Chapter 2

VAMP Hydrologic Planning & Implementation

This section documents the planning and implementation undertaken by the Hydrology Group of the San Joaquin River Technical Committee (SJRTC) for the 2005 VAMP investigations. Implementation of VAMP is guided by the framework provided in the San Joaquin River Agreement (SJRA) and anticipated hydrologic conditions within the watershed.

The Hydrology Group was established for the purpose of forecasting hydrologic conditions and for planning, coordinating, scheduling and implementing the flows required to meet the test flow target in the San Joaquin River near Vernalis. The Hydrology Group is also charged with exchanging information relevant to the forecasted flows, and coordinating with others in the SJRTC, in particular the Biology Group, responsible for planning and implementing the salmon smolt survival study.

Participation in the Hydrology Group is open to all interested parties, with the core membership consisting of the designees of the agencies responsible for the water project operations that would be contributing flow to meet the target flow. In 2005, the agencies belonging to the Hydrology Group included: Merced Irrigation District (Merced), Turlock Irrigation District (TID), Modesto Irrigation District (MID), Oakdale Irrigation District (OID), South San Joaquin Irrigation District (SSJID), San Joaquin River Exchange Contractors (SJRECWA), and the U.S. Bureau of Reclamation (USBR). Though not a water provider, the California Department of Water Resources (DWR) was closely involved with the coordination of operations relating to the installation of the HORB and the planning of Delta exports consistent with the VAMP.

2005 VAMP SUMMARY

Generally wet conditions in the San Joaquin River basin and tributary basins resulted in relatively high flow conditions entering the Spring of 2005. Due to these high flows DWR was unable to install the temporary Head of Old River Barrier (HORB). Additionally, the flow in the San Joaquin River at Vernalis exceeded the maximum VAMP target flow of 7,000 cfs during the VAMP pulse flow period, therefore no supplemental water was provided by the SJRGA agencies.

The planning and implementation process for the VAMP operation remained nearly unchanged from those of prior VAMP years and that outlined in the SJRA. Daily operation plans were updated on a frequent basis to keep the SJRTC informed of changed conditions. Operation conference calls were not conducted during the 2005 VAMP but contact was maintained with the operating entities to track reservoir releases. The Technical Committee placed an added emphasis on analyzing the flow and fish movement into Old River absent the HORB. Monitoring of real-time flow data was maintained throughout the planning and implementation phases.

VAMP BACKGROUND AND DESCRIPTION

This section provides information on the background and description of the water operations and factors to be considered when planning for the VAMP each year. Even with the high flow conditions during 2005 these factors continued to be considered in the planning process and implementation.

Table 2-1
VAMP Vernalis Flow and Delta Export Targets

Forecasted Existing Flow (cfs)	VAMP Target Flow (cfs)	Delta Export Target Rates (cfs)
0 to 1,999	2,000	
2,000 to 3,199	3,200	1,500
3,200 to 4,449	4,450	1,500
4,450 to 5,699	5,700	2,250
5,700 to 7,000	7,000	1,500 or 3,000
Greater than 7,000	Provide stable flow to extent possible	

The VAMP provides for a 31-day pulse flow (target flow) at the Vernalis gage on the San Joaquin River (see Figure 2-1, inside front cover) during the months of April and May, along with a corresponding reduction in State Water Project (SWP) and Central Valley Project (CVP) Sacramento-San Joaquin Delta exports. The VAMP target flow and reduced Delta export are determined based on a forecast of the San Joaquin River flow that would occur during the pulse flow period absent the VAMP (Existing Flow) as shown in Table 2-1. The Existing Flow is defined in the SJRA as "the forecasted flows in the San Joaquin River at Vernalis during the Pulse Flow Period that would exist absent the VAMP or water acquisitions," including such flows as minimum in-stream flows, water quality or scheduled fishery releases from New Melones Reservoir, flood control releases, uncontrolled reservoir spills, and/or local runoff. Achieving the target flow requires the coordinated operation of the three major San Joaquin River tributaries upstream of Vernalis: the Merced River, the Tuolumne River and the Stanislaus River.

As part of the development of the VAMP experimental design, the VAMP Hydrology and Biology Groups jointly identified a level of variation in San Joaquin River flow and SWP/CVP export rate thought to be within an acceptable range for specific VAMP test conditions. In developing the criteria, the VAMP Hydrology and Biology Groups examined both the ability to effectively monitor and manage flows and exports within various ranges (e.g., the ability to accurately manage and regulate export rates is substantially greater than the ability to manage San Joaquin River flows) and the flow and export differences among VAMP targets (Table 2-1). Through these discussions, the technical committees agreed that SWP/CVP export rates would be managed to a level of plus or minus 2.5% of a given export rate target. Furthermore, the technical committees agreed that, to the extent possible, it would be desirable that exports be allocated approximately evenly between SWP and CVP diversion facilities.

The ability to manage and regulate the San Joaquin River flow near Vernalis is difficult due to uncertainty and variation in unregulated flows, inaccuracy in real-time flows due to changing channel conditions, lags and delays in transit time, and a variety of other factors. Concern was expressed that variation in San Joaquin River flow on the order of plus or minus 10% would potentially result in overlapping flow conditions between two VAMP targets. To minimize the probability of overlapping flow conditions among VAMP targets, the technical committees explored an operational guideline of plus or minus 5% flow variation at the Vernalis gage; however, system operators expressed concern about the ability to maintain flows within this range. As a result of these discussions and analysis, the Hydrology and Biology Groups agreed to a target range variation of plus or minus 7% of the Vernalis flow target. It was recognized by the Hydrology and Biology Groups that these guidelines are not absolute conditions, but are to be used by the VAMP Hydrology and Biology workgroups to evaluate experimental test conditions and the potential effect of flow and export variation on our ability to detect and assess variation in juvenile Chinook salmon survival rates among VAMP test conditions.

Under the SJRA, the following San Joaquin River Group Authority (SJRGA) agencies have agreed to provide the supplemental water needed to achieve the VAMP target flows, limited to a maximum of 110,000 acre-feet: Merced, OID, SSJID, SJRECWA, MID and TID. The Merced supplemental water would be provided on the Merced River from storage in Lake McClure and would be measured at the Cressey gage on the Merced River. The OID and SSJID supplemental water would be provided on the Stanislaus River through diversion reductions and would be measured below Goodwin Dam. The SJRECWA supplemental water would be provided via Salt Slough, West Delta Drain, Boundary Drain and/or Orestimba Creek. The MID and TID supplemental water would be provided on the Tuolumne River from storage in New Don Pedro Reservoir and would be measured at the Tuolumne River below LaGrange Dam gage.

The target flow of 2,000 cubic feet per second (cfs) shown in Table 2-1 does not represent a VAMP experiment target

flow data point, but, rather, is used to define the SJRGA supplemental water obligation limit when Existing Flow is less than 2,000 cfs. In preparation of the conceptual framework for the VAMP it was recognized that in extremely dry conditions the San Joaquin River flow and associated exports would be determined in accordance with the existing biological opinions under the Endangered Species Act and the 1994 Bay-Delta Accord. In consideration of these factors, when the Existing Flow is less than 2000 cfs, the target flow will be 2,000 cfs and the USBR, in accordance with the SJRA, shall act to purchase additional water from willing sellers to fulfill the requirements of existing biological opinions.

When the Existing Flow exceeds 7,000 cfs, as was the case in 2005, the Parties will exert their best efforts to maintain a stable flow during the VAMP pulse flow period to the extent reasonably permitted. Under such conditions the SJRTC shall attempt to develop a plan to carryout the studies pursuant to the SJRA.

Based upon hydrologic conditions, the target flow in a given year could either be increased to the next higher value (double-step) or the supplemental water requirement could be eliminated entirely (off-ramp). These potential adjustments to the target flow are dependent on the hydrologic year type as defined by the SWRCB San Joaquin Valley Water Year Hydrologic Classification (60-20-20 classification), which is given a numerical indicator as shown in Table 2-2 to make this determination. A double-step flow year occurs when the sum of the numerical indicators for the previous year's year type and current year's forecasted 90 percent exceedence year type is seven (7) or greater, a general recognition of either abundant reservoir storage levels or a high probability of abundant runoff. An off-ramp year occurs when the sum of the numerical indicators for the two previous years' year types and the current year's forecasted 90 percent exceedence year type is four (4) or less, an indication of extended drought conditions.

Table 2-2
San Joaquin Valley Water Year Hydrologic Year Classifications Used in VAMP

60-20-20 Water Year Classification	VAMP Numerical Indicator
Wet	5
Above Normal	4
Below Normal	3
Dry	2
Critical	1

Under the SJRA, the maximum amount of supplemental water to be provided to meet VAMP target flows in any given year is 110,000 acre-feet. In a double-step year, the quantity of supplemental water required may be as high as 157,000 acre-feet. In any year in which more than 110,000 acre-feet of supplemental water is needed, the USBR will attempt to acquire the needed additional water on a willing seller basis. In accordance with the SJRA, the SJRGA has agreed to extend a "favored purchaser" offer to the USBR through each current year's VAMP period.

HYDROLOGIC PLANNING FOR 2005 VAMP

Hydrology Group Meetings

Beginning in February 2005, and continuing until early April, the Hydrology Group held three planning and coordination meetings (February 16, March 23 and April 11). The March 23 and April 11 meetings were joint meetings of the Hydrology and Biology Groups. At these meetings, forecasts of hydrologic and operational conditions on the San Joaquin River and its tributaries were discussed and refined.

Monthly Operation Forecast

As part of the initial planning efforts in February, a monthly operation forecast was developed by the Hydrology Group to provide an initial estimate of the Existing Flow and VAMP Target Flow. Inflows to the tributary reservoirs used in these forecasts were based on DWR Bulletin 120 runoff forecasts. The monthly operation forecasts used the 90 percent and 50 percent probability of exceedence runoff forecasts to provide a range of estimates. The initial monthly operation forecast was presented at the February 16 Hydrology Group meeting. The 90 percent exceedence forecast was indicating a VAMP target flow of 4,450 cfs and the 50 percent exceedence forecast was indicating a VAMP target flow of 5,700 cfs.

Daily Operation Plan Development

Starting in mid-March, the Hydrology Group began development of a daily operation plan, updating it as hydrologic conditions and operational requirements changed. The purpose of the daily operation plan is to provide a forecast of the Existing Flow which sets the VAMP target flow and to coordinate the tributary operations needed to meet that target. It also provides a forecast of the daily flows expected during the HORB installation period. In years like 2005 where the Existing Flow exceeds the maximum VAMP target flow, the daily operation plan is used to determine to what extent a stable flow can be provided during the VAMP pulse flow period. The daily operation plan calculates an estimated mean daily flow at

Vernalis based on estimates of the daily flow at the major tributary control points, estimates of ungaged flow between those control points and Vernalis, and estimates of flow in the San Joaquin River above the major tributaries.

The following travel times for flows from the tributary measurement points and upper San Joaquin River to the Vernalis gage are used in the development of the daily operation plan. Whole day increments are used because the daily operation plan is developed using mean daily flows.

Flow Travel Times

a. Merced River at Cressey to Vernalis ..... 3 days

b. San Joaquin River above Merced River to Vernalis ..... 2 days

c. Tuolumne River below LaGrange Dam to Vernalis ..... 2 days

d. Stanislaus River below Goodwin Dam to Vernalis ..... 2 days

By definition, the ungaged flow at Vernalis is the unmeasured flow entering or leaving the system between the Vernalis gage and the upstream measuring points and is calculated as follows:

Ungaged flow at Vernalis =
$VNS - GDW_{lag} - LGN_{lag} - CRS_{lag} - USJR_{lag}$

Where:

VNS	=	San Joaquin River near Vernalis
GDW_{lag}	=	Stanislaus River below Goodwin Dam lagged 2 days
LGN_{lag}	=	Tuolumne River below LaGrange Dam lagged 2 days
CRS_{lag}	=	Merced River at Cressey lagged 3 days
$USJR_{lag}$	=	San Joaquin River above Merced River lagged 2 days (USJR is not a gaged flow but is the calculated difference between the gaged flows at the San Joaquin River at Newman (NEW) and the Merced River near Stevinson (MST)).

The forecast of the ungaged flow is the factor with the greatest uncertainty in the development of the daily operation plan. An extensive review of historical ungaged flows has been made to determine if there are any correlations between the ungaged flow and the current hydrologic conditions that could be used to reduce the uncertainty. Unfortunately, no significant correlations were found. However, the review did indicate that the amount of ungaged flow at the beginning of the VAMP pulse flow period is a reasonable estimate of the average ungaged flow for pulse flow period. It is impossible to forecast day-to-day fluctuations of the ungaged flow, so the daily operation plan is developed assuming a constant ungaged flow throughout the pulse flow period essentially equal to the value entering the pulse flow period.

The VAMP 31-day pulse flow period can occur anytime between April 1 and May 31. Factors that are considered in the determination of the timing of the VAMP pulse flow period include installation of HORB, availability of juvenile salmon at the MRFF, and manpower and equipment availability for salmon releases and recapture. Until a specific start date is defined, a default pulse flow period of April 15 to May 15 is used for the VAMP operation planning.

As part of the daily operation plan development, the determination must be made on whether the current year is likely to fall into the "off-ramp" or "double-step" category. As noted earlier, an "off-ramp" condition would occur when the sum of VAMP numerical indicators for the previous two years and the current year is equal to or less than four. The 60-20-20 water year classifications for 2003 and 2004 were "BELOW NORMAL" (VAMP numerical indicator of three) and "DRY" (VAMP numerical indicator of two), respectively. Under these conditions there was no possibility of 2005 being an off-ramp year since the off-ramp criterion was already exceeded without including the current year's numerical indicator. A "double-step" condition would occur if sum of the VAMP numerical indicators for the previous year and current year is equal to or greater than seven, with the current year's indicator based on the 90% probability of exceedence forecast of the 60-20-20 water year classification. This also was not a factor in 2005 since all indications during the planning phase were pointing to a VAMP target flow of 7,000 cfs or greater.

The initial daily operation plan was prepared on March 23. This forecast showed an existing flow of 6,665 cfs, indicating a VAMP target flow of 7,000 cfs. In this forecast New Don Pedro Reservoir on the Tuolumne River and Lake McClure on the Merced River were expected to be making flood control releases and the Stanislaus River was expected to be at its institutional maximum of 1,500 cfs throughout the VAMP pulse flow period. This forecast also indicated that it was likely that the flow would be too high to allow for the safe installation of the Head of Old River Barrier (HORB). Weighing all of these factors the SJRTC determined that delaying the start of the VAMP pulse flow period would increase the chances of installation of the HORB and declared a VAMP pulse flow period of May 1 to May 31. Hydrologic conditions continued to get wetter and by early April the daily operation plan forecasts were

Table 2-3
Summary of Daily Operation Plans

Phase	VAMP Forecast Date	VAMP Target Flow Period	Assumed Ungaged Flow at Vernalis (cfs)	Existing Flow (cfs)	VAMP Target Flow (cfs)	Supplemental Water needed to meet Target Flow (acre-feet)
Planning	March 23, 2005	April 15 - May 15	800	6,665	7,000	20,600
			1,200	7,465	na	0
	March 25, 2005	May 1 - May 31	800	6,811	7,000	11,610
			1,200	7,211	na	0
	April 5, 2005	May 1 - May 31	600	8,839	na	0
			1,200	9,439	na	0
	April 13, 2005	May 1 - May 31	600	6,764	7,000	14,520
			1,200	8,139	na	0
	April 21, 2005	May 1 - May 31	1,000	7,938	na	0
	April 28, 2005	May 1 - May 31	400	7,943	na	0

Table 2-4
Real-time Mean Daily Flow Data Sources

Measurement Location	Data Source
San Joaquin River near Vernalis	USGS, station 11303500 (http://waterdata.usgs.gov/ca/nwis/dv?format=pre&period=31&site_no=11303500)
Stanislaus River below Goodwin Dam	USBR, Goodwin Dam Daily Operation Report (http://www.usbr.gov/mp/cvo/vungvari/gdwdop.pdf)
Tuolumne River below LaGrange Dam	USGS, station 11289650 (http://waterdata.usgs.gov/ca/nwis/dv?format=pre&period=31&site_no=11289650)
Merced River at Cressey	CDEC, station CRS (http://cdec.water.ca.gov/cgi-progs/queryDgroups?s=fw2)
Merced River near Stevinson	CDEC, station MST (http://cdec.water.ca.gov/cgi-progs/queryDgroups?s=fw2)
San Joaquin River at Newman	USGS, station 11274000 (http://waterdata.usgs.gov/ca/nwis/dv?format=pre&period=31&site_no=11274000)

Table 2-5
Summary of USGS Flow Measurements at the San Joaquin River near Vernalis Gage

Date	Gage Height (ft)	Measured Flow (cfs)	Current Rating Shift Flow (cfs)	Percent Difference	Rating Shift Change
4/20/05 (11:30)	15.98	8,410	8,710	-3.4%	no
4/20/05 (12:19)	15.97	8,490	8,700	-2.4%	no
4/27/05 (10:57)	14.65	6,450	6,950	-7.2%	yes
5/3/05 (11:12)	15.71	8,360	7,780	7.5%	yes
5/10/05 (09:02)	16.24	9,000	8,740	3.0%	no
5/17/05 (10:08)	16.18	9,150	8,660	5.7%	yes

SEE USEFUL WEB PAGES

indicating that the possibility of HORB installation had essentially been eliminated. It was also looking more likely that the existing flow would exceed the maximum VAMP target flow of 7,000 cfs. Continually increasing runoff forecasts resulted in continually increasing forecasts of flood control releases on the Tuolumne and Merced Rivers such that by April 28 the daily operation forecast was looking at an existing flow of approximately 8,000 cfs. Table 2-3 summarizes the various iterations of the daily operation plan during the VAMP planning phase, and demonstrates the evolutionary nature, of its development. The daily operation plans prepared during the VAMP planning phase are provided in Appendix A-1, Tables 1 through 10.

Tributary Flow Coordination

As previously noted, by late April the forecast existing flow was greater than the maximum VAMP target flow of 7,000 cfs. Under these conditions the tributary operations were coordinated to the degree possible to provide as stable a flow as possible during the VAMP pulse flow period. With this in mind the tributary operations prior to the VAMP were adjusted to the degree possible to maximize the very limited potential operational flexibility during the VAMP pulse flow period.

Delta Exports

The VAMP experimental design does not mandate specific magnitudes of reduced export rates when the existing flow at Vernalis is expected to exceed the maximum VAMP target flow rate of 7,000 cfs, but does provide the following suggested export rates.

Vernalis Flow	Suggested Export Rate
Up to 10,000 cfs	1,500 cfs or 3,000 cfs
Up to 15,000 cfs	2,250 cfs
Over 15,000 cfs	3,000 cfs

On March 30, April 15 and April 27 the projected VAMP operation plan was discussed with the CalFed Operations Group. On April 28, the CalFed Water Operation Management Team (WOMT), which is made up of representatives from the DWR, USBR, USFWS, CDFG and NMFS, settled on a combined State and Federal export rate of 1,500 cfs for the first half of May and 3,000 cfs for the second half of May. On May 4 the WOMT revised the combined export rate to 2,250 cfs for the VAMP period provided the Vernalis flow stayed in the vicinity of 8,000 cfs, and noted that the export rate reduction would be reassessed if the Vernalis flow increased significantly above 8,000 cfs.

IMPLEMENTATION

Operation Conference Calls

Due to the excess flow conditions and the fact that the operation was being controlled by flood control considerations and not by the VAMP target flow, the operation conference calls that had been conducted in previous years were not conducted in 2005.

Operation Monitoring

The planning and implementation of the VAMP spring pulse flow operation was accomplished using the best available real-time data from the sources listed in Table 2-4. The real-time flow data used during the implementation of the VAMP flow have varying degrees of quality. The CDEC real-time data has not been reviewed for accuracy or adjusted for rating shifts, whereas the USGS real-time data has had some preliminary review and adjustment. During the VAMP flow period, the real-time flows at Vernalis and in the San Joaquin River tributaries are continuously monitored. Similarly, the computed ungaged flow at Vernalis and the flow in the San Joaquin River upstream of the Merced River are continuously updated.

Normally, the USGS makes monthly measurements of the flow at Vernalis to check the current rating shift. The real-time flows reported by the USGS and CDEC are dependent on the most current rating shift, therefore a new measurement and shift can result in a sudden and significant change in the reported real-time flow. In order to minimize the potential for these sudden and significant changes, arrangements were made with the USGS to measure the flow at Vernalis on a weekly basis between April 20 and May 17. The results of these measurements are summarized in Table 2-5. There were no significant rating shifts during the 2005 VAMP operation period.

RESULTS OF OPERATIONS

The final accounting for the VAMP operation was accomplished using provisional mean daily flow data available from USGS and DWR as of August 1, 2005. Provisional data is data that has been reviewed and adjusted for rating shifts but is still considered preliminary and subject to change. Plots of the real-time and provisional flows at the primary measuring points are provided in Appendix A-2, Figures 1 through 8, to illustrate the differences between the real-time and the provisional data.

The mean daily flow at the Vernalis gage averaged 10,390 cfs during the May 1 – May 31 VAMP pulse flow period. The flow was relatively steady for the first 19 days of the pulse flow period, ranging from 7,500 cfs to 9,200 cfs. For the latter portion of the pulse flow period the flow at Vernalis

Table 2-6
2005 Vernalis Adaptive Management Plan (VAMP)
Final Flows and Accounting of Supplemental Water Contributions
Pulse flow period: May 1 - May 31 * Target Flow: greater than 7,000 cfs

	Merced R. at Cressey (3 day Travel Time to Vernalis)			Tuolumne R. blw LaGrange Dam (2 day Travel Time to Vernalis)			Stanislaus R. blw Goodwin Dam (2 day Travel Time to Vernalis)			Upper SJR	Vernalis Ungaged	San Joaquin River at Vernalis		
Date	Existing Flow (cfs)	Observed Flow (cfs)	VAMP Supplemental Water (cfs)	Existing Flow (cfs)	Observed Flow (cfs)	VAMP Supplemental Water (cfs)	Existing Flow (cfs)	Observed Flow (cfs)	VAMP Supplemental Water (cfs)	Observed Flow (cfs)	Observed Flow (cfs)	Existing Flow (cfs)	Observed Flow (cfs)	VAMP Supplemental Water (cfs)
04/01/05	4,190	4,190		7,010	7,010		229	229		2,460	500	15,100	15,100	
04/02/05	4,100	4,100		6,670	6,670		229	229		2,230	951	15,000	15,000	
04/03/05	3,810	3,810		6,870	6,870		229	229		2,010	781	15,000	15,000	
04/04/05	3,850	3,850		7,140	7,140		226	226		1,630	1,681	15,000	15,000	
04/05/05	3,600	3,600		6,990	6,990		229	229		1,410	1,491	14,700	14,700	
04/06/05	3,430	3,430		5,490	5,490		229	229		1,290	1,594	14,400	14,400	
04/07/05	3,270	3,270		5,020	5,020		226	226		1,090	921	13,400	13,400	
04/08/05	3,270	3,270		4,570	4,570		227	227		950	1,391	12,000	12,000	
04/09/05	3,240	3,240		4,050	4,050		225	225		910	1,734	11,500	11,500	
04/10/05	3,240	3,240		4,120	4,120		229	229		940	1,683	10,700	10,700	
04/11/05	3,200	3,200		4,830	4,830		232	232		940	1,945	10,400	10,400	
04/12/05	2,740	2,740		4,940	4,940		226	226		1,010	1,771	10,300	10,300	
04/13/05	2,660	2,660		4,010	4,010		227	227		980	1,558	10,800	10,800	
04/14/05	2,700	2,700		4,070	4,070		228	228		860	524	9,900	9,900	
04/15/05	2,720	2,720		3,950	3,950		231	231		770	1,363	9,320	9,320	
04/16/05	2,680	2,680		4,040	4,040		229	229		700	1,262	9,080	9,080	
04/17/05	2,630	2,630		4,050	4,050		342	342		650	1,359	9,010	9,010	
04/18/05	2,570	2,570		4,060	4,060		406	406		620	1,121	8,810	8,810	
04/19/05	2,500	2,500		4,030	4,030		403	403		610	1,028	8,750	8,750	
04/20/05	2,430	2,430		4,000	4,000		400	400		570	944	8,660	8,660	
04/21/05	2,380	2,380		3,980	3,980		404	404		550	767	8,380	8,380	
04/22/05	2,350	2,350		3,840	3,840		401	401		530	540	8,010	8,010	
04/23/05	2,250	2,250		3,520	3,520		402	402		470	366	7,730	7,730	
04/24/05	2,210	2,210		3,290	3,290		409	409		470	339	7,490	7,490	
04/25/05	2,060	2,060		3,020	3,020		414	414		530	448	7,190	7,190	
04/26/05	1,780	1,780		3,220	3,220		401	401		590	331	6,750	6,750	
04/27/05	1,600	1,600		3,680	3,680		405	405		610	316	6,490	6,490	
04/28/05	1,550	1,550		3,750	3,750		401	401		560	449	6,720	6,720	
04/29/05	1,510	1,510		3,760	3,760		1,285	1,285		550	485	6,960	6,960	
04/30/05	1,830	1,830		3,760	3,760		1,504	1,504		480	729	7,040	7,040	
05/01/05	1,980	1,980		3,770	3,770		1,498	1,498		430	375	7,520	7,520	0
05/02/05	1,930	1,930		3,770	3,770		1,504	1,504		440	716	7,970	7,970	0
05/03/05	1,380	1,380		3,750	3,750		1,499	1,499		630	592	8,120	8,120	0
05/04/05	1,340	1,340		3,770	3,770		1,500	1,500		650	166	7,860	7,860	0
05/05/05	1,820	1,820		3,760	3,760		1,519	1,519		520	(139)	7,670	7,670	0
05/06/05	1,970	1,970		3,740	3,740		1,518	1,518		420	610	7,910	7,910	0
05/07/05	1,950	1,950		3,760	3,760		1,505	1,505		570	1,051	8,190	8,190	0
05/08/05	1,960	1,960		3,980	3,980		1,503	1,503		620	912	8,410	8,410	0
05/09/05	2,000	2,000		4,230	4,230		1,507	1,507		680	825	8,630	8,630	0
05/10/05	1,990	1,990		4,220	4,220		1,501	1,501		750	817	8,870	8,870	0
05/11/05	2,000	2,000		4,230	4,230		1,501	1,501		830	553	8,930	8,930	0
05/12/05	1,990	1,990		4,220	4,220		1,507	1,507		970	409	8,880	8,880	0
05/13/05	1,970	1,970		4,230	4,230		1,501	1,501		1,020	389	8,940	8,940	0
05/14/05	2,010	2,010		4,250	4,250		1,501	1,501		970	343	9,040	9,040	0
05/15/05	2,010	2,010		4,250	4,250		1,504	1,504		910	329	9,070	9,070	0
05/16/05	2,040	2,040		4,240	4,240		1,505	1,505		840	239	8,930	8,930	0
05/17/05	2,370	2,370		4,230	4,230		1,500	1,500		870	106	8,780	8,780	0
05/18/05	2,460	2,460		4,510	4,510		1,504	1,504		1,200	175	8,770	8,770	0
05/19/05	2,430	2,430		5,580	5,580		1,506	1,506		1,580	560	9,200	9,200	0
05/20/05	2,410	2,410		6,620	6,620		1,504	1,504		1,890	616	10,200	10,200	0
05/21/05	2,410	2,410		6,580	6,580		1,507	1,507		2,160	274	11,400	11,400	0
05/22/05	2,360	2,360		6,620	6,620		1,503	1,503		2,480	(244)	12,200	12,200	0
05/23/05	2,320	2,320		6,640	6,640		1,505	1,505		2,840	143	12,800	12,800	0
05/24/05	2,690	2,690		6,590	6,590		1,506	1,506		3,140	87	13,100	13,100	0
05/25/05	2,700	2,700		6,180	6,180		1,503	1,503		3,420	155	13,500	13,500	0
05/26/05	2,670	2,670		5,830	5,830		1,506	1,506		3,950	244	13,800	13,800	0
05/27/05	3,050	3,050		5,760	5,760		1,501	1,501		4,450	7	13,800	13,800	0
05/28/05	3,590	3,590		5,640	5,640		1,507	1,507		4,900	214	14,200	14,200	0
05/29/05	3,860	3,860		5,560	5,560		1,504	1,504		5,330	219	14,600	14,600	0
05/30/05	3,940	3,940		5,330	5,330		1,433	1,433		5,820	103	15,200	15,200	0
05/31/05	3,930	3,930		5,070	5,070		1,340	1,340		6,300	(384)	15,600	15,600	0
VAMP Period														
Average (cfs):	2,151	2,151		4,775	4,775		1,497	1,497		1,629	337	10,390	10,390	
Supplemental Water (ac-ft):			0			0			0					0

VAMP Period

Observed Flow Sources:
Merced River at Cressey (CA DWR B05155): California DWR, San Joaquin District, 8/24/05
Tuolumne River below LaGrange Dam near LaGrange (USGS 11289650): USGS, provisional data as of 8/1/05
Stanislaus River below Goodwin Dam: USBR, Goodwin Reservoir Daily Operations Report - OID/SSJID/Tri-Dams, 5/2/05 (April report) and 6/1/05 (May report)
San Joaquin River near Vernalis (USGS 11303500): USGS, provisional data as of 8/1/05

was impacted by flood releases from Friant Dam (Millerton Lake), reaching a VAMP period maximum of 15,600 cfs on May 31 as shown in Figure 2-2. Plots of the flow at the Merced River, Tuolumne River and Stanislaus River measurement points are provided in Figure 2-3. A tabulation of the observed mean daily flows during and around the VAMP period is provided in Table 2-6.

Near the end of April, just prior to the pulse flow period, the computed ungaged flow had dropped into the range of 400 to 600 cfs, so that a value of 400 cfs was used in the April 28 daily operation plan. The final accounting shows that the average ungaged flow during the VAMP pulse flow period was 284 cfs, with a minimum of -544 cfs and maximum of 741 cfs. A plot of the ungaged flow is provided in Figure 2-4.

Another unknown in the forecast equation similar to the ungaged flow is the flow in the San Joaquin River upstream of the Merced River. This unknown tends not to be as variable as the ungaged flow, but like the ungaged flow, it may be adjusted if the observed flow warrants it. During the 2005 VAMP the greatest uncertainty in regards to the San Joaquin River above Merced River flow was the potential for Friant Dam flood releases which could significantly affect this flow. As can be seen in Figure 2-5, the observed flow was slightly greater than the forecast for the first half of the pulse flow period due to the wet conditions in the basin. In mid-May it became necessary for Friant Dam to make significant flood control releases which resulted in the observed flow in the San Joaquin River above the Merced River significantly exceeding the forecasted flow as shown in Figure 2-5.

As previously stated, the combined CVP and SWP Delta export rate target was set at 2,250 cfs provided the Vernalis flow remained near 8,000 cfs. The export rate was held near the target rate for the first 25 days of the VAMP pulse flow period (see Figure 2-6) with an average of 2,260 cfs. However, due to the significant increase in the flow at Vernalis in the latter part of May, the DWR and USBR increased the combined export rate to between 6,000 and 7,000 cfs for the last five days in May. The resulting average combined export rate for the 31 day VAMP target flow data was 2,986 cfs.

Hydrologic Impacts

The Merced VAMP supplemental water is provided from storage in Lake McClure on the Merced River and the MID/TID VAMP supplemental water is provided from storage in New Don Pedro Reservoir. The OID/SSJID VAMP supplemental water is made available from their diversion entitlements and therefore there are no storage impacts in New Melones Reservoir on the Stanislaus River due to the SJRA. Due to the extended nature of the VAMP, a 12-year plan, the storage impacts can potentially carry over from year to year. Reservoir storage impacts are reduced or eliminated when the reservoirs make flood control releases.

As of November 1, 2004, following the Fall 2004 SJRA water transfer, the cumulative impact of the SJRA on the storage in Lake McClure was a reduction of 215,197 acre-feet (see Table 2-7), assuming Merced I.D. diversions from the Merced River would have been the same both without and with the SJRA. It should be noted, however, that as a direct result of the SJRA, Merced I.D. has undertaken a number of conservation measures that have resulted

Table 2-7
Storage Impact History, Lake McClure (Merced River)

Calendar Year	VAMP Supplemental Water (acre-feet) [a]	Fall Supplemental Water (acre-feet)	SJRA Storage Impact Replenishment (acre-feet)	End of Year Cumulative Storage Impact (acre-feet)
2000	46,750	12,500	46,750 (May 2000)	-12,500
2001	43,146	12,496	0	-68,142
2002	27,120	12,470	0	-107,732
2003	39,586	12,500	0	-159,818
2004	42,879	12,500	0	-215,197
2005	0	12,500	215,197 (Jan.-Mar. 2005)	0 [b]

[a] Includes ramping flows.
[b] Fall Supplemental Water from re-opened flood-control release, therefore storage was not impacted.

Figure 2-2
2005 VAMP: San Joaquin River near Vernalis
With Lagged Contributions from Primary Sources

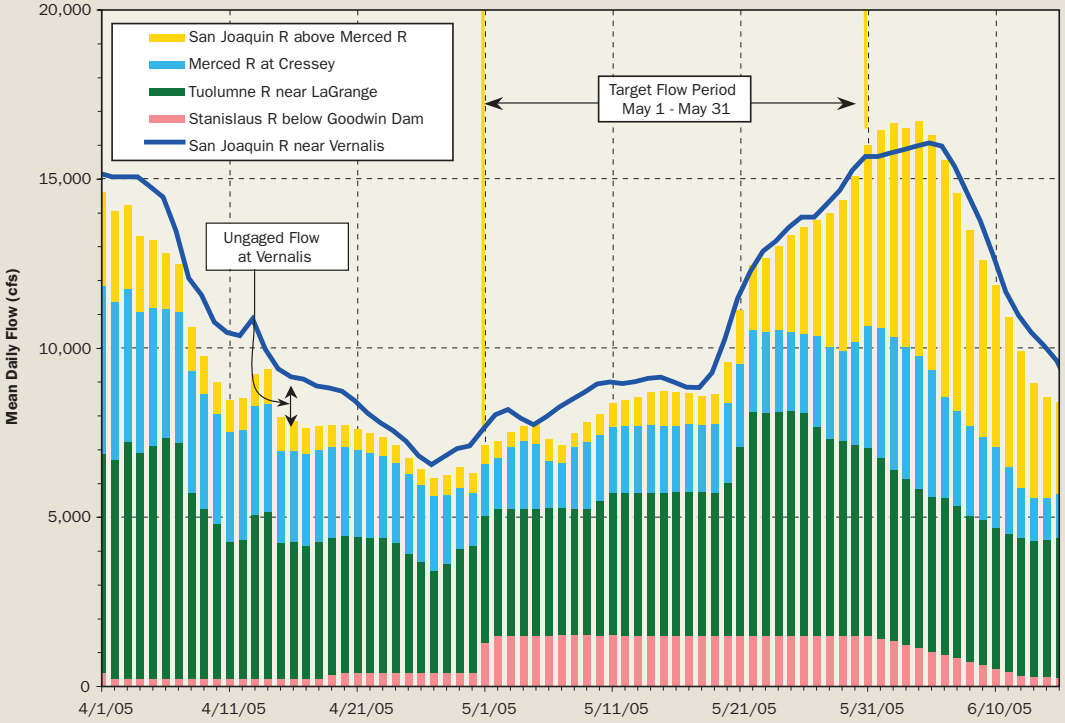


Figure 2-3
2005 VAMP: Flow at Tributary Measurement Points

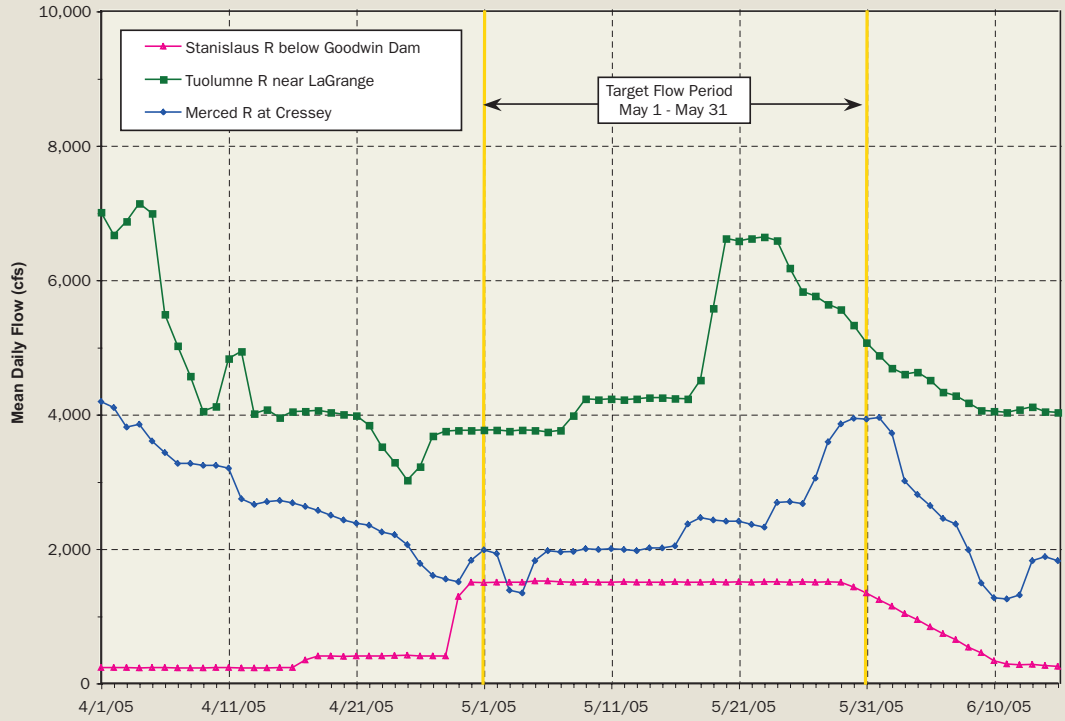


Figure 2-4
2005 VAMP - Ungaged Flow in San Joaquin River at Vernalis
Comparison of Forecasted and Observed

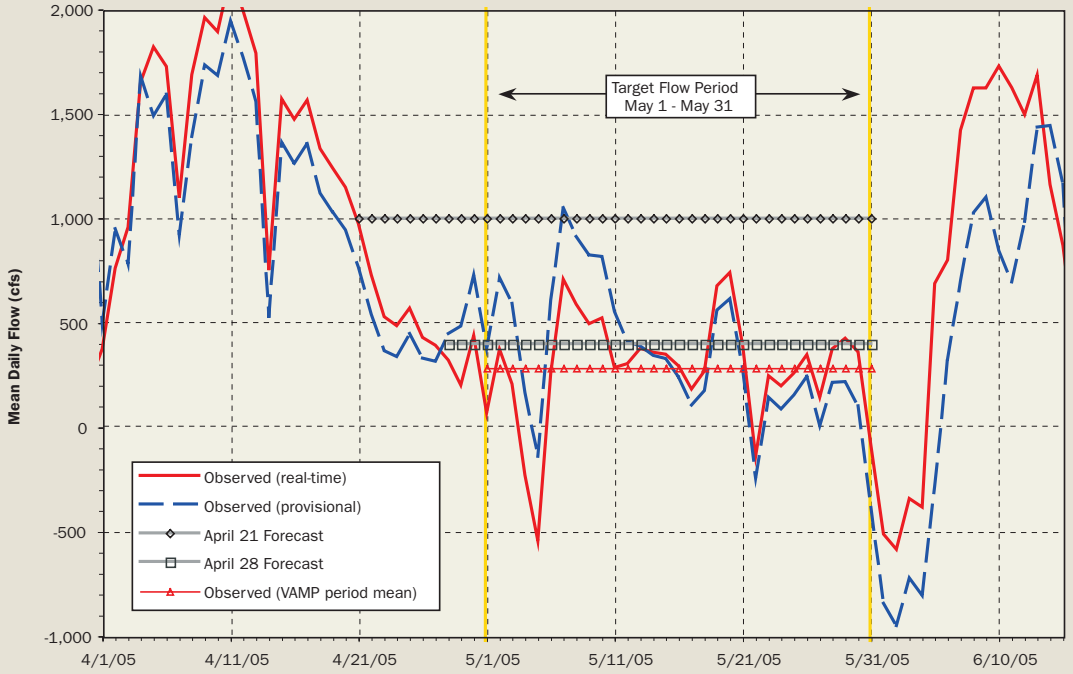


Figure 2-5
2005 VAMP - Upper San Joaquin River Flow
Comparison of Forecasted and Observed

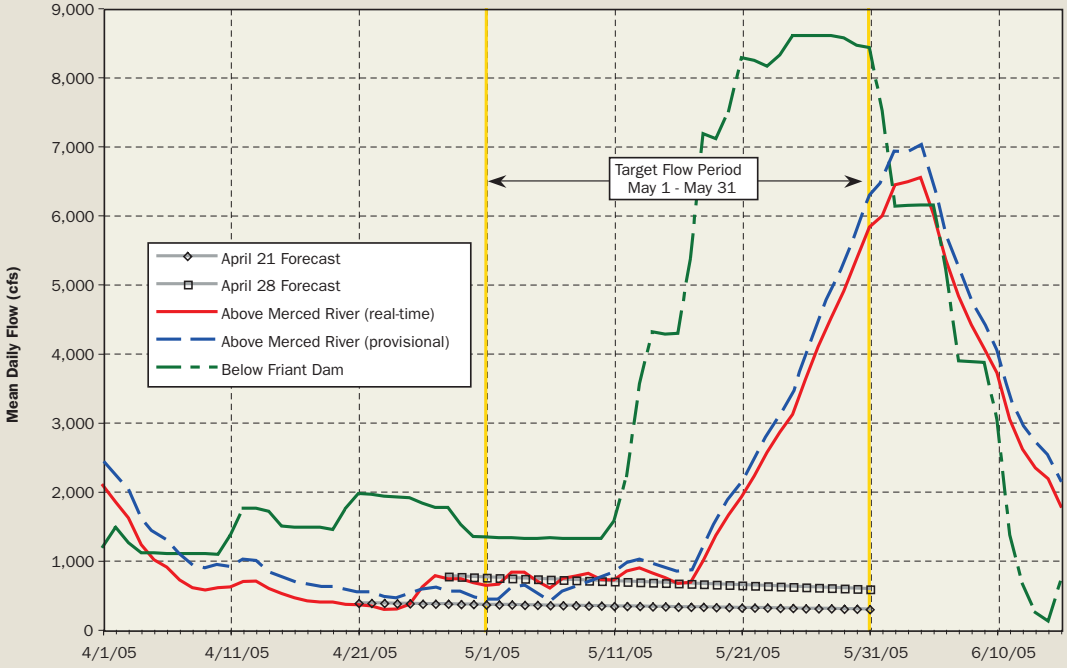


Figure 2-6
2005 VAMP - Federal and State Delta Exports

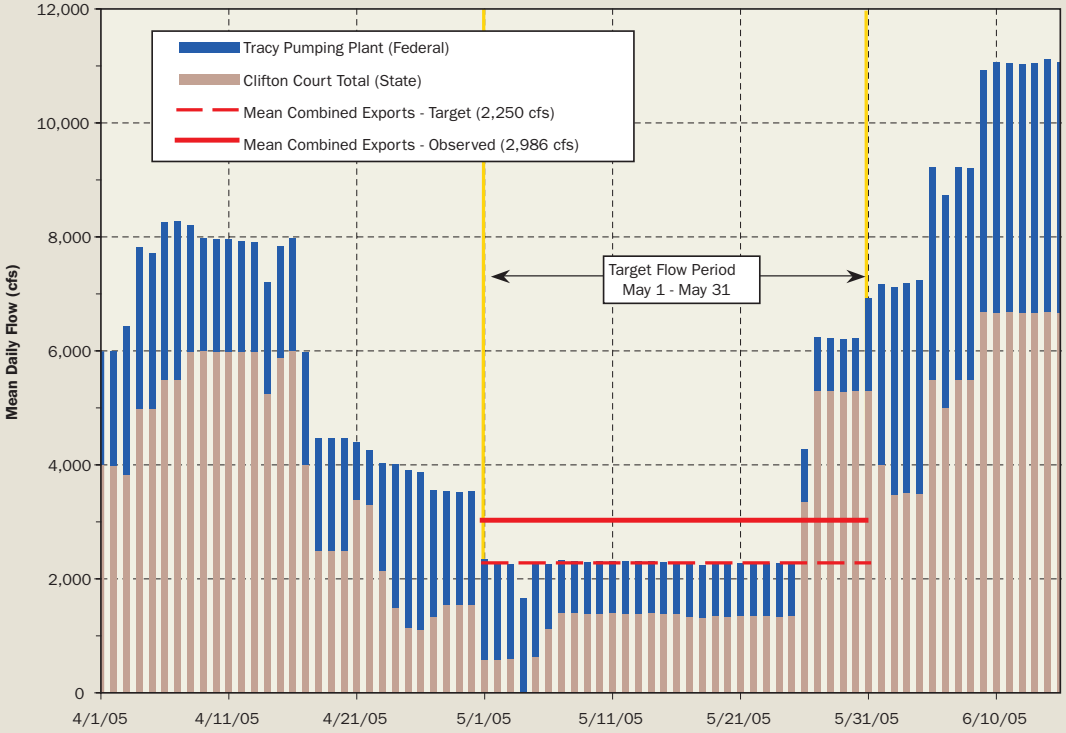
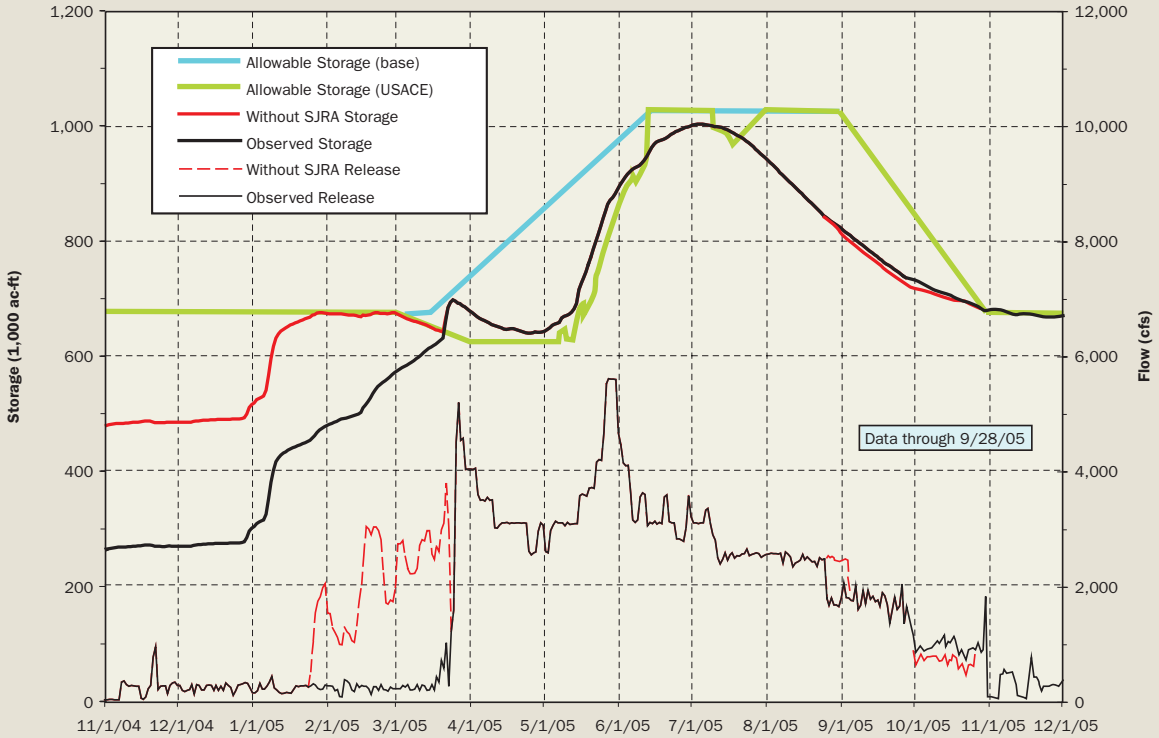


Figure 2-7
San Joaquin River Agreement Storage and Flow Impacts
Merced River - Lake McClure Storage and Release - 2005



in a reduced reliance on Merced River diversions. Any reductions in Merced River diversions would offset the 215,197 acre-foot storage impact. The impact of the conservation measures on Merced River diversions is in the process of being quantified and was not available at the time of publication of this report.

Assuming that the storage impact in Lake McClure was 215,197 acre-feet after the 2004 SJRA operation, the wet conditions in water year 2005 resulted in the complete replenishment of this water between January 25, 2005 and March 23, 2005 as shown in Figure 2-7. In compliance with D-1641, none of the following were in effect when this storage was replenished:

"(T)he USBR is releasing water from New Melones Reservoir for purpose of meeting the Vernalis salinity objective, or…Standard Permit Term 93 is in effect, or…salinity objectives at Vernalis are not being met."

Following the 2004 VAMP operation, the cumulative impact of the SJRA on storage in New Don Pedro Reservoir was a reduction of 11,151 acre-feet (see Table 2-8). This storage deficit was erased as a result of flood control operations in late January and early February 2005 as shown in Figure 2-8. This storage replenishment was also in compliance of the D-1641 terms noted above.

SUMMARY OF HISTORICAL VAMP OPERATIONS

2005 marks the sixth year of VAMP operation in compliance with D-1641. A summary of the VAMP target flows for these first six years is provided in Table 2-9. A summary of the SJRGA supplemental water contributions is provided in Table 2-10. The Hydrology Group monitors the cumulative impact of the SJRA on reservoir storage and stream flows. Plots of storage and flow impacts throughout the five years of VAMP operation are provided in Appendix D-1, Figures 1 through 4.

Over the first six years of the program considerable variation has occurred in both the flow entering the system upstream of the Merced River and the ungaged flow within the system. With each update of the daily operation plan throughout the planning and implementation phases the upstream and ungaged flows would vary causing the SJRGA to reduce or increase the contribution of supplemental water in order to support the VAMP target flow. Analysis of the variability in the ungaged flow at Vernalis and the San Joaquin River above Merced River flow and how these affect the forecasting of the existing and supplemental flows is ongoing.

Table 2-8
Storage Impact History, New Don Pedro Reservoir (Tuolumne River)

Calendar Year	VAMP Supplemental Water (acre-feet)	SJRA Storage Impact Replenishment (acre-feet)	End of Year Cumulative Storage Impact (acre-feet)
2000	22,651	14,955 (Sep.-Oct. 2000)	-7,696
2001	14,061	7,696 (Jan.-Feb. 2001)	-14,061
2002	0	0	-14,061
2003	9,729	0	-23,790
2004	11,151	23,790 (March 2004)	-11,151
2005	0	11,151 (Jan.-Feb. 2005)	0

Figure 2-8
San Joaquin River Agreement Storage and Flow Impacts
Tuolumne River - New Don Pedro Reservoir Storage and Release - 2005

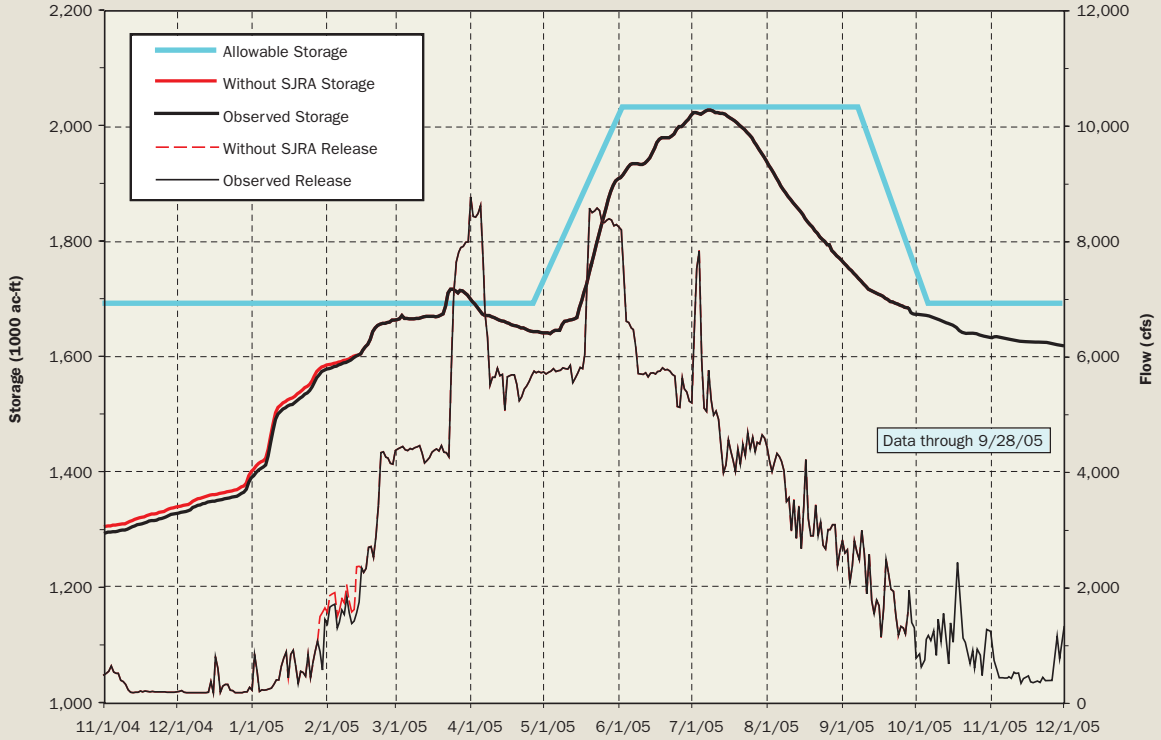


Table 2-9
Summary of VAMP Flows, 2000-2005

Year	60-20-20 Water Year Hydrologic Classification	VAMP Numerical Indicator	VAMP Target Flow (cfs)	Observed VAMP Flow (cfs)	Existing Flow (cfs)	VAMP Supplemental Water (acre-feet)	Delta Export Target (cfs)	Observed Delta Exports (cfs)
2000	Above Normal	4	5,700	5,869	4,800	77,680	2,250	2,155
2001	Dry	2	4,450	4,224	2,909	78,650	1,500	1,420
2002	Dry	2	3,200	3,301	2,757	33,430	1,500	1,430
2003	Below Normal	3	3,200	3,235	2,290	58,065	1,500	1,446
2004	Dry	2	3,200	3,155	2,088	65,591	1,500	1,331
2005	Wet	5	>7,000	10,390	10,390	0	2,250	2,986 [a]

[a] May 1 through 25 average was 2,260 cfs; exports were increased starting May 26 inconjunction with increasing existing flow; May 26 through 31 average was 6,012 cfs.

Table 2-10
Summary of VAMP Supplemental Water Contributions, 2000-2004

Year	VAMP Supplemental Water (acre-feet)		Supplemental Water (acre feet)					
			Merced ID	OID	SSJID	SJRECWA	MID	TID
2000	77,680	Observed:	46,750	(a)	(b)	8,280	15,200	7,450
		Division Agreement:	45,160	7,300	7,300	7,300	16,920	8,300
		Deviation:	+ 1590	0	0	+ 980	- 1,720	- 850
2001	78,650	Observed:	42,120	7,365	7,365	7,740	7,030	7,030
		Division Agreement:	42,150	7,300	7,300	7,300	7,300	7,300
		Deviation:	- 30	+ 65	+ 65	+ 440	- 270	- 270
2002	33,430	Observed:	25,840	3,795	3,795	0	0	0
		Division Agreement:	25,000	4,215	4,215	0	0	0
		Deviation:	+ 840	- 420	- 420	0	0	0
2003	58,065	Observed:	38,257	5,039	5,039	(c)	4,864.5	4,864.5
		Division Agreement:	38,065	5,000	5,000	5,000	5,000	5,000
		Deviation:	+ 192	+ 39	+ 39	0	-135.5	-135.5
2004	65,591	Observed:	42,680	5,880	5,880	(c)	5,575.5	5,575.5
		Division Agreement:	41,500	7,045.5	7,045.5	5,000	5,000	5,000
		Deviation:	+ 1,180	- 1165.5	- 1165.5	0	+ 575.5	+ 575.5
2005	0	Observed:	0	0	0	0	0	0
		Division Agreement:	0	0	0	0	0	0
		Deviation:	0	0	0	0	0	0