus	Flood	Nimbus	Nimbus	Nimbus	Nimbus	--	--	--	462
1963	Flood	Flood	Flood	Flood	Flood	Nimbus	--	Flood	Nimbus	--	Nimbus	--	608
1964	Nimbus	Flood	Nimbus	Nimbus	--	Nimbus	Nimbus	Nimbus	--	--	--	Nimbus	364
1965	Nimbus	Nimbus	Flood	Flood	Flood	Nimbus	Flood	--	Flood	--	Nimbus	--	543
1966	Nimbus	Flood	Flood	Flood	Flood	Nimbus	Nimbus	Nimbus	Nimbus	--	Nimbus	Nimbus	328
1967	Nimbus	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	650
1968	Nimbus	--	Nimbus	Nimbus	--	Flood	Nimbus	Nimbus	--	--	Nimbus	Nimbus	347
1969	Nimbus	--	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	--	Nimbus	Flood	650
1970	Nimbus	Flood	Flood	Flood	Flood	Flood	Nimbus	Nimbus	Nimbus	--	Nimbus	Nimbus	332
1971	Nimbus	Nimbus	Flood	Flood	--	Flood	Nimbus	Nimbus	Flood	--	Nimbus	Flood	650
1972	Nimbus	--	Flood	Nimbus	Flood	Flood	Nimbus	Nimbus	--	--	--	Nimbus	416
1973	Nimbus	Nimbus	Flood	Flood	Flood	Flood	Nimbus	Flood	--	--	--	--	508
1974	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	--	Flood	Flood	650
1975	Nimbus	--	Nimbus	Nimbus	Flood	Flood	Nimbus	Flood	Flood	--	Nimbus	Flood	650
1976	Nimbus	Flood	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	288
1977	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	H St.	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	90
1978	Nimbus	Nimbus	H St.	Flood	Flood	Flood	Flood	Flood	Flood	--	Nimbus	Nimbus	623
1979	--	--	Nimbus	Flood	Flood	Flood	Nimbus	Nimbus	--	--	--	--	440
1980	--	Nimbus	Nimbus	Flood	Flood	Flood	Nimbus	Nimbus	Nimbus	--	Nimbus	--	572
1981	--	--	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	--	Nimbus	Nimbus	275
1982	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	650
1983	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	Flood	650
1984	Nimbus	Flood	Flood	Flood	Flood	Flood	--	Flood	Nimbus	--	Nimbus	--	565
1985	--	Flood	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	--	--	--	Nimbus	361
1986	Nimbus	--	Nimbus	Flood	Flood	Flood	Flood	Flood	Flood	--	Nimbus	Flood	650
1987	--	--	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	244
1988	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	90
1989	H St.	Nimbus	Nimbus	Nimbus	Nimbus	Flood	Flood	--	--	--	--	--	386
1990	--	--	Nimbus	Nimbus	--	Nimbus	--	Nimbus	--	--	--	--	382
1991	--	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	--	--	Nimbus	310
1992	Nimbus	--	Nimbus	Nimbus	Nimbus	Nimbus	--	--	Nimbus	Nimbus	--	Nimbus	109
1993	Nimbus	H St.	H St.	Flood	Flood	Flood	Flood	Flood	Flood	--	Nimbus	--	629
1994	--	--	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	Nimbus	--	Nimbus	Nimbus	180

Table II.6.1 shows the factors controlling Folsom Lake release. In the May 1928 to October 1934 dry period, there are 43 months when Nimbus minimum required flow controls, 3 months when flood control release control, 0 months when T. Min (Minimum Pumping at Tracy) controls, and 0 months when H St. (Minimum flow requirement at H Street) controls. The "—" symbol indicates a condition when the project is controlling.

Figure II.6.2
American River Flow at Nimbus Dam

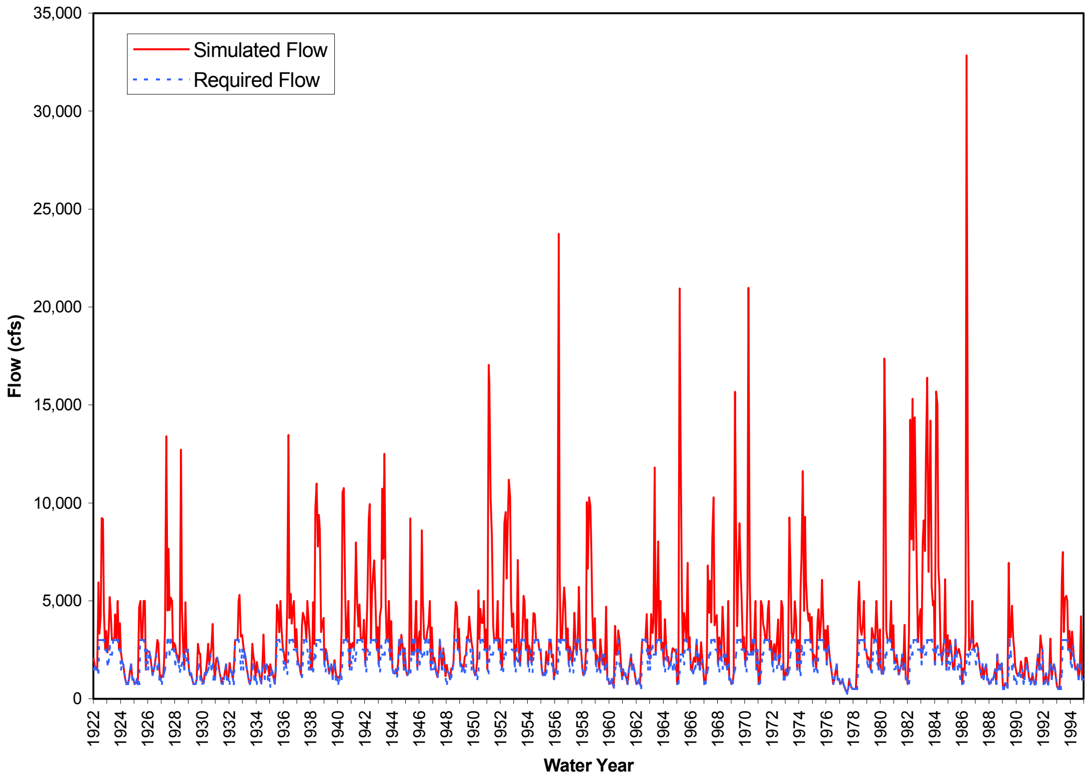

Figure II.6.2 shows the simulated and minimum instream required flows in the American River below Nimbus Dam. The minimum instream flows at Nimbus tend to control Folsom reservoir operations in some months of most years.

Figure II.6.3
American River Flow at H St

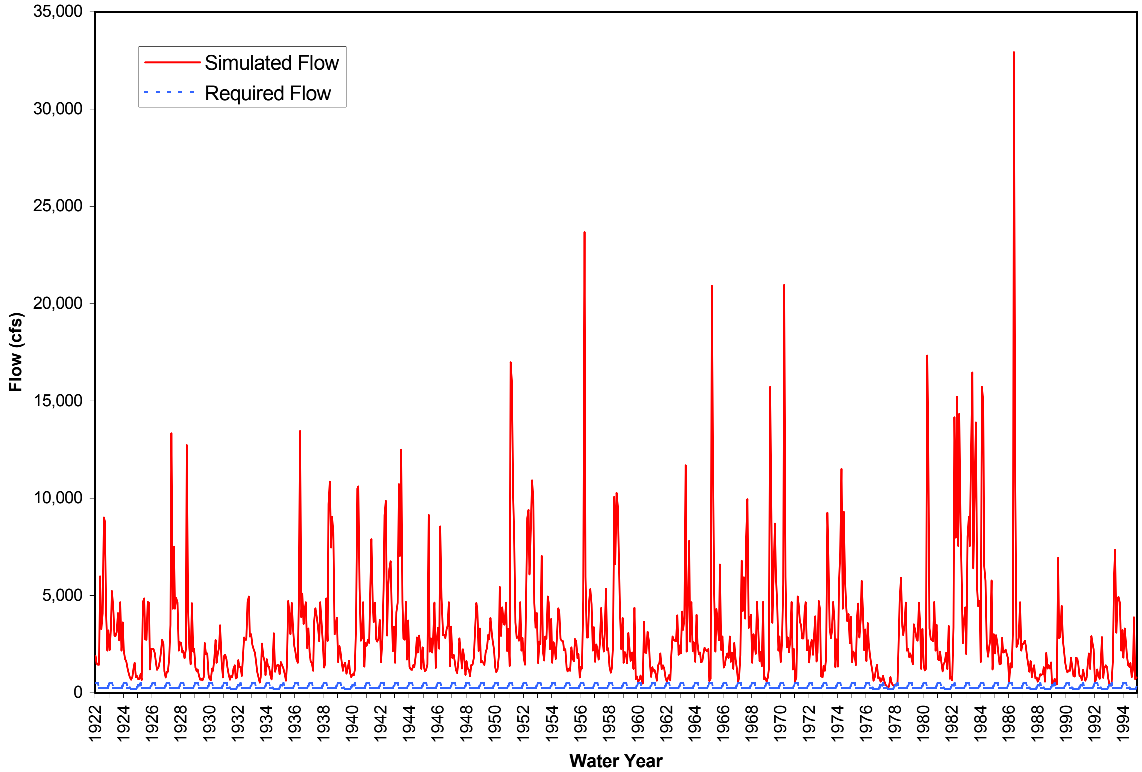

Figure II.6.3 shows the simulated and minimum instream required flows in the American River at H Street. The minimum instream flows at Nimbus tend to control Folsom reservoir operations in some months of most years.

II.7. Feather River

Figure II.7.1
Lake Oroville Storage

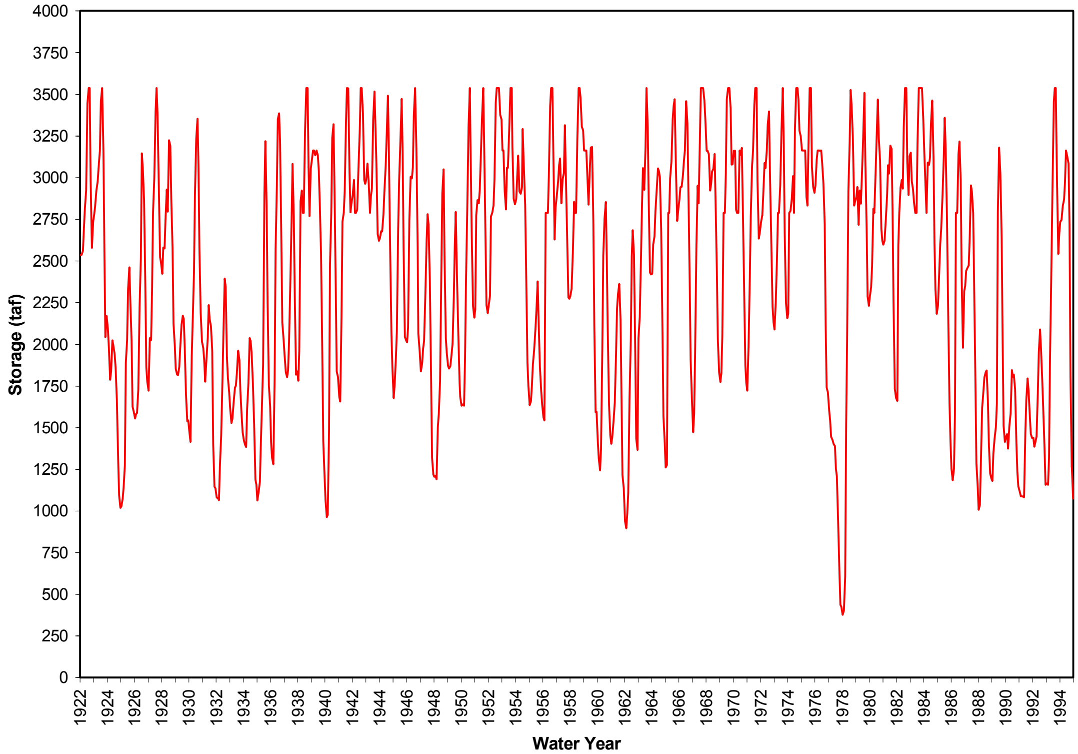

Figure II.7.1 shows Lake Oroville storage. The lowest storage value is 378 taf.

Figure II.7.2
Feather River Flow Below Thermalito

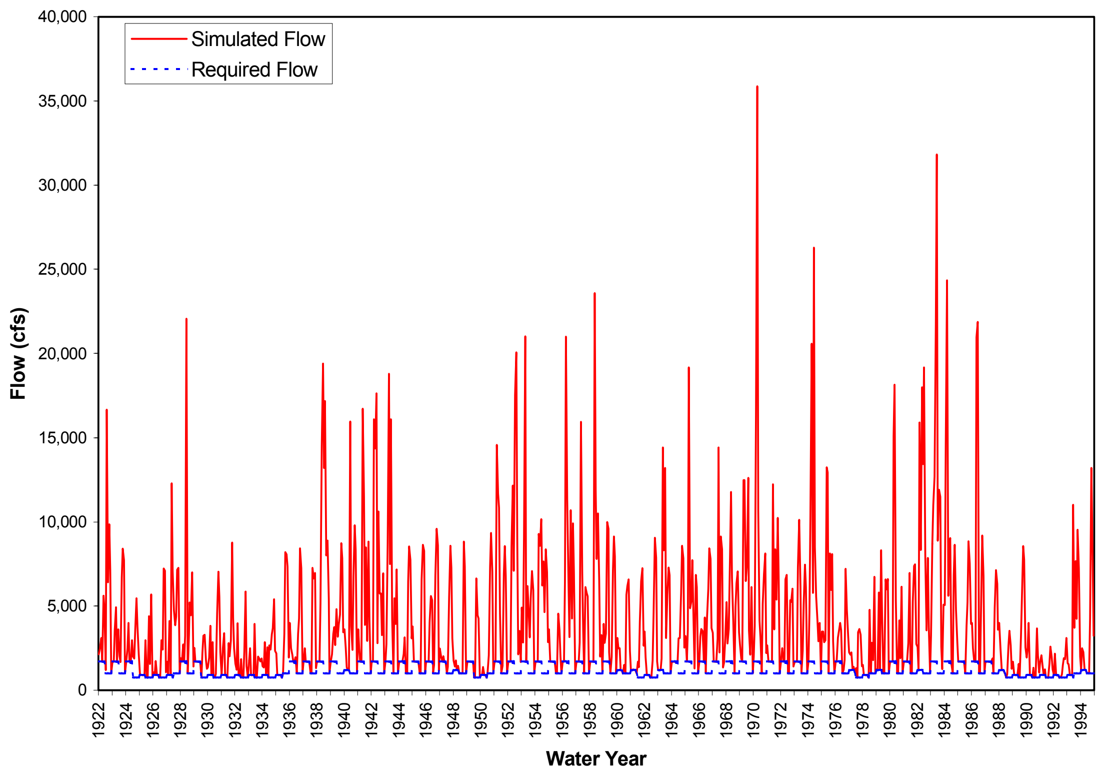

Figure II.7.2 shows simulated and minimum instream required flows in the Feather River below Thermalito Diversion Dam. The simulated flows are almost always higher than the minimum required flows. The river's minimum instream flow does not control Oroville reservoir operations in most years.

II.8. Stanislaus/San Joaquin Rivers

Figure II.8.1
New Melones Reservoir Storage

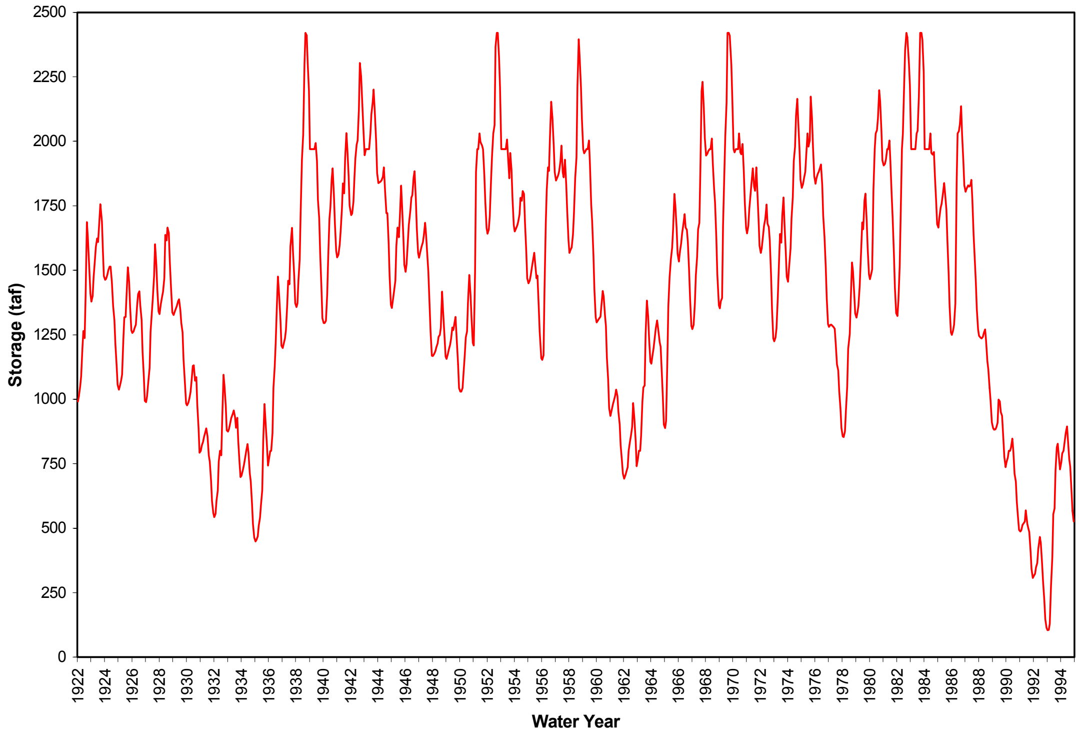

Figure II.8.1 shows New Melones Reservoir storage.

Figure II.8.2
Stanislaus River Flow Below Goodwin Dam

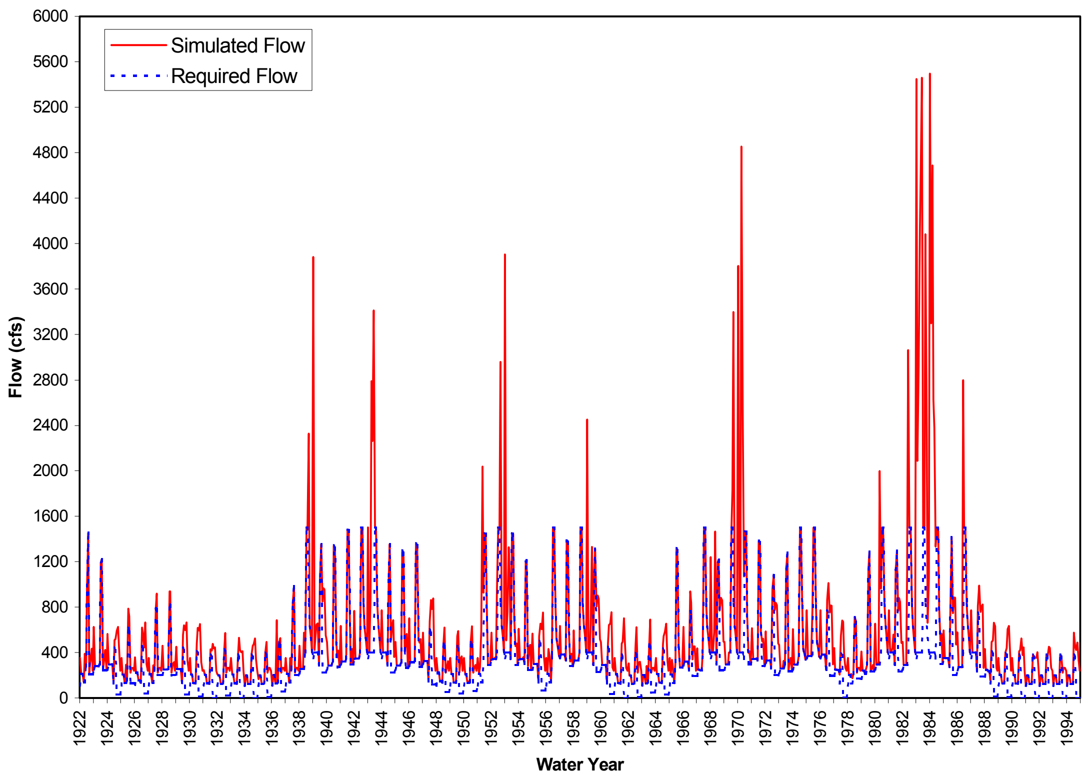

Figure II.8.2 shows the simulated and minimum instream required flows in the Stanislaus River at Goodwin. The minimum instream flows tend to control New Melones releases at Goodwin Dam in some months of most years.

Figure II.8.3
San Joaquin River simulated flow at Vernalis

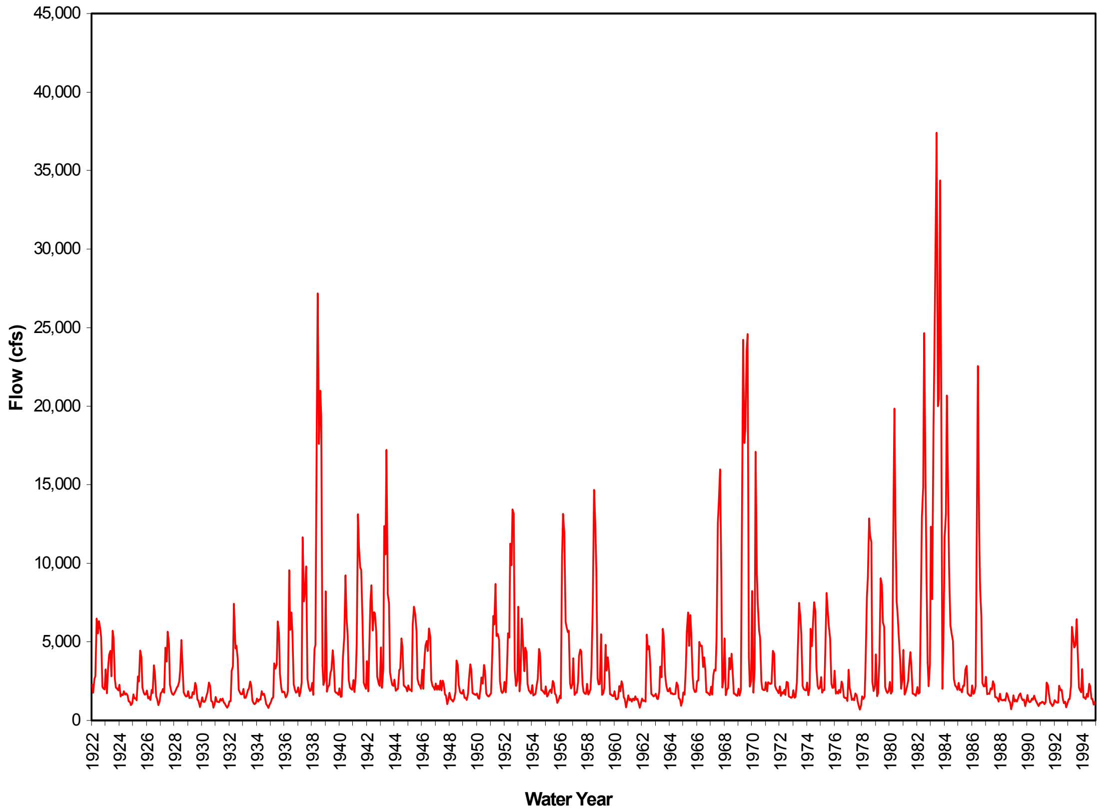

Figure II.8.3 shows the simulated San Joaquin River flow at Vernalis.

II.9. Delta

Figure II.9.1
Total Required Delta Outflow

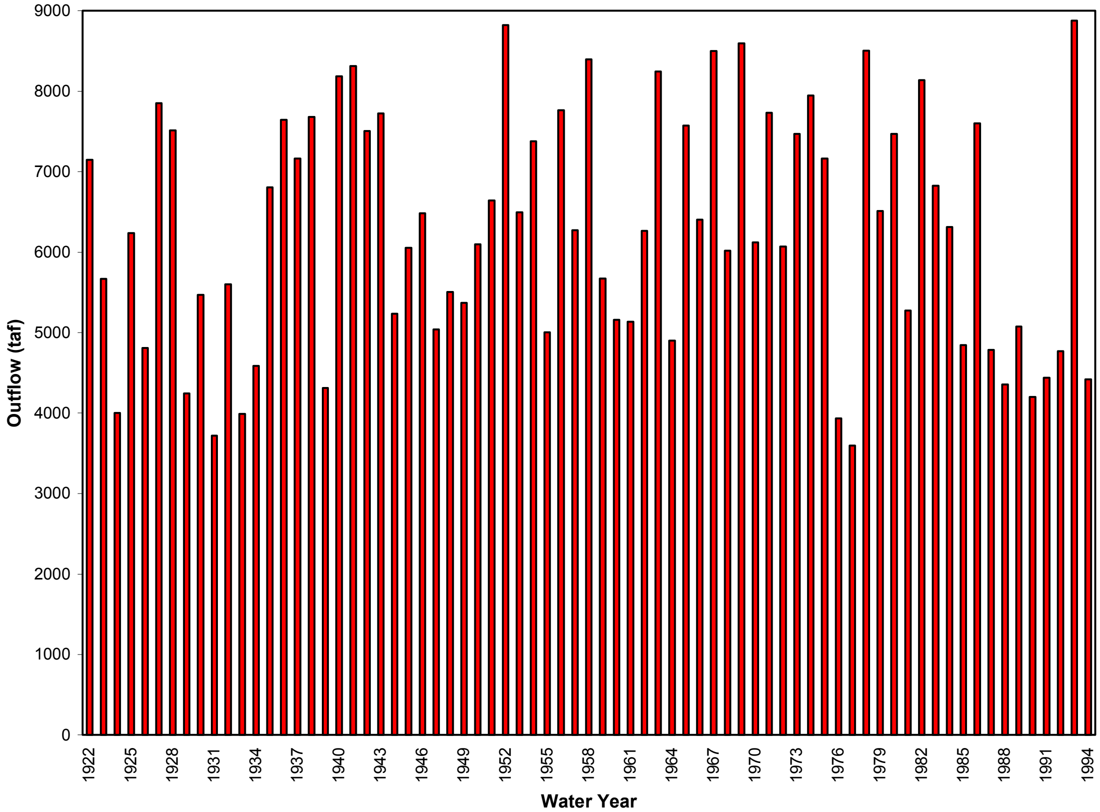

Figure II.9.1 shows the total annual required Delta outflow. The total required outflow is the flow needed to meet X2 and minimum outflow requirements. The average annual total required Delta outflow is 6270 taf.

Figure II.9.2
Total Delta Outflow

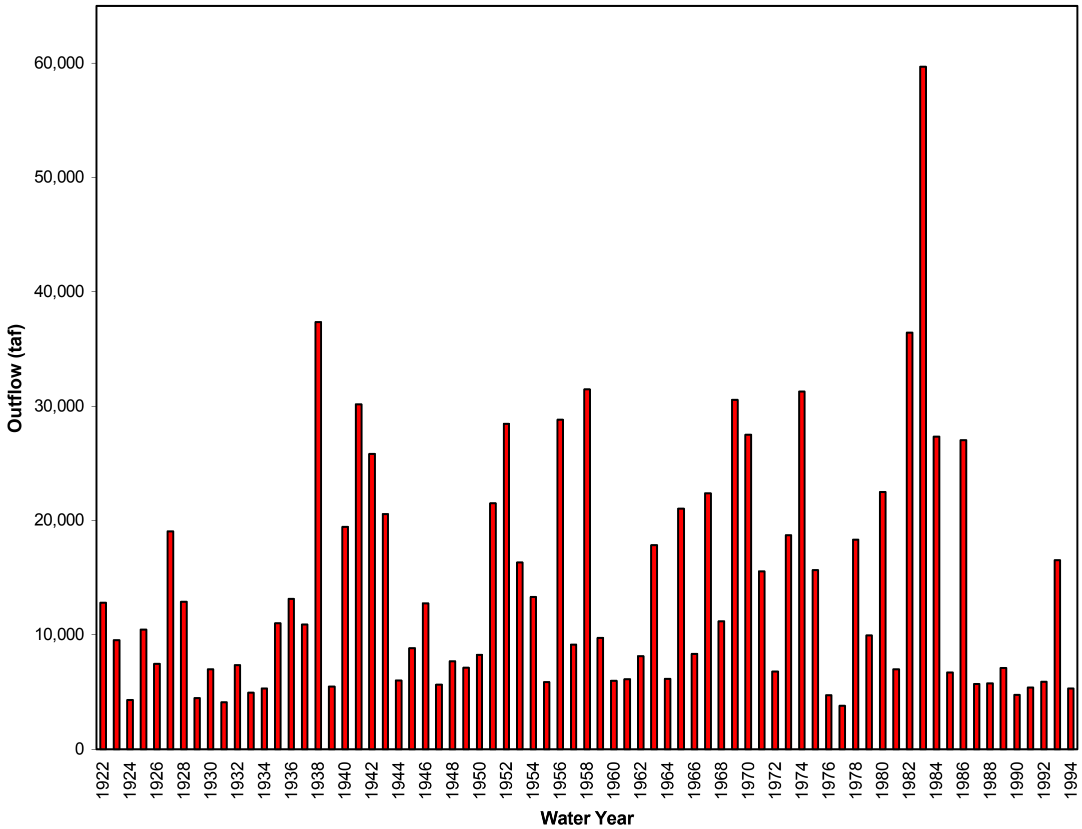

Figure II.9.2 shows annual total Delta outflow. The average annual total Delta outflow is 14215 taf.

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Figure II.9.3
X2 Position

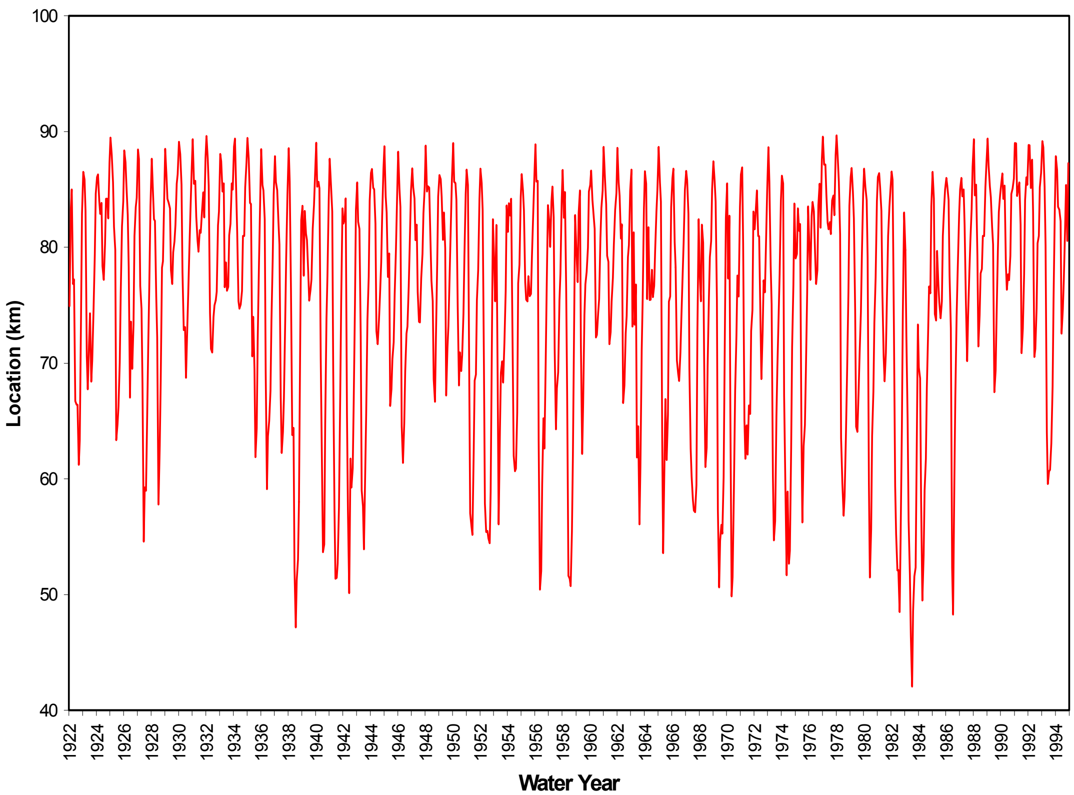

Figure II.9.3 shows the monthly resulting X2 position. The X2 position ranges from 42 km to 90 km.

Figure II.9.4
Average Monthly QWEST Flows

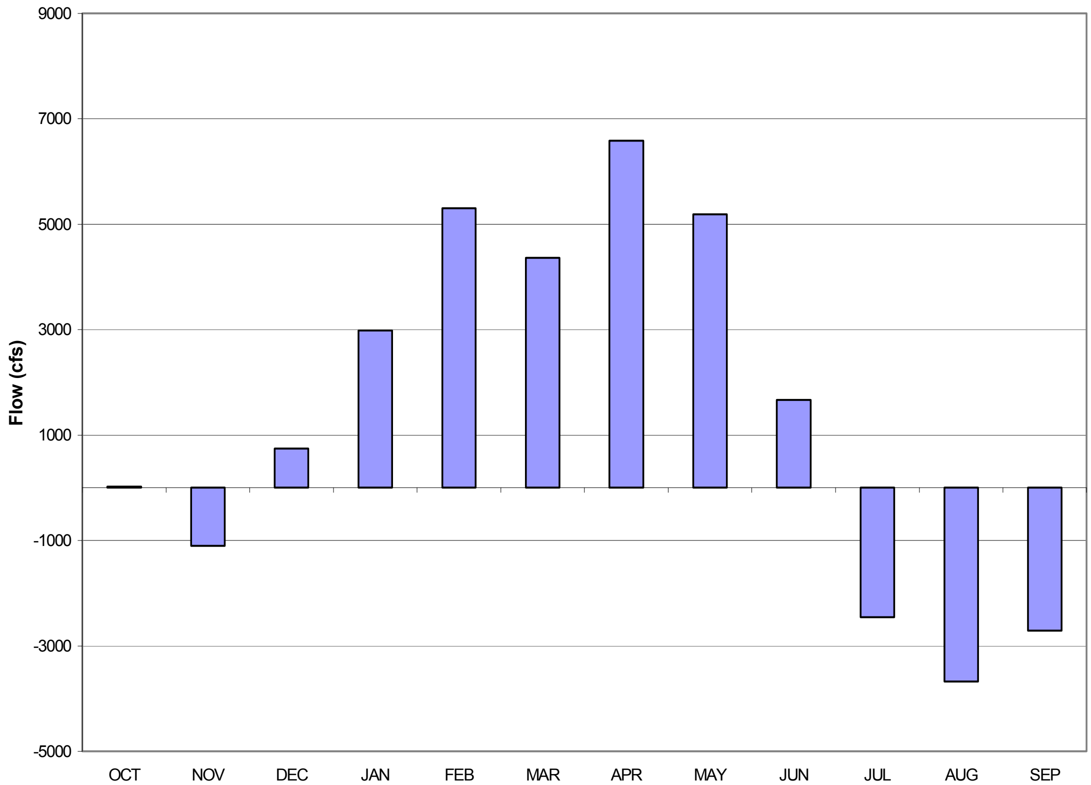

Figure II.9.4 shows the average monthly QWEST flows.

II.10. South-of-Delta

Figure II.10.1
SWP San Luis Reservoir Storage

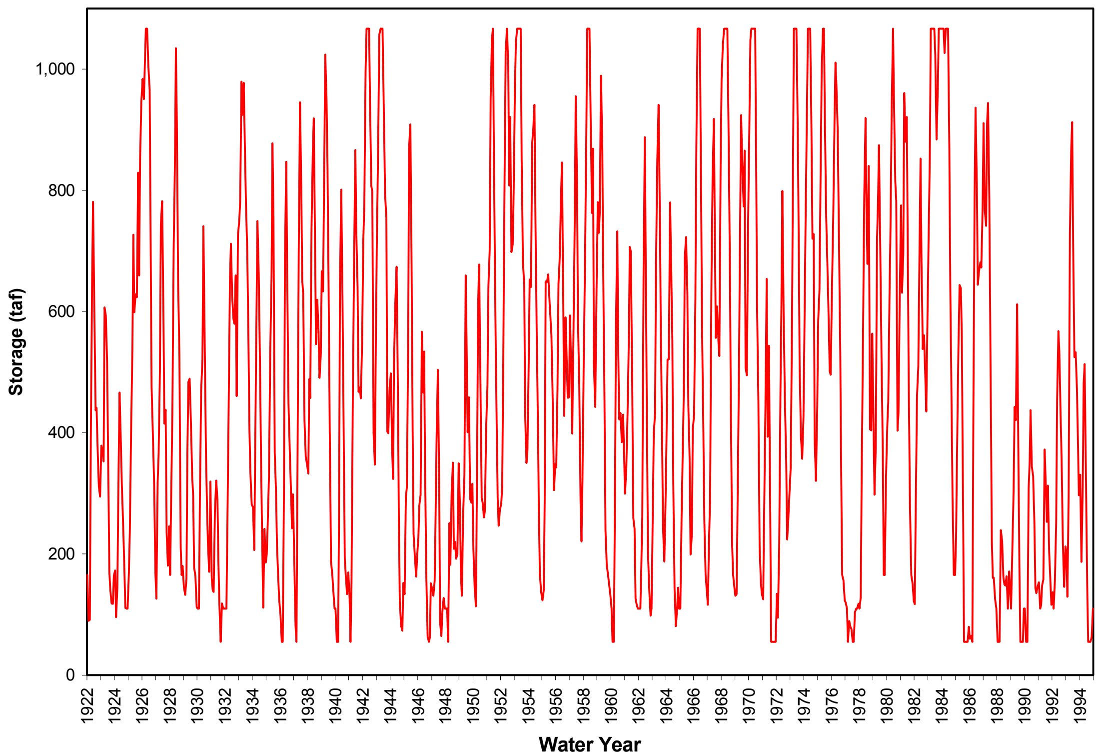

Figure II.10.1 shows SWP San Luis reservoir storage. The low points shown do not include EWA's storage debt owed to the SWP. The September end-of-month storage in SWP San Luis includes EWA debt payback.

Figure II.10.2
CVP San Luis Reservoir Storage

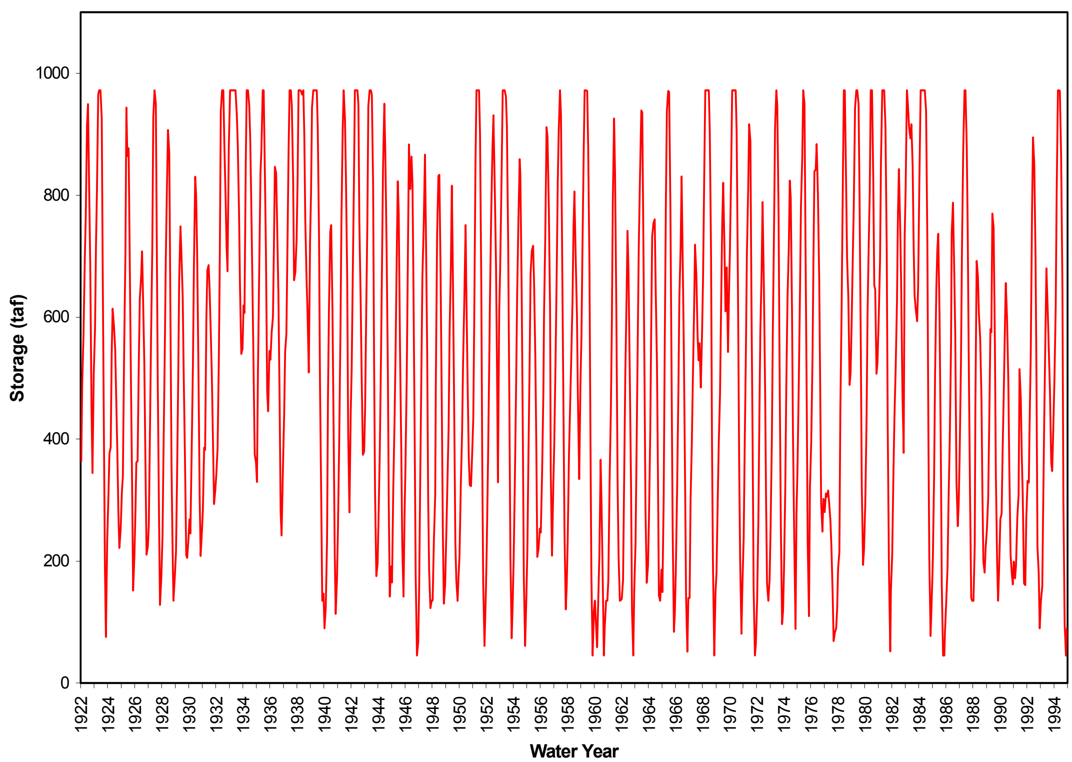

Figure II.10.2 shows CVP San Luis reservoir storage. The low points shown do not include EWA's storage debt owed to the projects. The September end-of-month storage in CVP San Luis Reservoir includes EWA debt payback.