2007 Annual Technical Report

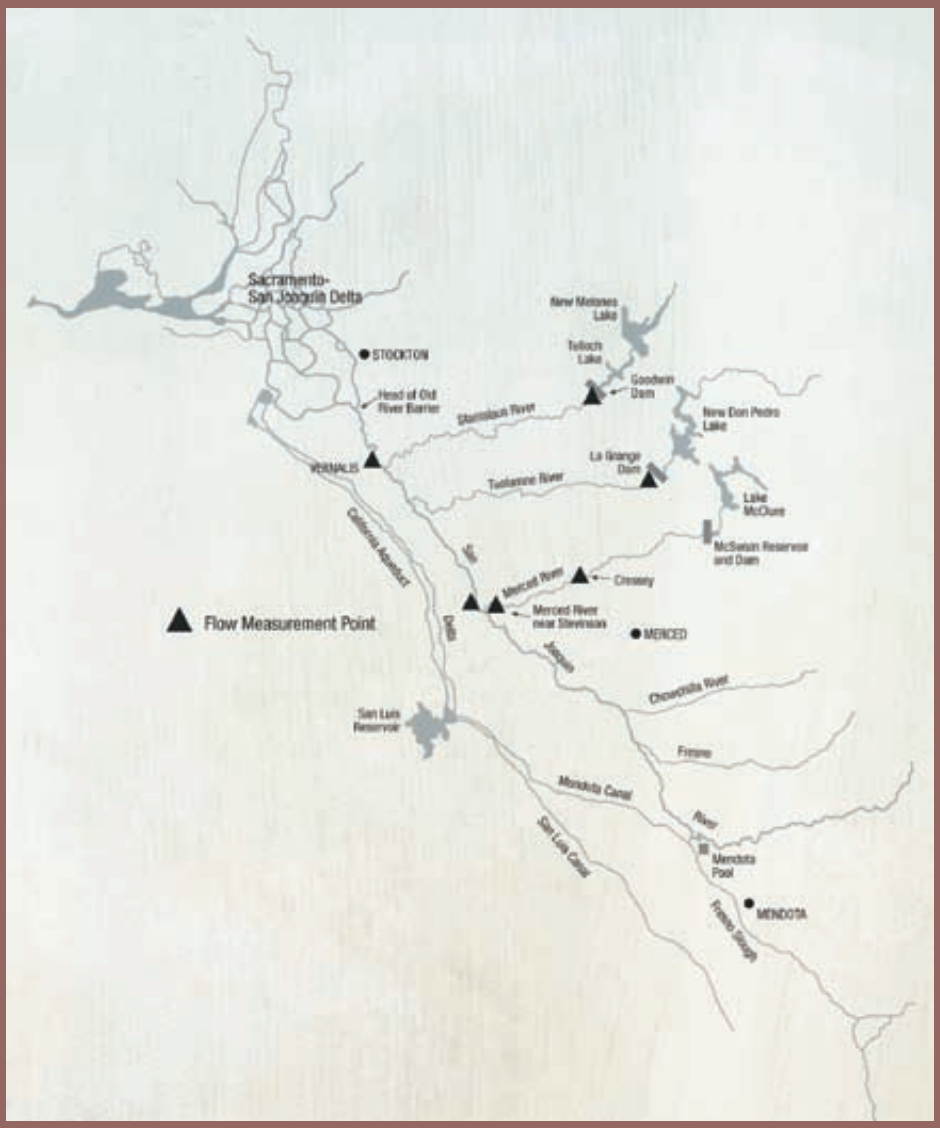
SAN JOAQUIN RIVER AGREEMENT

SAN JOAQUIN RIVER GROUP AUTHORITY

CITY OF STOCKTON

EXHIBIT 3

Figure 2-1
Sacramento – San Joaquin Estuary



2007 ANNUAL TECHNICAL REPORT

On implementation and Monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan

Prepared by
San Joaquin River Group Authority

Prepared for the
California Water Resource Control Board
in compliance with D-1641

JANUARY 2008

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EXECUTIVE SUMMARY

The San Joaquin River Agreement (SJRA) and Vernalis Adaptive Management Plan (VAMP) is the cornerstone of a history-making commitment to implement the State Water Resources Control Board (SWRCB) 1995 Water Quality Control Plan (WQCP) for the lower San Joaquin River and the San Francisco Bay-Delta Estuary (Bay-Delta). VAMP, officially initiated in 2000 as part of SWRCB Decision 1641, is a large-scale, long-term (12-year), experimental/management program designed to protect juvenile Chinook salmon migrating from the San Joaquin River through the Sacramento-San Joaquin Delta. VAMP is also a scientific experiment to determine how salmon survival rates change in response to alterations in San Joaquin River flows and State Water Project (SWP)/Central Valley Project (CVP) exports with the installation of the Head of Old River Barrier (HORB).

The lack of returning adults to the Merced River Hatchery and subsequent low salmon smolt production resulted in the California Department of Fish and Game's (CDFG) inability to provide test fish for a coded wire tag study in 2007 VAMP. The SJRA technical committee (SJRATC) concluded that an acoustic telemetry monitoring program, relying on 1,000 acoustic tagged salmon smolts, would be conducted over the same VAMP period. The VAMP test period was delayed one week from the default period of April 15-May 15 to April 22-May 22 to allow the test fish to increase in size to better accommodate the acoustic tag to body weight ratio standard of less than 5 percent. Water Year 2007 was very dry on the San Joaquin River watershed, with the four-basin April-July forecasted runoff ranging from 41% to 52% of average. The VAMP Vernalis test flow over the April 22-May 22 period was set at 3,200 cfs based on the SJRA criteria.

The 2007 Annual Technical Report consolidates the annual SJRA Operations and the Vernalis Adaptive Management Plan (VAMP) Monitoring Reports. The VAMP 2007 program represents the eighth year of formal compliance with SWRCB Decision 1641 (D-1641). D-1641 requires the preparation of an annual report documenting the implementation and results of the VAMP program. Specifically, this 2007 report includes the following information on the implementation of the SJRA: the hydrologic chronicle; management of any additional SJRA water; flow and fisheries monitoring in the lower San Joaquin River, Old River, and Delta; results of the juvenile salmon acoustic tag study; discussion of complementary investigations; and conclusions and recommendations.

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VAMP is intended to employ an adaptive management strategy using current knowledge to protect Chinook salmon as they migrate through the Delta, while gathering information to allow more efficient protection in the future. 2007 represented the first year of a monitoring program relying fully on the use of acoustic telemetry technology. Implementation of this new technology was not without some difficulties. The lack of two key monitoring stations, receiver malfunctions and the unexplained mortality near Stockton of a sizable number of test fish impacted our ability to complete a survival analysis. In addition to providing improved protection for juvenile Chinook salmon emigrating from the San Joaquin River system, specific experimental objectives of VAMP 2007 included:

- Quantification of Chinook salmon smolt survival along individual river segments between Durham Ferry, Mossdale, Head of Old River, Bowman Road (near Dos Reis), and Stockton by detection of acoustic signals from transmitters implanted in the test fish.
- Evaluation of the San Joaquin River – Old River flow split at the Head of Old River under the 2007 flow conditions with the installed HORB.
- Monitoring in Old River to evaluate the movement of salmon smolts in Old River under the 2007 flow conditions with the installed HORB.
- Evaluation of fish mortality across Clifton Court Forebay between the Clifton Court Forebay inlet structure and the Skinner Fish Facility.
- Health and physiology testing of VAMP fish was conducted at the MRH, Durham Ferry and Mossdale to evaluate the incidence of disease.

The VAMP design provides for a 31-day pulse flow (target flow) in the San Joaquin River at the Vernalis gage along with a corresponding reduction in SWP/CVP exports. The magnitude of the pulse flow is based on an estimated flow that would occur during the pulse period absent the VAMP. As part of the implementation planning, the VAMP hydrology and biology groups meet regularly throughout the year to review current and projected information on hydrologic conditions occurring within the San Joaquin River watershed. This facilitates communication and coordination for both the VAMP Chinook salmon smolt survival experiments and for scheduling streamflow releases on the Tuolumne, Merced, and Stanislaus rivers to facilitate the experimental investigations and protection for juvenile salmon within the tributaries.

Hydrologic conditions in 2007 were similar to those experienced in 2002. In the March 21 operation plan the existing a flow was forecasted to be between 2,182 and 2,582 cfs calling for a VAMP target flow of either 3,200 cfs or 4,450 cfs. The forecasts throughout the weeks leading up to the VAMP period indicated the HORB could safely be installed; however the uncertain condition of the Delta smelt controlled the final decision on its installation. A decision by the Delta smelt working group allowed for the barrier to be constructed and closed on April 22. The HORB culverts remained closed until May 16 when they were opened due to Delta smelt concerns. As the dry conditions continued through the spring it became evident the double step criteria would not be a factor in determining the target flow for VAMP. By April 13 forecasts of existing flow at Vernalis was projected to be about 2,770 cfs between April 22 and May 22. In planning for the VAMP the SJRA Technical Committee recommended delaying the start of the VAMP pulse period until April 22 in an effort to provide larger smolt sized fish for the implantation of acoustic tags. The study was designed to measure survival along three segments of the San Joaquin River; Durham Ferry to Mossdale, Mossdale to Bowman Road and Bowman Road to Jersey Point.

EX - 1
Proposed Fish Release and Detection Locations.

	Fish Release Locations				
	Durham Ferry to	**Mossdale to**	**Bowman Road to**	**Stockton to**	**Downstream of HORB**
Planned Detection Locations	Upstream of HORB	Upstream of HORB			Tracy Fish Facility
	Bowman Road	Bowman Road			Clifton Court Inlet
	Stockton	Stockton	Stockton		Old River at Highway 4
	Jersey Point*	Jersey Point*	Jersey Point*	Jersey Point*	
	Chipps Island*	Chipps Island*	Chipps Island*	Chipps Island*	Chipps Island*

* Jersey Point and Chipps Island receivers not installed in 2007.

In an effort to document migratory behavior of salmon entering the Old River 100 acoustically tagged fish were released in the Old River immediately downstream of the HORB.

Unfortunately due to physical and technical difficulties beyond the control of the SJRA parties the acoustic receiver stations at Jersey Point and Chipps Island could not be installed in time for the 2007 VAMP. Thus survival to Jersey Point and Chipps Island could not be estimated.

Vamp experimental test conditions that have occurred over the past eight years are summarized below:

Water temperature data were collected with a series of computerized recorders at the Merced River Fish Facility, in the transport trucks, at the release sites and throughout the lower San Joaquin River and Delta. Overall the average temperature at all sites remained below 20 C, which is considered suitable for salmon smolts.

Survival of fish between Mossdale and Stockton was relatively high, but survival estimates in some reaches were suspect due to periods of receiver malfunction. Survival between Durham Ferry and Mossdale appeared lower. As mentioned earlier without the deployment of acoustic receivers at Jersey Point and Chipps Island

EX - 2
VAMP Experimental Test Conditions.

Year	VAMP Period	Average Vernalis Flow (cfs)	Average SWP/CVP Exports (cfs)	Head of Old River Barrier
2000	April 15-May 15	5,869	2,155	Installed
2001	April 20-May 20	4,220	1,420	Installed
2002	April 15-May 15	3,300	1,430	Installed
2003	April 15-May 15	3,235	1,446	Installed
2004	April 15-May 15	3,155	1,331	Installed
2005	May 1-May 31	10,390	2,986	Not Installed
2006	May 1-May 31	26,020	1,559/5,748 (a)	Not Installed
2007	April 22 - May 22	3,263	1,486	Installed

survival through the Delta could not be estimated. Deploying receivers at these two stations are being given high priority for the 2008 study.

The health of the CWT fish in 2007 was relatively good, but all test fish examined were infected with the parasite that causes PKD. It is uncertain how such infection affects long term survival of the smolts released as part of VAMP. Dummy tags were implanted in twenty fish during tagging and held for 7 to 14 days to assess tagging and handling stress. No mortalities were observed and the condition characteristics assessed were normal.

The relationship of survival to exports is difficult to detect based on the data gathered to date. The escapement data for adult salmon indicate that the flow/export ratio explains more of the variability in adult escapement than flow alone without the HORB, but the smolt survival data is too limited to detect these effects, if they are real. These relationships could not be tested in 2007. To further refine the relationship between survival and exports with the HORB, the VAMP experiments were designed to estimate survival at a flow of 7,000 cfs at two export levels, 1,500 and 3,000 cfs. We have not yet been able to estimate survival under these experimental conditions.

In addition to recommending these conditions to test, it is noteworthy that survival from Dos Reis to Jersey Point in 2003, 2004, 2005 and the second release group in 2006, was significantly less then prior years (Figure 5-10, SJRG 2007). Flows and exports during the VAMP tests in 2003-2004 were similar to those in 2002 (Table 2), but survival was significantly less. Although, 2007 had the same VAMP targets as in 2002-2004, we were not able to estimate survival to Jersey Point. The high mortality observed near Stockton may explain some of the poor survival in past years. Future studies to estimate survival through the Delta are important in documenting these types of occurrences. Measuring survival at 3200 flow at an export rate of 1500 will help document whether survival has rebounded to pre-2003 levels.

The decline in fish production at the Merced River Hatchery and the continued concern for the abundance of Delta smelt will greatly influence future VAMP designs. A priority will be to design future acoustic monitoring studies so that results can be compared to those generated from the previous coded wire tag studies.


AWARNING
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CHAPTER 1

INTRODUCTION

Actions associated with the Vernalis Adaptive Management Plan (VAMP) were implemented between April 22 and May 22, 2007 to protect juvenile Chinook salmon and evaluate the survival of marked juvenile Chinook salmon migrating through the Sacramento – San Joaquin Delta. Diminished adult salmon returns and low smolt production at the Merced River Fish Hatchery did not allow for the standard VAMP coded wire tag study. As an alternative an acoustic telemetry study was conducted in 2007. The VAMP period was postponed 7 days from previous years to allow for additional growth of the experimental fish. Fish, tagged with acoustic transmitters, were released on May 3-4 and 10-11, 2007. The water districts maintained stable flow in accordance with the SJRA throughout the April - May study period, as were the export rates. The Delta Smelt workgroup permitted installing the HORB for the 2007 VAMP period. Survival estimates through the Delta were not possible in 2007 due to the lack of acoustic receivers at Jersey Point and Chipps Island. Studies conducted in 2007, represented the eighth year of the VAMP. Results from previous VAMP experiments are available in San Joaquin River Agreement Technical Reports, for each respective year. Similar coded wire tag (CWT) experiments were conducted prior to the official implementation of VAMP with results available in South Delta Temporary Barriers Annual Reports (DWR 2001 and DWR 1998). This report will describe the experimental design used in 2007, the hydrologic planning and implementation, the additional water supply arrangements and deliveries, fishery monitoring within the San Joaquin River and Old River with the HORB, the acoustic tag experiment and complimentary studies related to VAMP. Conclusions and recommendations for future VAMP studies are also included.

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Experimental Design Elements

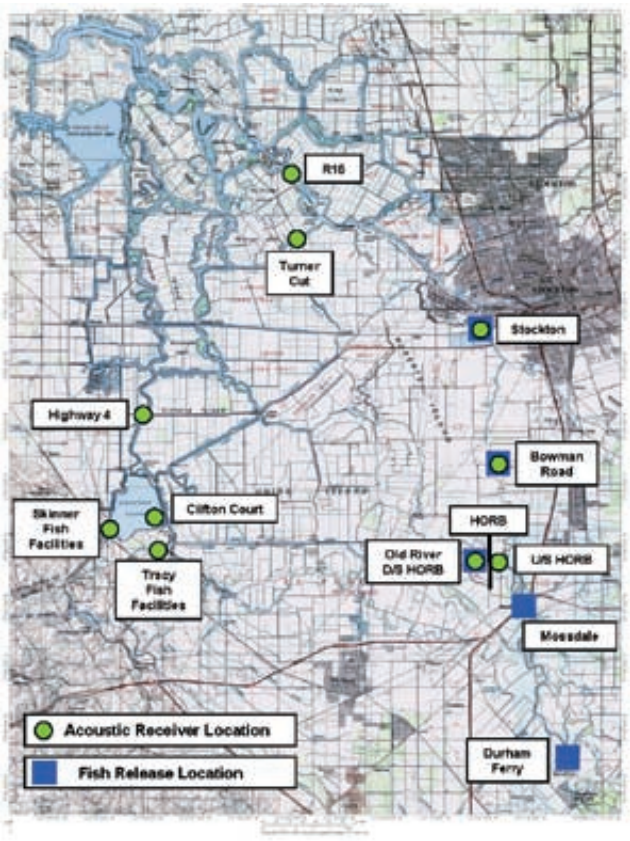
The VAMP experimental design used in previous years measured salmon smolt survival through the Delta under six different combinations of flow and export rates. The experimental design includes two mark-recapture studies performed each year during the April-May juvenile salmon outmigration period that provide estimates of salmon survival under each set of conditions. During 2007, for the first time since inception of the program, test fish were not available from the Merced River Fish Hatchery to permit a coded wire tag (CWT) study. In lieu of a CWT study an acoustic telemetry study was conducted. A total of 1,000 juvenile Chinook salmon were made available from the Merced River Hatchery (MRH) for the VAMP acoustic study. Study fish were surgically implanted with acoustic transmitters, capable of emitting an electronic signal for up to 3 weeks. It was not possible to estimate Chinook salmon survival through the entire Delta due to the lack of acoustic receivers at Jersey Point and Chipps Island. However, data was collected on salmon smolt behavior and mortality conditions within the South Delta and survival was estimated on the San Joaquin River from Durham Ferry and Mossdale to Stockton.

As described the SJRA and VAMP is an experimental/management program designed to protect juvenile Chinook salmon migrating from the San Joaquin River while at the same time conducting a scientific experiment to determine how salmon survival changes in response to alterations in San Joaquin River flows, SWP/CVP export rates, and the operation of the HORB.

Even though survival estimates could not be determined from the 2007 experiment valuable information on how to implement an acoustic tag experiment was collected. This annual technical report describes the flow and HORB conditions encountered in 2007, the alternative experimental plan, and the findings.

Due to a decline of the delta smelt population in the Bay-Delta estuary the delta smelt workgroup analyzed the potential impacts of installing the HORB. Based on

Figure 1-1
Fish release locations and acoustic receiver locations during the 2007 VAMP experiments.



delta smelt monitoring and particle tracking models the workgroup permitted the HORB be installed in 2007. The 2007 VAMP experimental design included both multiple release locations (Durham Ferry, Mossdale, Old River, Bowman Road and Highway 4 at Stockton), and multiple detection locations, Figure 1-1.

During the 2007 VAMP period the Acoustic Telemetry study was conducted to evaluate movement and survival of acoustic tagged fish detected by acoustic receivers as they moved downstream. Fish were released at Durham Ferry, Mossdale, Old River, Bowman Road and near Stockton over 2 one week period during the VAMP. Ten acoustic receivers located along the lower San Joaquin River, Old River, in south Delta channels and at the export fish facilities were used to track smolt movement throughout the south Delta.

For the 2007 acoustic telemetry study a cadre of biologists were trained by the U.S. Geological Survey's Columbia River Research Laboratory in the proper surgical tagging procedures. The 2007 VAMP program used net pen studies to assess overall condition and health of marked fish used in the acoustic tag study. Improvements were made in 2007 relative to measuring flow in the San Joaquin River downstream of the confluence with Old River.

SEE USEFUL WEB PAGES

CHAPTER 2

VAMP Hydrologic Planning and Implementation

This section documents the planning and implementation undertaken by the Hydrology Group of the San Joaquin River Technical Committee (SJRTC) for the 2007 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 2007, 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 potential installation of the HORB and the planning of Delta exports consistent with the VAMP.

2007 VAMP Summary

The Water Year 2007[1] winter was very dry in the San Joaquin River watershed, with seasonal precipitation in the San Joaquin Hydrologic Region (Cosumnes, Mokelumne, Stanislaus, Merced and San Joaquin Rivers) measuring only 65% of average on April 1, 2007. The forecasted April-July runoff as of April 1 in the four basins above Vernalis (Stanislaus, Tuolumne, Merced and San Joaquin) ranged from 41% to 52% of average. Water Year 2006 was classified as a Wet year as per the San Joaquin Valley Water Year Type Index (60-20-20), therefore a forecasted 90% exceedence forecast Water Year Type classification for 2007 of Dry or wetter would result in a double-step VAMP target flow for 2007. The only way for the 2007 VAMP not to be a double-step was for the 2007 Water Year Type Classification to be Critical. Due to continuing dry conditions, interrupted briefly by above average precipitation in March, the 90% exceedence forecast Water Year Type classification for 2007 as of April 1 was indeed Critical, thereby making the 2007 VAMP a single-step operation. Also, as a result of the critically dry conditions, the forecasted mean flow in the San Joaquin River near Vernalis for the VAMP test flow period of April 22 through May 22 was approximately 2,600 cfs, setting the VAMP target flow at the minimum value of 3,200 cfs.

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. VAMP planners and reservoir operators took part in conference calls twice a week during the implementation phase of VAMP to discuss the current status of the operation and make adjustments as needed. 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. The VAMP provides for a steady 31-day pulse flow (target flow) at the Vernalis gage on the San Joaquin River (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

[1]*Water Year 2007 is October 2006 through September 2007.*

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.

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	1,500, 2,250 or 3,000*

* Suggested rates at higher flows.

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 technical committees to evaluate the potential effect of flow and export variation on the ability to detect and assess variation in juvenile Chinook salmon survival.

Under the SJRA, the Merced, OID, SSJID, SJRECWA, MID and TID members of the San Joaquin River Group Authority (SJRGA) agencies have agreed to jointly provide the supplemental water needed to achieve the VAMP target flows, limited to a maximum of 110,000 acre-feet:. 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 Don Pedro Lake 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 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 2007 VAMP

The SJRTC met four times between January 23 and April 16 to discuss and plan the 2007 VAMP experiment and operation. 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 22 SJRTC meeting. Based upon the February 14 runoff forecast the VAMP target flow would follow the single-step criteria. The 90 percent exceedence runoff forecast indicated an existing flow of about 1,800 cfs and a corresponding VAMP target flow of 2,000 cfs. The 50 percent exceedence runoff forecast indicated an existing flow of about 2,800 and a corresponding VAMP target flow of 3,200 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. 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 at 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

The forecast of the ungaged flow is the factor with the greatest uncertainty in the development of the daily operation plan. By definition, the ungaged flow at Vernalis is the unmeasured flow entering or leaving

Table 2-3
Summary of Daily Operation Plans

Phase	VAMP Forecast Date	DWR Runoff Forecast Date	VAMP Target Flow Period	Single or Double Step	Assumed Ungaged Flow at Vernalis (cfs)	Existing Flow (cfs)	VAMP Target Flow (cfs)	Other Supplemental Water (acre-feet)	SJRGA Supplemental Water Requirement (acre-feet)
Planning	3/21/07	3/13/07	April 22 - May 22	Single	100	2,182	3,200	46,080 [1]	16,520
					500	2,582	3,200	46,080 [1]	0
			April 22 - May 22	Double	100	2,182	4,450	24,070 [1]	115,400
					500	2,582	4,450	28,060 [1]	86,800
	4/6/07	3/27/07	April 22 - May 22	Single	100	1,880	2,000	0	7,300
					300	2,080	3,200	0	68,790
					100	1,880	2,000	46,080 [1]	0
					300	2,080	3,200	46,080 [1]	22,670
	4/13/07	4/1/07	April 22 - May 22	Single	100	2,570	3,200	–	38,730
					300	2,770	3,200	–	26,430
	4/16/07	4/1/07	April 22 - May 22	Single	300	2,770	3,200	–	26,430
	4/18/07	4/1/07	April 22 - May 22	Single	300	2,700	3,200	–	30,500
Implementation	5/4/07	–	April 22 - May 22	Single	200 (5/4 - 5/22)	2,720	3,200	–	29,420

[1] Assumed b(2) water used on Stanislaus River was not part of existing flow, but offset a portion of the VAMP Supplemental Water requirement.

the system between the Vernalis gage and the upstream measuring points and is calculated as follows:

Ungaged flow at Vernalis = VNS - GDWlag - LGNlag - CRSlag - USJRlag

Where:

VNS = San Joaquin River near Vernalis

GDW = 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)).

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 salmon smolt at the MRH, 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. In its February meeting the SJRTC defined a VAMP target flow period of April 22 to May 22 for 2007 to allow the test smolt to mature to the desirable size.

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 in critically dry periods when the sum of VAMP numerical indicators for the previous two years

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	Time	Gage Height (ft)	Measured Flow (cfs)	Reported Real-time Flow (cfs)	Percent Difference	Rating Curve Shift Adjustment (ft.)
2/14/07	11:18	11.34	2,760	2,670	3.4%	-0.61
3/22/07	10:32	10.66	2,180	2,110	3.3%	-0.61
4/17/07	12:13	10.18	1,840	1,780	3.4%	-0.61
4/23/07	10:52	11.95	3,800	3,210	18.4%	0
4/30/07	11:26	11.88	3,230	3,700	-12.7%	-0.56
5/7/07	11:01	11.66	3,010	3,030	-0.7%	-0.59
5/15/07	11:05	11.79	3,440	3,170	8.5%	-0.25
6/18/07	11:42	10.10	1,690	2,560	-34.0%	-0.74

and the current year is equal to or less than four. The 60-20-20 water year classification for both 2005 and 2006 was "Wet" (VAMP numerical indicator of five), therefore there was no possibility of 2007 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 the 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. Since 2006 was a Wet year, a 2007 classification of Dry or wetter would result in a double-step target. The April 1 90% probability of exceedence forecast of the 60-20-20 water year classification was "Critical" making 2007 a "single-step" condition.

The initial daily operation plan was prepared on March 21. The daily operation plan was modified as hydrologic conditions and operational requirements changed. Table 2-3 provides a summary of the daily operation plans developed during the VAMP planning and implementation. The complete daily operation plans are provided in Appendix A-1, Tables 1 through 13.

Tributary Flow Coordination

Although the primary goal of the VAMP operation is to provide a stable target flow in the San Joaquin River near Vernalis, an important consideration in the planning and operation is that the flows that are scheduled on the Merced, Tuolumne and Stanislaus Rivers to achieve this goal are beneficial and do not conflict with studies or flow requirements on those rivers. During the development of the daily operation plan, the Hydrology Group consults with DFG and the tributary biological teams to determine periods when pulse flows and stable flows are desirable on the tributaries, what flow rates are desired, what rates of change are acceptable, and what minimum and maximum flows are acceptable.

For the 2007 VAMP operation the Stanislaus River was expected to be at a steady flow of 1,500 cfs and therefore providing no operational flexibility. For the other tributaries the plan was for a single pulse of about 12 days on the Merced River during the middle of the VAMP period surrounded by 7 to 9 day pulses on the Tuolumne River.

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Implementation

Operation Conference Calls

During implementation of the VAMP pulse flow, conference calls were conducted every Tuesday and Thursday between April 24 and May 18 at 6:30 A.M. to discuss the status of the pulse flow and to make operational changes if needed. The calls were held at 6:30 A.M. so that if operational changes were called for they could be implemented on that day.

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. The monitoring is done to assure that the supplemental water deliveries are adhering to the tributary allocations contained in the SJRA Division Agreement to the extent possible, as well as to determine if adjustments need to be made to the operation plan.

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 17 and May 15. The results of these measurements are summarized in Table 2-5.

The April 17 measurement indicated no change from the effective rating shift at that time which was -0.61 feet. However, on April 25 the USGS reported that they had measured a flow of 3,800 cfs on April 23, almost 600 cfs greater than the real-time flow of 3,210 cfs, and significantly exceeding the VAMP target flow of 3,200 cfs. This measurement resulted in a change in the rating curve shift from -0.61 feet to 0.0 feet. In response, the VAMP operation was adjusted by reducing tributary releases in an attempt to reduce the flow at Vernalis to bring it in line with the target flow. On May 1, just as the operation adjustments that had been made in response to the April 23rd measurement were being seen at Vernalis, the USGS reported that they had measured a flow of 3,280 cfs on April 30, 420 cfs less than the reported real-time flow of about 3,700 cfs. This measurement resulted in a change in the rating curve shift from 0.0 feet to -0.56 feet, almost identical to the shift in effect prior to the April 23rd measurement. Once again VAMP operations were adjusted in response, this time with increased tributary releases. The next flow measurement by the USGS was made May 7th and it agreed with the rating curve shift from the April 30th measurement. On May 16 the USGS reported that they had measured a flow of 3,440 cfs on May15, 270 cfs greater than the reported real-time flow of 3,170 cfs, changing the rating curve shift from -0.59 feet to -0.25 feet. It should be noted that the first flow measurement following the VAMP period was made on June 18th and resulted in a change in the rating curve shift from -0.25 feet to -0.74 feet. The Hydrology Group made every effort to manage the VAMP flow based on the available real-time flow data. Adjusting the 2007 operations to the changing USGS measurements resulted in a greater than desirable fluctuation in the VAMP flow. It is the author's opinion that the flow measurements made on April 23rd and May 15th are questionable for the following reasons:

• Numerous flow measurements surrounding the two questionable measurements were all in agreement with a rating curve shift of about -0.6 feet. The questionable measurements imply the repeated occurrence of significant sediment scour and deposition at the gage site, which seems unlikely considering the mean velocity at the gage site was no greater than 1.2 feet per second.

• Previous VAMP periods with similar target flows (2002, 2003 and 2004) showed little or no change in rating curve shifts during the VAMP operation.

• The variability in the mean daily flow is not reflected in the DWR Mossdale gage which is located about 12 miles downstream of the Vernalis gage and about 3 miles upstream of Old River as shown in Figure 2-2. There are no significant inflows or diversions from the San Joaquin River between the Vernalis and Mossdale gages at the subject flow rates.

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 July 30, 2007. 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 7, to illustrate the differences between the real-time and the provisional data.

The mean daily flow in the San Joaquin River at the Vernalis gage averaged 3,260 cfs during the VAMP target flow period (April 22 – May 22). Figure 2-3 shows the observed flow and the estimated existing (no VAMP) flow, along with the supplemental water contributions. The flow varied between 2,830 cfs and 3,790 cfs during the target flow period. The flow variability was the result of operations adjustments made in response to the reported USGS flow measurements and accompanying rating curve shifts. It is the author's opinion that the flow variability during the target flow period is likely not as large as indicated for the reasons noted previously. During the VAMP target flow period the gage height at the Vernalis gage varied from a maximum of 11.99 feet to a minimum of 11.38 feet, a difference of 0.61 feet. This gage height difference represents a flow of 510 cfs on the unadjusted rating curve, somewhat less than the 960 cfs range indicated by the gage record.

The sources of the flow at Vernalis are shown in Figure 2-4. Figures 2-5, 2-6 and 2-7 show the with and without VAMP flows at the tributary measurement points for the Merced River, Tuolumne River and Stanislaus River, respectively. A tabulation of the observed mean daily flows during and around the VAMP target flow period is provided in Table 2-6.

The mean daily ungaged flow at Vernalis averaged 214 cfs during the VAMP target flow period, ranging from a minimum of -62 cfs to a maximum of 749 cfs. A plot of the ungaged flow is provided in Figure 2-8.

As previously stated, the combined CVP and SWP Delta export rate target was 1,500 cfs. The observed exports, shown in Figure 2-9, averaged 1,486 cfs during the target flow period.

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 Don Pedro Lake, thereby resulting in potential impacts on reservoir storage as a result of the VAMP operation. Any storage impacts, though, would be offset by any water conservation measures that have been instituted as a result of the SJRA and that result in a reduced reliance on river diversions. 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.

Due to the flood control operations in 2006 there were no SJRA storage impacts entering the 2007.

If it is assumed that Merced ID diversions from the Merced River are the same as they would have been without the SJRA, then the storage impact on Lake McClure following the 2007 VAMP operation and Fall SJRA transfer would be 41,460 acre-feet, as shown in Figure 2-10. However, as a result of the SJRA, Merced ID has undertaken a number of conservation measures that have resulted in a reduced reliance on Merced River diversions. Any reductions in Merced River diversions would offset the storage deficit shown in Figure 2-10. The impact of the Merced ID SJRA related conservation measures on Merced River diversions have not yet been quantified. It should be noted that even under the assumption that the storage deficit is equal to the supplemental water contribution, the SJRA has resulted in no reductions in Merced River flow during the eight years of VAMP operation as shown in Appendix B-1, Figure 3.

The cumulative storage impact to Don Pedro Reservoir as a result of the 2007 VAMP operation is 4,370 acre-feet, as shown in Figure 2-11.

Summary of Historical VAMP Operations

2007 marks the eighth year of VAMP operation in compliance with D-1641. A summary of the VAMP target flows for these first eight years is provided in Table 2-7. A summary of the SJRGA supplemental water contributions is provided in Table 2-8. The SJRTC Hydrology Group monitors the cumulative impact of the SJRA on reservoir storage and stream flows. Plots of storage and flow impacts throughout the seven years of VAMP operation are provided in Appendix B-1, Figures 1 through 4.

Over the first eight 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.

Figure 2-2
2007 VAMP - Flow Comparison, San Joaquin River near Vernalis and San Joaquin River at Mossdale

Figure 2-3
2007 VAMP - San Joaquin River near Vernalis with and without VAMP

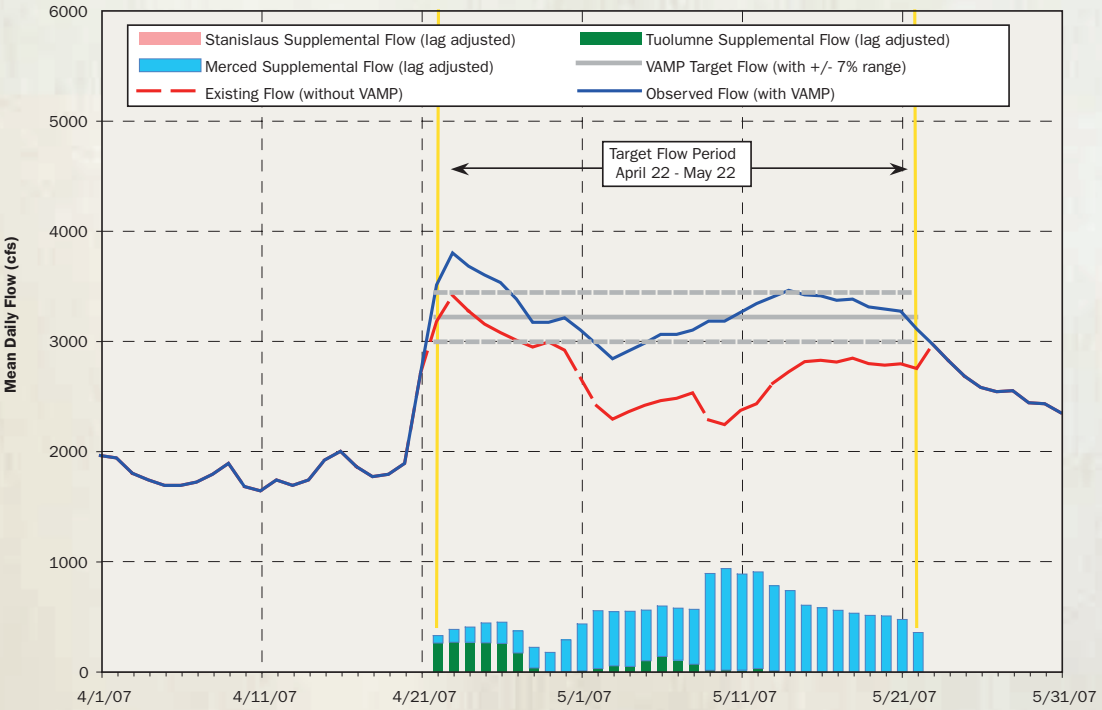


Figure 2-4
2007 VAMP: San Joaquin River near Vernalis
With Lagged Contributions from Primary Sources

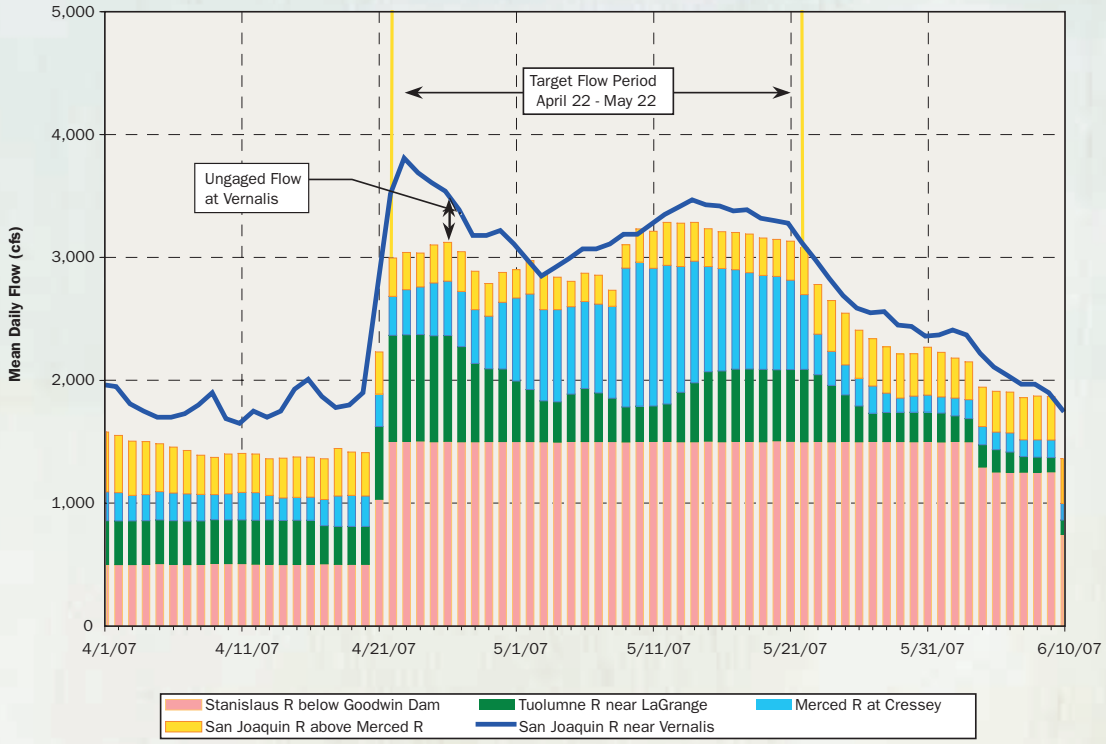


Figure 2-5
2007 VAMP - Merced River at Cressey with and without VAMP

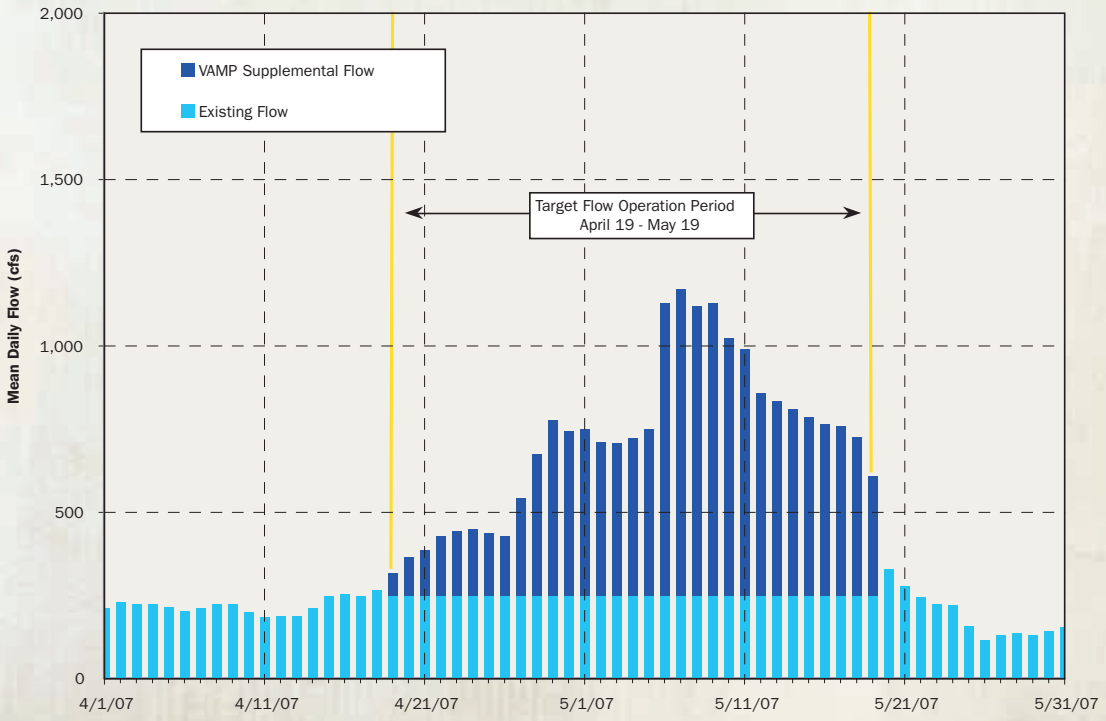


Figure 2-6
2007 VAMP - Tuolumne River below LaGrange Dam with and without VAMP

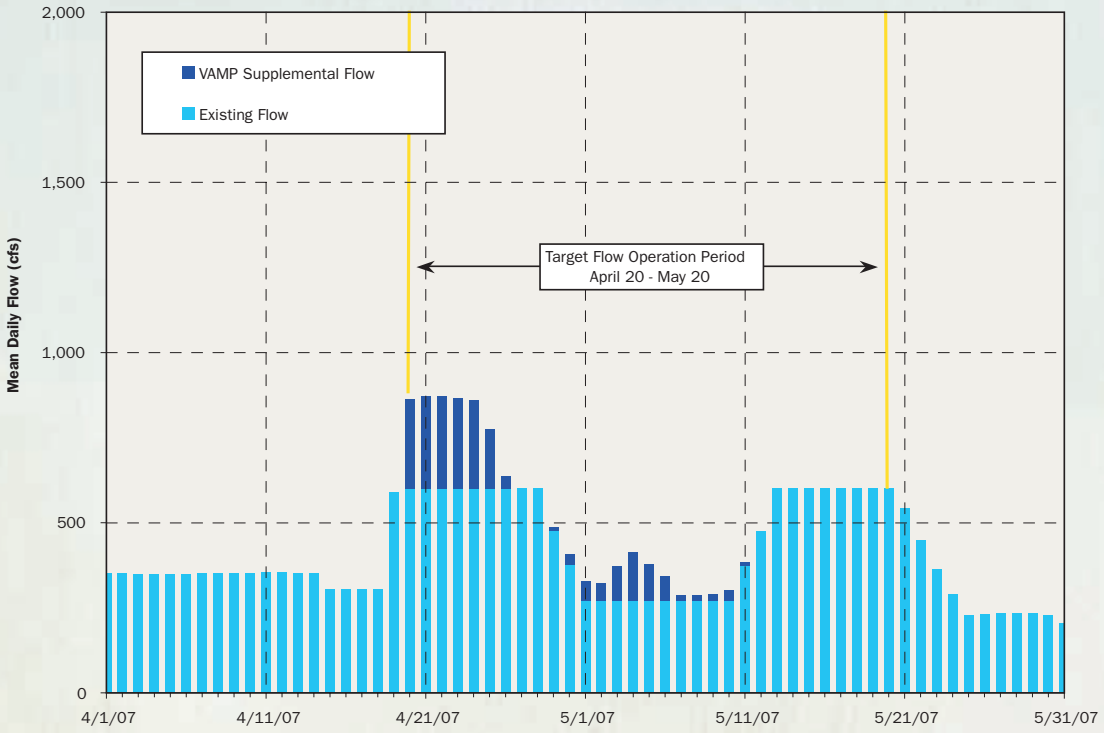


Figure 2-7
2007 VAMP - Stanislaus River below Goodwin Dam with and without VAMP

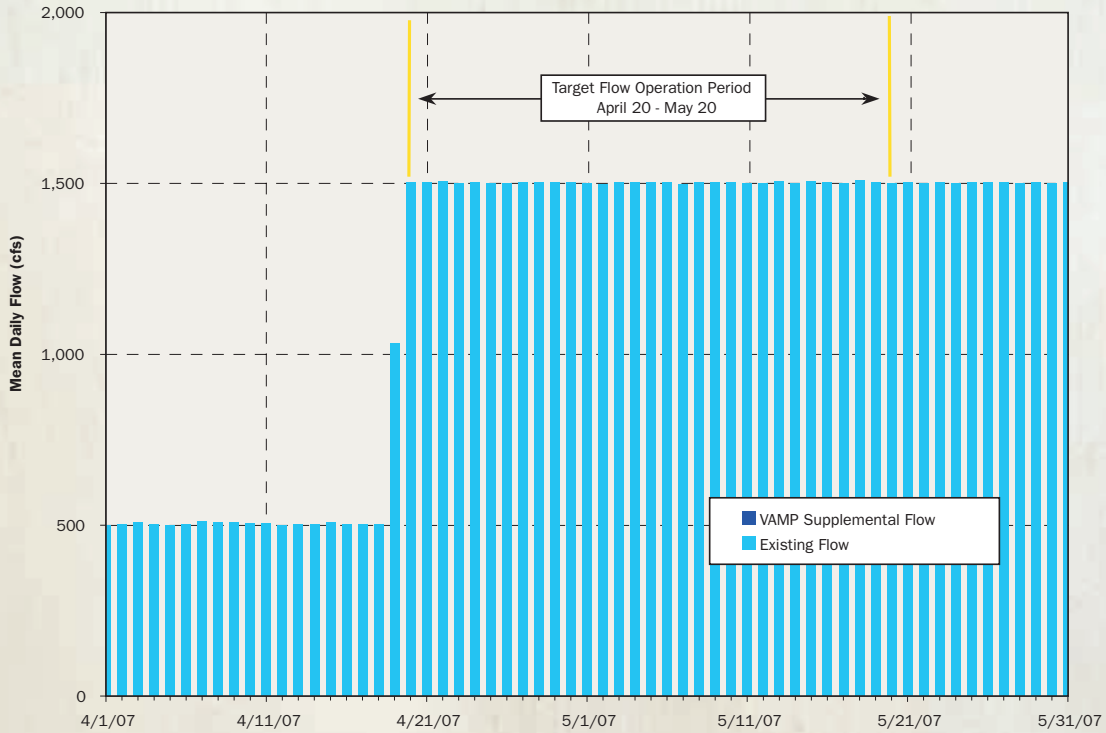


Table 2-6
2007 Vernalis Adaptive Management Plan (VAMP)
Final Flows and Accounting of Supplemental Water Contributions
Target Flow Period: April 22 - May 22 • Target Flow: greater than 3,200 cfs

	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 [2]	Vernalis Ungaged	San Joaquin River at Vernalis		
Date	Existing Flow [1] (cfs)	Observed Flow (cfs)	VAMP Supplemental Water (cfs)	Existing Flow [1] (cfs)	Observed Flow (cfs)	VAMP Supplemental Water (cfs)	Existing Flow [1] (cfs)	Observed Flow (cfs)	VAMP Supplemental Water (cfs)	Observed Flow (cfs)	Observed Flow (cfs)	Existing Flow [1] (cfs)	Observed Flow (cfs)	VAMP Supplemental Water (cfs)
04/01/07	213	213		351	351		500	500		442	372	1,950	1,950	
04/02/07	231	231		350	350		502	502		431	378	1,930	1,930	
04/03/07	225	225		349	349		509	509		389	284	1,790	1,790	
04/04/07	224	224		349	349		503	503		373	228	1,730	1,730	
04/05/07	216	216		348	348		500	500		352	196	1,680	1,680	
04/06/07	204	204		349	349		502	502		318	224	1,680	1,680	
04/07/07	213	213		350	350		510	510		304	280	1,710	1,710	
04/08/07	224	224		350	350		508	508		324	389	1,780	1,780	
04/09/07	225	225		350	350		508	508		318	506	1,880	1,880	
04/10/07	199	199		351	351		504	504		314	269	1,670	1,670	
04/11/07	183	183		355	355		504	504		298	224	1,630	1,630	
04/12/07	187	187		353	353		500	500		325	330	1,730	1,730	
04/13/07	188	188		352	352		503	503		328	318	1,680	1,680	
04/14/07	213	213		352	352		503	503		326	363	1,730	1,730	
04/15/07	247	247		304	304		507	507		332	534	1,910	1,910	
04/16/07	253	253		303	303		503	503		386	615	1,990	1,990	
04/17/07	248	248		303	303		503	503		352	488	1,850	1,850	
04/18/07	265	265		303	303		503	503		352	315	1,760	1,760	
04/19/07	250	318	68	590	590		1,032	1,032		343	364	1,780	1,780	
04/20/07	250	367	117	600	863	263	1,503	1,503	0	312	469	1,880	1,880	
04/21/07	250	388	138	600	870	270	1,503	1,503	0	302	468	2,700	2,700	
04/22/07	250	430	180	600	870	270	1,507	1,507	0	275	504	3,169	3,500	331
04/23/07	250	443	193	600	866	266	1,501	1,501	0	309	749	3,403	3,790	387
04/24/07	250	448	198	600	860	260	1,504	1,504	0	316	634	3,262	3,670	408
04/25/07	250	438	188	600	774	174	1,501	1,501	0	324	488	3,144	3,590	446
04/26/07	250	429	179	600	637	37	1,500	1,500	0	312	397	3,067	3,520	453
04/27/07	250	542	292	600	592	0	1,502	1,502	0	265	323	2,998	3,370	372
04/28/07	250	676	426	600	591	0	1,502	1,502	0	243	273	2,935	3,160	225
04/29/07	250	777	527	475	486	11	1,502	1,502	0	231	372	2,981	3,160	179
04/30/07	250	743	493	375	406	31	1,502	1,502	0	273	322	2,908	3,200	292
05/01/07	250	749	499	270	326	56	1,500	1,500	0	286	189	2,653	3,090	437
05/02/07	250	711	461	270	322	52	1,497	1,497	0	264	(16)	2,402	2,960	558
05/03/07	250	708	458	270	372	102	1,504	1,504	0	207	(32)	2,281	2,830	549
05/04/07	250	723	473	270	412	142	1,502	1,502	0	230	61	2,349	2,900	551
05/05/07	250	749	499	270	377	107	1,502	1,502	0	235	163	2,407	2,970	563
05/06/07	250	1,129	879	270	341	71	1,502	1,502	0	130	178	2,450	3,050	600
05/07/07	250	1,172	922	270	286	16	1,498	1,498	0	190	194	2,470	3,050	580
05/08/07	250	1,121	871	270	287	17	1,503	1,503	0	270	357	2,520	3,090	570
05/09/07	250	1,129	879	270	288	18	1,504	1,504	0	300	67	2,275	3,170	895
05/10/07	250	1,024	774	270	301	31	1,504	1,504	0	350	(62)	2,231	3,170	939
05/11/07	250	989	739	375	385	10	1,501	1,501	0	352	37	2,361	3,250	889
05/12/07	250	857	607	475	469	0	1,500	1,500	0	316	44	2,420	3,330	910
05/13/07	250	834	584	600	565	0	1,505	1,505	0	307	111	2,606	3,390	784
05/14/07	250	810	560	600	579	0	1,501	1,501	0	299	165	2,711	3,450	739
05/15/07	250	785	535	600	590	0	1,505	1,505	0	303	176	2,803	3,410	607
05/16/07	250	764	514	600	593	0	1,503	1,503	0	314	190	2,816	3,400	584
05/17/07	250	758	508	600	593	0	1,500	1,500	0	305	156	2,800	3,360	560
05/18/07	250	727	477	600	583	0	1,508	1,508	0	301	179	2,835	3,370	535
05/19/07	250	609	359	600	589	0	1,503	1,503	0	317	142	2,786	3,300	514
05/20/07	329	329		600	591	0	1,501	1,501	0	382	134	2,772	3,280	508
05/21/07	278	278		541	541		1,504	1,504		404	128	2,783	3,260	477
05/22/07	245	245		447	447		1,500	1,500		413	20	2,741	3,100	359
05/23/07	225	225		363	363		1,504	1,504		420	181	2,960	2,960	
05/24/07	222	222		290	290		1,501	1,501		392	160	2,810	2,810	
05/25/07	157	157		229	229		1,503	1,503		385	123	2,670	2,670	
05/26/07	116	116		232	232		1,502	1,502		377	161	2,570	2,570	
05/27/07	132	132		234	234		1,502	1,502		359	191	2,530	2,530	
05/28/07	138	138		234	234		1,501	1,501		345	267	2,540	2,540	
05/29/07	132	132		234	234		1,504	1,504		390	215	2,430	2,430	
05/30/07	144	144		229	229		1,499	1,499		363	203	2,420	2,420	
05/31/07	154	154		203	203		1,504	1,504		326	70	2,340	2,340	
VAMP Period														
Average (cfs):	250	721		471	538		1,502	1,502		285	214	2,721	3,263	
Supplemental Water (ac-ft):			28,960			4,370			0					33,330

VAMP Period

[1] Existing Flow: Flow that would have occured without VAMP operation.

[2] Upper SJR = Flow in San Joaquin River above Merced River = San Joaquin River at Newman minus Merced River at Stevinson.

Observed Flow Sources:

Merced River at Cressey (CA DWR B05155): California DWR, Water Data Library, 7/30/07

Merced River near Stevinson (CA DWR B05125): California DWR, Water Data Library. 7/30/07

Tuolumne River below LaGrange Dam near LaGrange (USGS 11289650): USGS, provisional data as of 7/30/07

Stanislaus River below Goodwin Dam: USBR, Goodwin Reservoir Daily Operations Report - OID/SSJID/Tri-Dams, 6/18/07 (April report) and 6/26/07 (May report)

San Joaquin River near Vernalis (USGS 11303500): USGS, provisional data as of 7/30/07

San Joaquin River at Newman (USGS 11274000): USGS, provisional data as of 7/30/07

Table 2-7
Summary of VAMP Flows, 2000-2007

VAMP Target Flow Period	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)
4/15 - 5/15, 2000	Above Normal	4	5,700	5,869	4,800	77,680	2,250	2,155
4/20 - 5/20, 2001	Dry	2	4,450	4,224	2,909	78,650	1,500	1,420
4/15 - 5/15, 2002	Dry	2	3,200	3,301	2,757	33,430	1,500	1,430
4/15 - 5/15, 2003	Below Normal	3	3,200	3,235	2,290	58,065	1,500	1,446
4/15 - 5/15, 2004	Dry	2	3,200	3,155	2,088	65,591	1,500	1,331
5/1 - 5/31, 2005	Wet	5	>7,000	10,390	10,390	0	2,250	2,986 [a]
5/1 - 5/31, 2006	Wet	5	>7,000	26,220/24,262 [b]	26,020	0	1,500/6,000	1,559/5,748 [b]
4/22 - 5/22, 2007	Critical	1	3,200	3,263	2,721	33,330	1,500	1,486

[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.
[b] "First fish release-recapture period"/"Second fish release-recapture period"

Table 2-8
Summary of VAMP Supplemental Water Contributions, 2000-2007

Year	VAMP Supplemental Water (acre-feet)		Supplemental Water (acre-feet) Merced ID	Oakdale ID	South San Joaquin ID	SJRECWA	Modesto ID	Turlock ID
2000	77,680	Observed:	46,750	[a]	[b]	8,280	15,200	7,450
		Division Agreement:	45,160	[a]	[b]	7,300	16,920	8,300
		Deviation:	+ 1590			+ 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	[c]	5,000	5,000
		Deviation:	+ 192	+ 39	+ 39		-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	[c]	5,000	5,000
		Deviation:	+ 1,180	- 1165.5	- 1165.5		+ 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
2006	0	Observed:	0	0	0	0	0	0
		Division Agreement:	0	0	0	0	0	0
		Deviation:	0	0	0	0	0	0
2007	33,330	Observed:	28,960	2,185 [d]	2,185 [d]	0	0	0
		Division Agreement:	25,000	4,165	4,165	0	0	0
		Deviation:	+ 3,960	- 1,980	- 1,980	0	0	0

[a] Provided by Modesto ID
[b] Provided by Merced ID (54.55%), Oakdale ID (15.91%), Modesto ID (15.91%) and Turlock ID (13.64%)
[c] Provided by Merced ID
[d] Provided by Modesto ID/Turlock ID on the Tuolumne River due to flow constraints on the Stanislaus River

Figure 2-8
2007 VAMP - Ungaged Flow in San Joaquin River at Vernalis

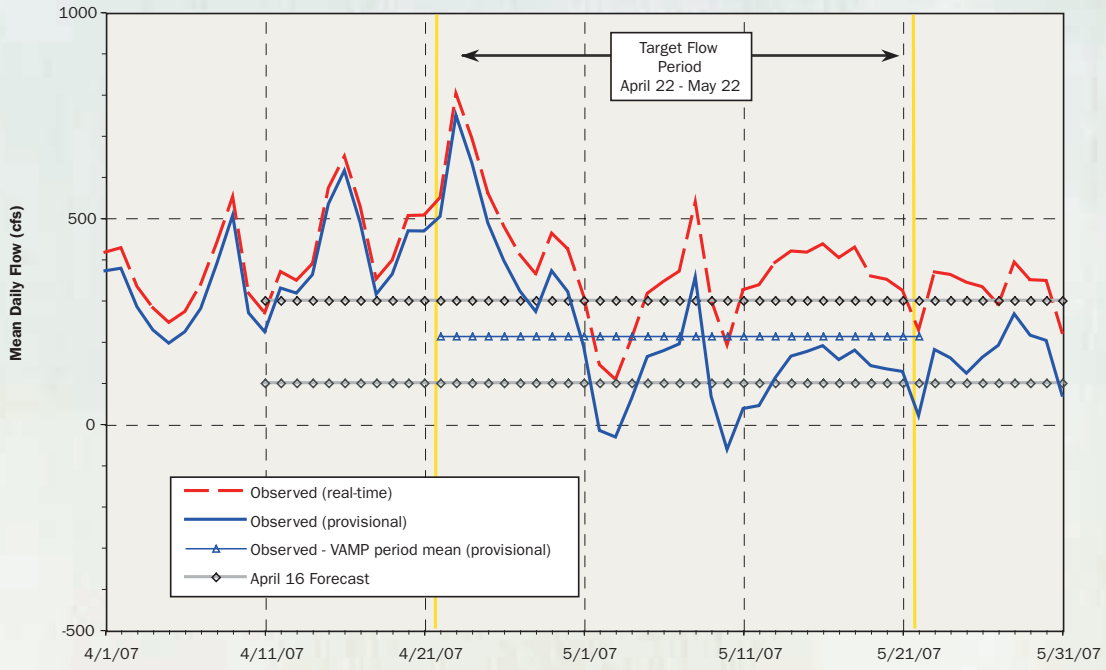


Figure 2-9
2007 VAMP - Federal and State Delta Exports

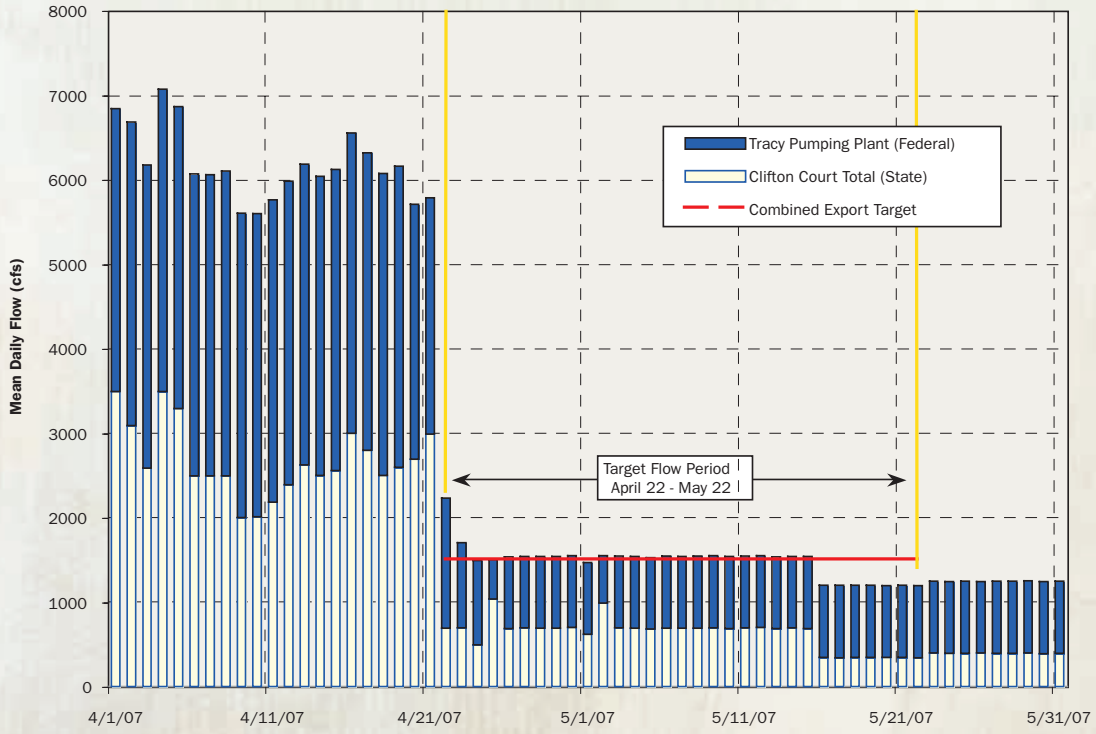


Figure 2-10
San Joaquin River Agreement Storage and Flow Impacts
Merced River - Lake McClure Storage and Release - 2007

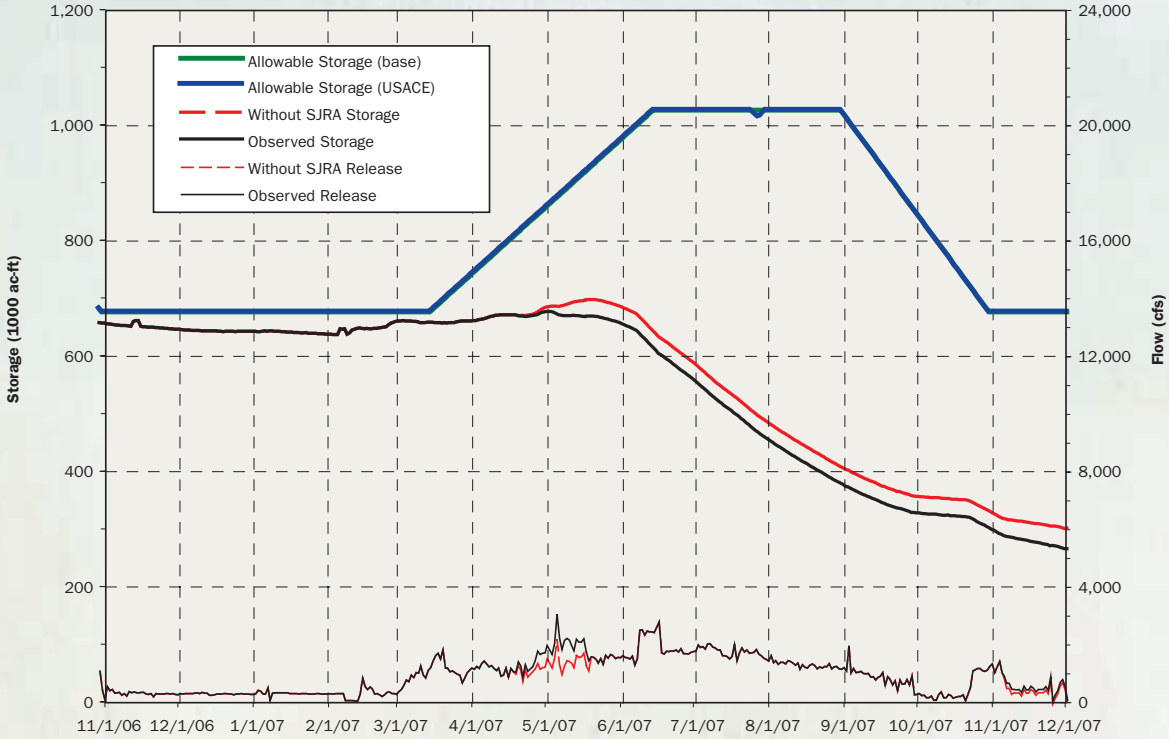
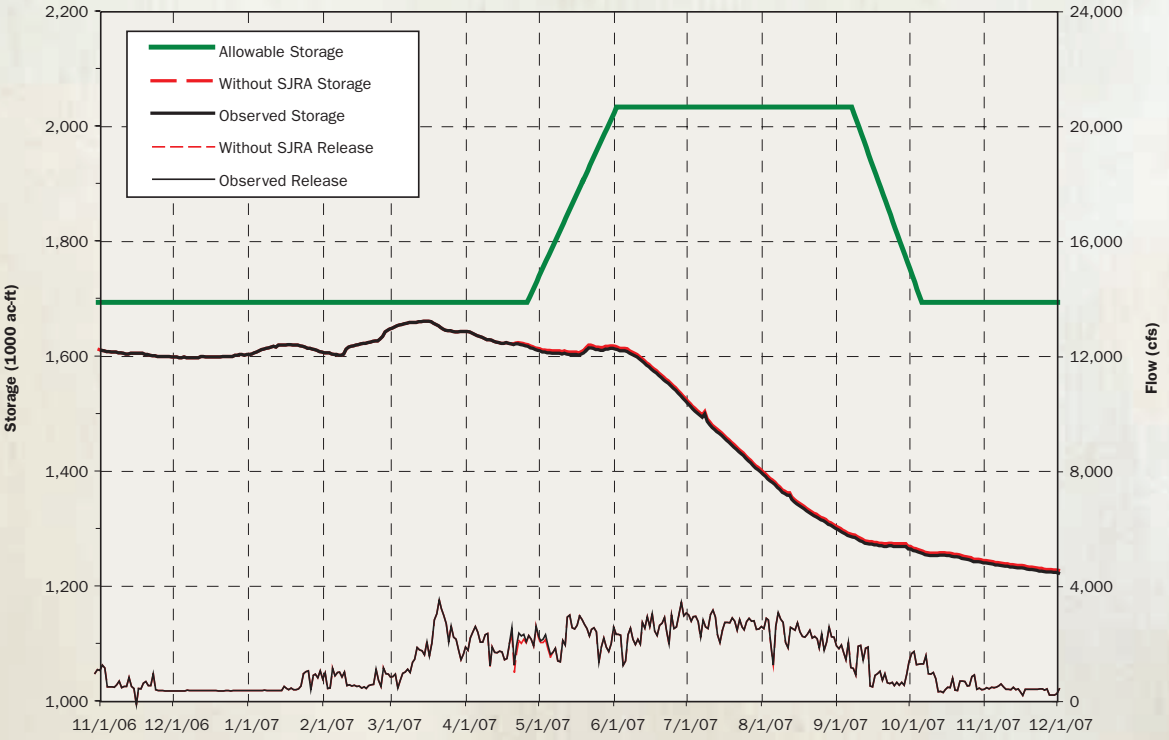


Figure 2-11
San Joaquin River Agreement Storage and Flow Impacts
Tuolumne River - New Don Pedro Reservoir Storage and Release - 2007



CHAPTER 3

ADDITIONAL WATER SUPPLY ARRANGEMENTS & DELIVERIES

Paragraph 8.4 of the SJRA states that "Merced Irrigation District (Merced) shall provide, and the USBR shall purchase 12,500 acre-feet of water…during October of all years." The SJRA also states in Paragraph 8.4.4 that "Water purchased pursuant to Paragraph 8.4 may be scheduled for months other than October provided Merced, DFG and USFWS all agree." Paragraph 8.5 of the SJRA states that "Oakdale Irrigation District (OID) shall sell 15,000 acre-feet of water to the USBR in every year of this Agreement." Paragraph 8.5 also states that "in addition to the 15,000 acre-feet, Oakdale will sell the difference between the water made available to VAMP under the SJRGA agreement and 11,000 acre-feet," which is referred to as the Difference Water. The purpose of additional water supply deliveries in the fall months is to provide instream flows to attract and assist adult salmon during spawning.

Merced Irrigation District

The Paragraph 8.4 water is referred to as the Fall SJRA Transfer Water. The daily schedule for the Fall SJRA Transfer Water is developed by the California Department of Fish and Game (DFG), United States Fish and Wildlife Services (USFWS) and Merced ID.

In addition to providing water in the fall of 2007 pursuant to the Agreement, Merced entered into a contract with USBR to transfer up to 25,000 acre-feet of water to the CALFED Environmental Water Account (EWA). This additional water transfer is referred to as the EWA Transfer Water. The EWA Transfer Water was to be delivered south of the Delta via the CVP Jones Pumping Plant and/or the SWP Banks Pumping Plant, depending on the availability of excess pumping capacity. Since the likelihood of having excess pumping capacity decreases near the end of the year, the EWA Transfer Water was scheduled to be provided first followed by the Fall SJRA Transfer Water. The schedule for the Merced 2007 fall water transfers was finalized on September 27, 2007, with the EWA Transfer Water to be provided from October 24 through November 8 and the Fall SJRA Transfer Water to be provided from November 6 through December 31, as shown in Table 3-1 and Figure 3-1. Table 3-1 also includes the final accounting for the period with provisional flow data available at the time of the writing of this report.

Oakdale Irrigation District

The combined Paragraph 8.5 water is referred to as the OID Additional Water.

OID provided 2,185 acre-feet of supplemental water for the 2007 VAMP operation, therefore the amount of additional water purchased by the USBR from OID was 23,815 acre-feet (15,000 acre-feet plus 8,815 acre-feet of Difference Water). The OID additional water is made available in New Melones reservoir for use by the USBR for any authorized purpose of the New Melones project.

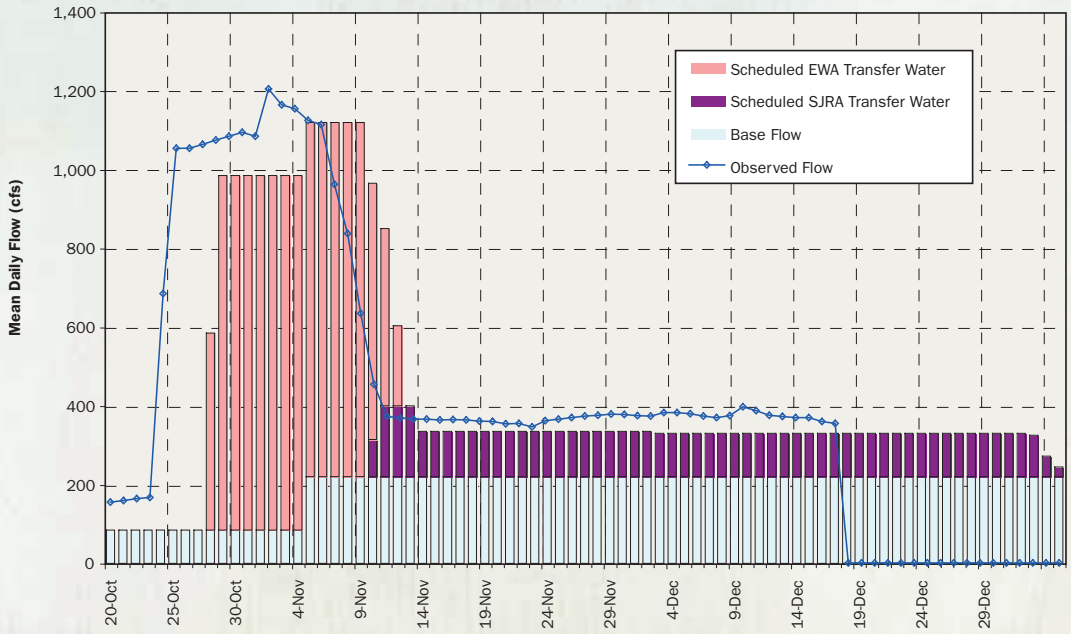
The 23,815 ac-ft of OID Additional Water was released from May 21, 2007 through June 1, 2007 to provide supplemental flow to the Stanislaus River for fishery purposes.

Table 3-1
2007 Merced Irrigation District Fall Water Transfers
Daily Summary

		SCHEDULED					OBSERVED				
		SJRA Transfer [Nov. 6 - Dec. 31]		EWA Transfer [Oct. 24 - Nov. 8]				SJRA Transfer [Nov. 6 - Dec. 31]		EWA Transfer [Oct. 24 - Nov. 8]	
Date	Base Flow at Shaffer Br/ Cressey (cfs)	SJRA Transfer Water Flow (cfs)	Cumulative SJRA Transfer Water Volume (acre-ft)	EWA Transfer Water (cfs)	EWA Transfer Balance (acre-ft)	Target Flow at Shaffer Br/ Cressey (cfs)	Shaffer Br/ Cressey Flow (cfs)	SJRA Transfer Water Flow (cfs)	Cumulative SJRA Transfer Water Volume (acre-ft)	EWA Transfer Water Flow (cfs)	Cumulative EWA Transfer Water Volume (acre-ft)
20-Oct	85	0	0	0	0	85	154				
21-Oct	85	0	0	0	0	85	158				
22-Oct	85	0	0	0	0	85	163				
23-Oct	85	0	0	0	0	85	166				
24-Oct	85	0	0	500	992	585	682			597	1,184
25-Oct	85	0	0	900	2,777	985	1,050			965	3,098
26-Oct	85	0	0	900	4,562	985	1,050			965	5,012
27-Oct	85	0	0	900	6,347	985	1,060			975	6,946
28-Oct	85	0	0	900	8,132	985	1,070			985	8,900
29-Oct	85	0	0	900	9,917	985	1,080			995	10,874
30-Oct	85	0	0	900	11,702	985	1,090			1,005	12,867
31-Oct	85	0	0	900	13,488	985	1,080			995	14,841
1-Nov	220	0	0	900	15,273	1,120	1,200			980	16,785
2-Nov	220	0	0	900	17,058	1,120	1,160			940	18,649
3-Nov	220	0	0	900	18,843	1,120	1,150			930	20,494
4-Nov	220	0	0	900	20,628	1,120	1,120			900	22,279
5-Nov	220	0	0	900	22,413	1,120	1,110			890	24,044
6-Nov	220	95	188	650	23,702	965	959	95	188	644	25,321
7-Nov	220	180	545	450	24,595	850	834	180	545	434	26,182
8-Nov	220	180	902	204	25,000	604	632	180	902	232	26,642
9-Nov	220	180	1,260	0		400	452	232	1,362		
10-Nov	220	115	1,488	0		335	371	151	1,662		
11-Nov	220	115	1,716	0		335	367	147	1,954		
12-Nov	220	115	1,944	0		335	364	144	2,240		
13-Nov	220	115	2,172	0		335	364	144	2,526		
14-Nov	220	115	2,400	0		335	362	142	2,808		
15-Nov	220	115	2,628	0		335	363	143	3,092		
16-Nov	220	115	2,856	0		335	362	142	3,374		
17-Nov	220	115	3,084	0		335	359	139	3,650		
18-Nov	220	115	3,312	0		335	358	138	3,924		
19-Nov	220	115	3,540	0		335	352	132	4,186		
20-Nov	220	115	3,769	0		335	353	133	4,450		
21-Nov	220	115	3,997	0		335	344	124	4,696		
22-Nov	220	115	4,225	0		335	360	140	4,974		
23-Nov	220	115	4,453	0		335	364	144	5,260		
24-Nov	220	115	4,681	0		335	368	148	5,554		
25-Nov	220	115	4,909	0		335	372	152	5,855		
26-Nov	220	115	5,137	0		335	374	154	6,160		
27-Nov	220	115	5,365	0		335	377	157	6,471		
28-Nov	220	115	5,593	0		335	376	156	6,780		
29-Nov	220	110	5,812	0		330	373	153	7,083		
30-Nov	220	110	6,030	0		330	372	152	7,384		
1-Dec	220	110	6,248	0		330	381	161	7,703		
2-Dec	220	110	6,466	0		330	381	161	8,022		
3-Dec	220	110	6,684	0		330	378	158	8,335		
4-Dec	220	110	6,902	0		330	372	152	8,636		
5-Dec	220	110	7,121	0		330	368	148	8,930		
6-Dec	220	110	7,339	0		330	373	153	9,233		
7-Dec	220	110	7,557	0		330	395	175	9,580		
8-Dec	220	110	7,775	0		330	386	166	9,909		
9-Dec	220	110	7,993	0		330	374	154	10,214		
10-Dec	220	110	8,212	0		330	371	151	10,514		
11-Dec	220	110	8,430	0		330	368	148	10,808		
12-Dec	220	110	8,648	0		330	368	148	11,102		
13-Dec	220	110	8,866	0		330	358	138	11,376		
14-Dec	220	110	9,084	0		330	353	133	11,640		
15-Dec	220	110	9,302	0		330	[1]				
16-Dec	220	110	9,521	0		330	[1]				
17-Dec	220	110	9,739	0		330	[1]				
18-Dec	220	110	9,957	0		330	[1]				
19-Dec	220	110	10,175	0		330	[1]				
20-Dec	220	110	10,393	0		330	[1]				
21-Dec	220	110	10,612	0		330	[1]				
22-Dec	220	110	10,830	0		330	[1]				
23-Dec	220	110	11,048	0		330	[1]				
24-Dec	220	110	11,266	0		330	[1]				
25-Dec	220	110	11,484	0		330	[1]				
26-Dec	220	110	11,702	0		330	[1]				
27-Dec	220	110	11,921	0		330	[1]				
28-Dec	220	110	12,139	0		330	[1]				
29-Dec	220	105	12,347	0		325	[1]				
30-Dec	220	52	12,450	0		272	[1]				
31-Dec	220	25	12,500	0		245	[1]				

[1] Provisional mean daily flow data not available at time of publication.

Figure 3-1
Merced I.D. Fall 2007 Water Transfers Merced River at Shaffer Bridge/Cressey



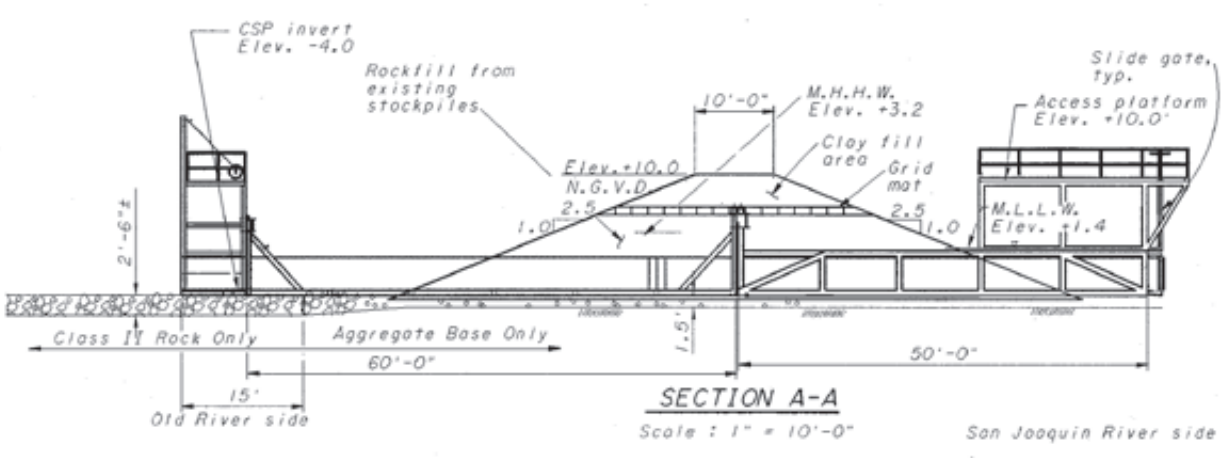
CHAPTER 4

HEAD OF OLD RIVER BARRIER

Barrier Design, Installation and Operation

Installation of the2007 temporary spring Head of Old River Barrier (HORB) was completed on April 20, two days earlier than scheduled, with the initial operation commencing on April 22. Construction clean-up continued for a short period of days following the initial operation. The spring HORB is a component of the south delta Temporary Barriers Project (TBP). The TBP mitigates for low water levels in the south delta and improves water circulation and quality for agricultural purposes

Figure 4-1
Spring Head of Old River Barrier Cross Section



The spring HORB was first constructed in 1992. Since then, the barrier has been installed in 1994, 1996, 1997, 2000, 2001, 2002, 2003, 2004 and 2007. The 1997 barrier included two open culverts, while the 2000 through 2007 barriers included six operable culverts. The HORB was not installed in 1993, 1995, 1998, 2005, and 2006 due to high San Joaquin River flows. The HORB was not installed in 1999 due to landowner access problems. The HORB, a key component of VAMP, is intended to increase San Joaquin River Chinook salmon smolt survival by preventing them from entering Old River.

Beginning in 2001, the barrier design included two versions. A "low-flow" barrier when San Joaquin River target flows are below 7,000 cfs would be built to a height of 10 feet mean sea level (MSL). A "high-flow" barrier for the target flow of 7,000 cfs would be built to a height of 11 feet MSL and additional material would be placed to raise the abutments to 13 feet MSL. Both barrier versions are equipped with six 48-inch diameter operable culverts and an overflow weir back-filled with clay. In 2007, the low-flow version was installed.

The dimensions of the 2007 HORB (Figure 4-1) were similar to the 2000, 2001, 2002, 2003, and 2004 HORB. The base width of the HORB in 2007 was 100 feet and the crest elevation was 10 feet MSL. The top of HORB was constructed with a 75-foot wide notch, protected with concrete grid mats and back-filled with clay. The HORB was designed to safely operate with flows corresponding to stages up to 8.5 feet MSL.

To help mitigate anticipated low water levels in the south delta (downstream of the HORB) caused by the operation of the HORB, two open culverts were installed in the barrier beginning in 1997, and six operable culverts were installed beginning in 2000. Operation of the culverts is controlled by slide gates located on the

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upstream side of HORB. DWR relied on daily modeling and field data collection to monitor water levels at three locations within the south Delta to determine when and how long to operate the culverts. Generally, the model forecasts would tend to forecast low-low water levels lower than actual levels observed in the field. Consequently, DWR takes this into consideration when making decisions regarding the culvert operations.

The downstream outlet of each culvert was designed so fyke nets could be attached to evaluate fish passage. DFG staff conducted a fishery-monitoring program as part of the 2007 HORB operations.

Permitting and Construction

The various permit conditions that are placed on the Temporary Barriers Program, by the USFWS, National Marine Fisheries Service (NMFS), and DFG, require that in-water construction activities for the Head of Old River (HOR), Middle River (MR), and Old River at Tracy (ORT) barriers can begin no earlier than April 7. In addition, construction of the northern abutment and boat ramps of the Grant Line Canal (GLC) barrier and construction of out-of-water portions of the HOR, MR, and ORT barriers may not be started any earlier than April 1. Full closure of the GLC barrier is not required but construction of the north abutment and boat ramps must be completed to the extent that full barrier closure and operation can be readily achieved in a reasonable time frame, if and when directed by DWR. The permit conditions also require that all the above work be completed by April 15th, a total of 15 working days. Following is a brief summary of the various permit conditions:

USFWS Biological Opinion
(1-1-01-F-81 dated March 30, 2001)

1) The spring HORB barrier installation may begin on April 1 but in-water work shall not occur until April 7, except for construction necessary to place the scour pad and the pad for the culverts (item No. 8, page 6);

2) DWR may begin construction of the Middle River barrier on April 1 but in-water work shall not occur until after April 7 (item No. 1, page 4);

3) DWR may begin construction of the Old River at Tracy barrier on April 1 but in-water work shall not commence before April 7 (item No. 2, page 4);

4) DWR may begin construction of the northern abutment and the boat ramp of the GLC barrier on April 1 provided that the HOR barrier is being constructed concurrently (item No. 3, page 5).

NMFS Biological Opinion
(SWR-00-SA-289: MEA on the proposed ACOE permit (200000696) filed on December 4, 2000)

1) The spring HORB installation shall begin on April 1 (item 8, page 8);

2) The MR barrier construction may begin on April 7 (item 1, page6);

3) The ORT barrier construction may begin on April 1 (item2, page 6);

4) The northern abutment and boat ramp of the GLC barrier may begin construction on April 1 provided that the HORB is being constructed concurrently (item 3, page 7).

DFG 1601 – HORB
(2081-2001-009-BD dated April 4, 2001)

HORB Spring Installation – All work in or near the stream zone will be confined to the period beginning no earlier than April 1

DFG 1601 – Agricultural Barriers

MR - All work in or near the stream zone will be confined to the period beginning no earlier than March 1

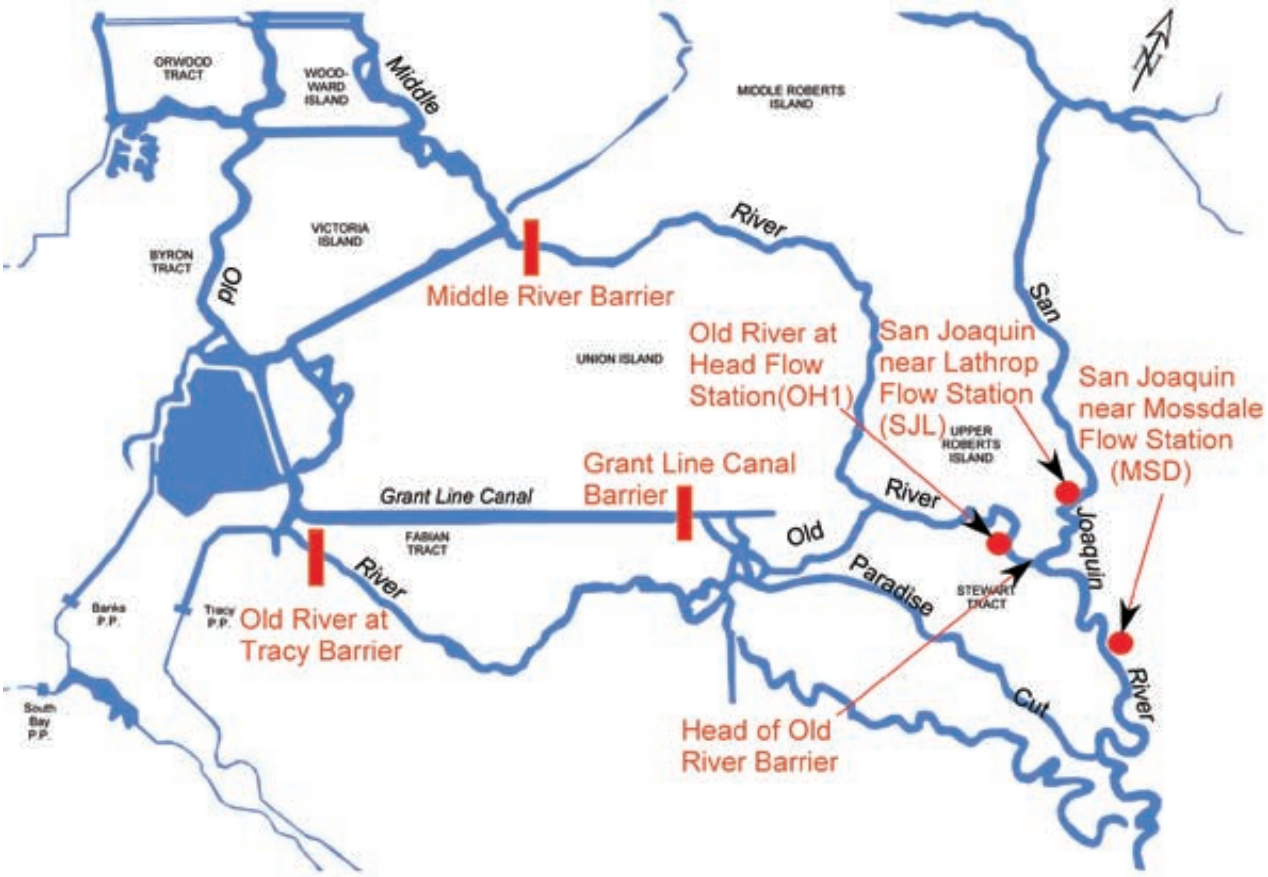
ORT – All work in or near the stream zone will be confined to the period beginning no earlier than April 1

GLC - All work in or near the stream zone will be confined to the period beginning no earlier than April 1

In addition to the above conditions, water users of the South Delta Water Agency (SDWA) and the fisheries agencies impose separate mitigation requirements on DWR for installation and operation of the HORB by itself. As a result, DWR's contractor must sequentially close and start operation of the MR and ORT barriers, and complete as much construction of north abutment and boat ramps on the GLC barrier as possible, before they can close and operate the HORB.

From the contractors point of view there are really two milestones that must be completed in sequence. First and foremost is to obtain closure and operation of the barriers in accordance with the conditions imposed by the project permits/biological opinions and mitigation requirements. The second is to satisfy DWR's contract specifications. The first milestone can be achieved within the required 15 working days but it is unlikely that the contractor can complete the entire amount of work required to satisfy DWR's contract specifications within the same time period.

Figure 4-2
South Delta Temporary Barriers



Therefore, the contractor's construction activities consist of placing enough materials to make sure they obtain closure and operation by April 15th, then following closure they continue placing barrier material above the water line until barrier construction is completed in accordance with DWR's contract specifications. The contractor then conducts site cleanup and demobilizes from the site. This is why work usually continues above water line beyond the April 15 deadline.

Barrier Operations and Monitoring Plan

A barrier operations and monitoring plan was developed based on forecasting and monitoring of tidal conditions. DWR determined the number of culverts to be opened at the HORB so that water levels at Old River near Tracy Road Bridge and Grant Line above Doughty Cut would remain above 0.0 feet MSL and Middle River near Howard Road above 0.3 feet MSL. Based on modeling results and/or field monitoring of water levels in the south delta, six culverts were open after the barrier's closure date of April 20, 2007. On April 26, 2007 three of the culverts were closed, but were reopened on May 16, 2007 because of the concern over the Delta Smelt.

Flow Measurements at and Around the Head of Old River

DWR operates two Acoustic Doppler Current Meters (ADCM) in the vicinity of head of Old River, one in the San Joaquin River 1,500 feet downstream of Old River (San Joaquin River below Old River near Lathrop, SJL) and another in Old River 840 feet downstream of the head of Old River (Old River at Head, OH1). A third acoustical Doppler was installed last year at the abutment of the railroad bridge near Mossdale (Figure 4-2). The ADCMs record velocity measurements at a 15 minute interval from which flow values can be determined. Table 4-1 lists the daily minimum, maximum and mean flows for the March 25, 2007 through June 30, 2007 period for the three ADCMs. Figures 4-3, 4-4, and 4-5 show the daily flow range and the mean for the Old River at Head gage, the San Joaquin River below Old River gage, and the San Joaquin River at Mossdale gage respectively.

Table 4-2 shows the mean daily flow of the San Joaquin River gage at Mossdale and the San Joaquin River near Vernalis gage for the duration from April 1, 2007

Table 4-1
Measured Flows in San Joaquin River at Mossdale, Old River at Head and San Joaquin River below Old River.

	Old River at Head (OH1)			San Joaquin River below Old River (SJL)			San Joaquin River at Mossdale (MSD)			Flow Split (% of Total Flow)	
Date	Minimum Flow (cfs)	Maximum Flow (cfs)	Mean Flow (cfs)	Minimum Flow (cfs)	Maximum Flow (cfs)	Mean Flow (cfs)	Minimum Flow (cfs)	Maximum Flow (cfs)	Mean Flow (cfs)	OH1	SJL
3/25/2007	1,210	2,100	1,700	-1,070	1,900	638	1,110	2,900	2,190	72.7%	27.3%
3/26/2007	869	2,210	1,680	-775	1,960	682	1,340	2,920	2,190	71.1%	28.9%
3/27/2007	898	2,380	1,630	-1,090	1,920	556	1,060	2,710	2,060	74.6%	25.4%
3/28/2007	870	2,120	1,570	-899	1,880	580	1,330	2,580	2,090	73.0%	27.0%
3/29/2007	941	2,210	1,610	-915	1,660	482	1,350	2,510	2,050	76.9%	23.1%
3/30/2007	1,070	2,250	1,600	-1,130	1,560	404	1,200	2,430	1,920	79.9%	20.1%
3/31/2007	808	2,290	1,610	-1,230	1,710	333	950	2,380	1,850	82.9%	17.1%
4/1/2007	1,020	2,440	1,690	-1,300	1,720	356	1,170	2,410	1,910	82.6%	17.4%
4/2/2007	921	2,190	1,590	-1,070	1,560	417	1,120	2,550	1,950	79.2%	20.8%
4/3/2007	806	1,970	1,530	-1,060	1,560	369	969	2,400	1,810	80.6%	19.4%
4/4/2007	687	2,000	1,510	-1,210	1,630	314	822	2,410	1,760	82.8%	17.2%
4/5/2007	632	2,100	1,480	-1,230	1,470	227	597	2,330	1,630	86.7%	13.3%
4/6/2007	567	2,050	1,500	-1,290	1,730	225	301	2,340	1,600	87.0%	13.0%
4/7/2007	544	2,000	1,470	-1,350	1,910	401	365	2,410	1,650	78.6%	21.4%
4/8/2007	564	1,990	1,480	-1,210	1,860	408	688	2,500	1,740	78.4%	21.6%
4/9/2007	796	1,920	1,510	-1,100	1,910	507	839	2,580	1,870	74.9%	25.1%
4/10/2007	623	1,780	1,330	-889	1,700	476	856	2,270	1,660	73.6%	26.4%
4/11/2007	663	2,050	1,360	-1,180	1,730	309	562	2,210	1,470	81.5%	18.5%
4/12/2007	621	2,080	1,380	-1,410	1,790	322	784	2,310	1,590	81.1%	18.9%
4/13/2007	721	2,100	1,400	-1,190	1,420	259	817	2,050	1,600	84.4%	15.6%
4/14/2007	683	2,020	1,400	-1,430	1,520	197	723	2,170	1,540	87.7%	12.3%
4/15/2007	836	2,080	1,460	-1,320	1,710	297	1,070	2,390	1,710	83.1%	16.9%
4/16/2007	926	2,250	1,570	-1,110	1,670	422	1,040	2,470	1,880	78.8%	21.2%
4/17/2007	870	2,090	1,600	-1,280	1,600	269	725	2,370	1,680	85.6%	14.4%
4/18/2007	836	2,200	1,410	-1,460	1,710	349	410	2,370	1,660	80.1%	19.9%
4/19/2007	875	1,890	1,480	-1,460	1,660	368	381	2,390	1,610	80.1%	19.9%
4/20/2007	511	2,280	1,060	-1,530	2,460	1,010	-44	2,430	1,640	51.2%	48.8%
4/21/2007	464	928	665	-18	2,900	1,920	866	3,000	2,180	25.7%	74.3%
4/22/2007	389	928	668	852	3,300	2,440	1,800	3,410	2,750	21.5%	78.5%
4/23/2007	558	951	711	2,020	3,390	2,850	2,570	3,570	3,100	20.0%	80.0%
4/24/2007	559	825	673	2,200	3,280	2,830	2,730	3,440	3,080	19.2%	80.8%
4/25/2007	513	811	658	2,240	3,210	2,790	2,630	3,390	3,030	19.1%	80.9%
4/26/2007	368	703	533	2,070	3,300	2,830	2,550	3,400	3,030	15.9%	84.1%
4/27/2007	388	633	482	2,310	3,270	2,880	2,610	3,290	3,010	14.3%	85.7%
4/28/2007	351	588	445	2,040	3,130	2,720	2,390	3,270	2,910	14.1%	85.9%
4/29/2007	323	585	448	2,050	3,240	2,770	2,260	3,370	2,940	13.9%	86.1%
4/30/2007	230	657	420	2,180	3,510	2,900	2,590	3,530	3,100	12.7%	87.3%
5/1/2007	230	500	379	2,130	3,430	2,830	2,380	3,470	2,990	11.8%	88.2%
5/2/2007	256	485	381	2,000	3,310	2,710	2,210	3,280	2,880	12.3%	87.7%
5/3/2007	249	470	350	1,540	3,260	2,610	1,940	3,210	2,720	11.8%	88.2%
5/4/2007	107	488	347	1,590	3,230	2,630	2,020	3,280	2,730	11.7%	88.3%
5/5/2007	275	616	437	1,890	3,350	2,770	2,150	3,240	2,820	13.6%	86.4%
5/6/2007	277	599	416	1,990	3,360	2,830	2,230	3,420	2,930	12.8%	87.2%
5/7/2007	124	571	403	2,080	3,430	2,850	2,290	3,390	2,940	12.4%	87.6%
5/8/2007	235	513	346	2,060	3,360	2,770	2,320	3,410	2,890	11.1%	88.9%
5/9/2007	220	522	356	2,020	3,400	2,790	2,390	3,410	2,950	11.3%	88.7%
5/10/2007	223	467	358	2,250	3,310	2,800	2,580	3,330	2,970	11.3%	88.7%
5/11/2007	269	523	396	2,230	3,220	2,800	2,600	3,310	2,990	12.4%	87.6%
5/12/2007	302	564	437	2,050	3,230	2,790	2,480	3,340	2,970	13.6%	86.4%
5/13/2007	329	562	460	2,090	3,250	2,840	2,550	3,420	3,090	13.9%	86.1%
5/14/2007	339	621	466	2,010	3,430	2,870	2,530	3,550	3,160	14.0%	86.0%
5/15/2007	297	546	450	1,730	3,420	2,780	2,340	3,490	3,030	13.9%	86.1%
5/16/2007	329	777	555	1,520	3,340	2,720	2,160	3,550	3,030	17.0%	83.0%
5/17/2007	491	785	611	1,170	3,360	2,620	1,930	3,560	3,010	18.9%	81.1%
5/18/2007	408	727	583	1,080	3,400	2,640	2,120	3,670	3,050	18.1%	81.9%
5/19/2007	425	800	578	1,420	3,350	2,640	2,150	3,530	3,010	18.0%	82.0%
5/20/2007	360	711	567	1,310	3,310	2,600	2,110	3,440	2,970	17.9%	82.1%
5/21/2007	462	812	606	1,650	3,330	2,680	2,340	3,550	3,020	18.5%	81.5%
5/22/2007	411	1,910	1,210	1,170	2,840	2,320	2,630	3,490	3,000	34.3%	65.7%
5/23/2007	1,260	2,710	1,720	882	2,280	1,790	2,500	3,110	2,820	49.0%	51.0%
5/24/2007	1,020	2,500	1,530	-188	2,100	1,410	2,010	2,930	2,600	52.0%	48.0%
5/25/2007	925	2,280	1,340	-515	2,060	1,270	1,760	2,790	2,450	51.3%	48.7%
5/26/2007	827	2,310	1,230	-816	2,150	1,220	1,520	2,770	2,330	50.2%	49.8%
5/27/2007	755	2,130	1,210	-846	2,270	1,240	1,390	2,790	2,290	49.4%	50.6%
5/28/2007	790	2,280	1,290	-871	2,350	1,210	1,380	2,910	2,350	51.6%	48.4%
5/29/2007	784	2,260	1,290	-1,290	2,410	1,040	1,150	2,930	2,230	55.4%	44.6%
5/30/2007	679	2,040	1,170	-1,070	2,470	1,150	1,230	2,960	2,270	50.4%	49.6%
5/31/2007	671	2,130	1,190	-1,080	2,470	1,140	985	2,930	2,240	51.1%	48.9%
6/1/2007	759	2,120	1,220	-1,060	2,440	1,130	1,060	3,010	2,260	51.9%	48.1%
6/2/2007	742	2,180	1,240	-972	2,470	1,140	1,100	2,910	2,260	52.1%	47.9%
6/3/2007	753	2,190	1,230	-1,210	2,600	1,200	1,100	2,950	2,300	50.6%	49.4%
6/4/2007	691	2,160	1,190	-1,030	2,400	1,110	1,050	2,770	2,140	51.7%	48.3%
6/5/2007	409	2,080	1,160	-1,050	2,410	1,030	1,020	2,580	2,000	53.0%	47.0%
6/6/2007	482	1,900	1,000	-818	2,280	1,160	1,200	2,500	2,020	46.3%	53.7%
6/7/2007	504	1,880	971	-660	2,000	1,060	1,320	2,350	1,940	47.8%	52.2%
6/8/2007	513	1,900	962	-699	1,840	1,000	1,230	2,260	1,900	49.0%	51.0%
6/9/2007	528	1,930	995	-840	1,850	969	1,140	2,220	1,850	50.7%	49.3%
6/10/2007	358	1,980	932	-1,040	1,980	867	840	2,100	1,710	51.8%	48.2%
6/11/2007	434	2,030	981	-1,280	2,190	952	703	2,370	1,830	50.7%	49.3%
6/12/2007	443	2,070	1,030	-1,400	2,230	973	609	2,480	1,880	51.4%	48.6%
6/13/2007	568	2,260	1,140	-1,380	2,360	984	799	2,670	2,040	53.7%	46.3%
6/14/2007	419	2,330	1,100	-1,490	2,350	794	587	2,480	1,760	58.1%	41.9%
6/15/2007	109	2,100	944	-1,510	2,520	727	60	2,340	1,490	56.5%	43.5%
6/16/2007	96	1,840	860	-1,570	2,550	829	128	2,310	1,500	50.9%	49.1%
6/17/2007	186	2,120	891	-1,520	2,540	957	326	2,370	1,660	48.2%	51.8%
6/18/2007	205	2,160	972	-1,420	2,460	876	596	2,360	1,720	52.6%	47.4%
6/19/2007	159	2,160	994	-1,390	2,360	721	591	2,290	1,600	58.0%	42.0%
6/20/2007	6	1,880	777	-1,100	2,240	876	618	1,970	1,510	47.0%	53.0%
6/21/2007	-82	1,660	635	-1,120	1,920	813	584	1,740	1,350	43.8%	56.2%
6/22/2007	71	1,790	678	-1,240	1,720	618	383	1,550	1,170	52.3%	47.7%
6/23/2007	-10	1,740	682	-1,490	1,780	527	261	1,530	1,030	56.4%	43.6%
6/24/2007	-104	1,680	619	-1,540	1,800	516	-11	1,390	906	54.5%	45.5%
6/25/2007	-73	1,700	656	-1,510	1,880	523	-68	1,470	953	55.6%	44.4%
6/26/2007	-97	1,780	703	-1,660	1,960	378	-73	1,450	859	65.1%	34.9%
6/27/2007	-155	1,710	698	-1,660	2,130	441	-135	1,480	863	61.3%	38.7%
6/28/2007	-219	1,620	715	-1,680	2,150	467	-104	1,720	893	60.5%	39.5%
6/29/2007	-195	1,710	727	-1,750	2,200	408	-223	1,570	828	64.0%	36.0%
6/30/2007	-325	1,490	596	-1,670	2,160	430	-275	1,450	763	58.1%	41.9%

through June 30, 2007. Moreover, Figure 4-6 presents in graphical format the mean daily flow for the San Joaquin River gage at Mossdale and the San Joaquin River near Vernalis gage for the same period.

DWR at the end of each year conducts a Delta Simulation Model 2 (DSM2) modeling run to be included in the yearly published South Delta Temporary Barriers Monitoring Report. Data collected from the two ADCMs will be used to verify the flow split of the San Joaquin River and Old River at the confluence against the output generated using the model.

Seepage Monitoring

A seepage-monitoring program was initiated in April 2000, to evaluate the effects of HORB operations on seepage and groundwater on Upper Roberts Island. In 2007 no seepage was observed at any of the monitoring sites. A link to the continuous time series data in the water data library is available on the internet.

In 2007, DWR installed Doppler "Argonaut" flow measuring devices inside culverts 1, 4 and 6. Data was recorded every 15 minutes during the period when the HORB was in operation. The flow through a completely submerged culvert is primarily dependent on the water levels at the two ends of the culvert, but is also dependent on culvert inlet geometry, slope, size and roughness. If it is assumed that all of these factors are similar for all six of the culverts, then the measured flow in any of these culverts would be a reasonable estimate of the flow in each of the other culverts. Table 4-3 summarizes the measured flows in culverts 1, 4, and 6 and estimates the total mean daily flow in all six culverts.

Barrier Emergency Response Plan

In addition to the operation and monitoring plan, DWR has also prepared an "Emergency Operations Plan for the Spring HORB". The plan provided that if the daily measured or forecasted flow at Vernalis exceeded a flow that would correspond to stage at the HORB of 10.0 feet MSL, and the stage was likely to exceed 11.0 feet MSL (the height of the barrier under the "high-flow" target), the barrier would be removed. Vernalis flows and stages at the barrier were not high enough in 2007 to warrant action under the emergency operations plan.

Fish Entrainment Monitoring at the Head of Old River Barrier

All six culverts in the Head of Old River Barrier (HORB) were installed for the 2007 VAMP test period. However, only three of the six culverts were open during entrainment monitoring. The six culverts are installed to maintain water quality and water levels in the south Delta, downstream of the HORB. Since the culverts are

Table 4-2
San Joaquin River Old River Mean Daily Flows

Date	Mean Daily Flow (cfs)	
	San Joaquin River at Mossdale [A]	San Joaquin River near Vernalis [B]
4/1/07	1,910	1,950
4/2/07	1,950	1,930
4/3/07	1,810	1,790
4/4/07	1,760	1,730
4/5/07	1,630	1,680
4/6/07	1,600	1,680
4/7/07	1,650	1,710
4/8/07	1,740	1,780
4/9/07	1,870	1,880
4/10/07	1,660	1,670
4/11/07	1,470	1,630
4/12/07	1,590	1,730
4/13/07	1,600	1,680
4/14/07	1,540	1,730
4/15/07	1,710	1,910
4/16/07	1,880	1,990
4/17/07	1,680	1,850
4/18/07	1,660	1,760
4/19/07	1,610	1,780
4/20/07	1,640	1,880
4/21/07	2,180	2,700
4/22/07	2,750	3,500
4/23/07	3,100	3,790
4/24/07	3,080	3,670
4/25/07	3,030	3,590
4/26/07	3,030	3,520
4/27/07	3,010	3,370
4/28/07	2,910	3,160
4/29/07	2,940	3,160
4/30/07	3,100	3,200
5/1/07	2,990	3,090
5/2/07	2,880	2,960
5/3/07	2,720	2,830
5/4/07	2,730	2,900
5/5/07	2,820	2,970
5/6/07	2,930	3,050
5/7/07	2,940	3,050
5/8/07	2,890	3,090
5/9/07	2,950	3,170
5/10/07	2,970	3,170
5/11/07	2,990	3,250
5/12/07	2,970	3,330
5/13/07	3,090	3,390
5/14/07	3,160	3,450
5/15/07	3,030	3,410
5/16/07	3,030	3,400
5/17/07	3,010	3,360
5/18/07	3,050	3,370
5/19/07	3,010	3,300
5/20/07	2,970	3,280
5/21/07	3,020	3,260
5/22/07	3,000	3,100
5/23/07	2,820	2,960
5/24/07	2,600	2,810
5/25/07	2,450	2,670
5/26/07	2,330	2,570
5/27/07	2,290	2,530
5/28/07	2,350	2,540
5/29/07	2,230	2,430
5/30/07	2,270	2,420
5/31/07	2,240	2,340
6/1/07	2,260	2,350
6/2/07	2,260	2,390
6/3/07	2,300	2,350
6/4/07	2,140	2,200
6/5/07	2,000	2,090
6/6/07	2,020	2,020
6/7/07	1,940	1,950
6/8/07	1,900	1,950
6/9/07	1,850	1,880
6/10/07	1,710	1,740
6/11/07	1,830	1,860
6/12/07	1,880	1,970
6/13/07	2,040	2,040
6/14/07	1,760	1,760
6/15/07	1,490	1,610
6/16/07	1,500	1,590
6/17/07	1,660	1,660
6/18/07	1,720	1,680
6/19/07	1,600	1,550
6/20/07	1,510	no data
6/21/07	1,350	no data
6/22/07	1,170	no data
6/23/07	1,030	1,110
6/24/07	906	1,100
6/25/07	953	1,130
6/26/07	859	1,060
6/27/07	863	1,090
6/28/07	893	1,090
6/29/07	828	1,040
6/30/07	763	1,000

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Figure 4-3
Daily Flow Range - Old River at Head

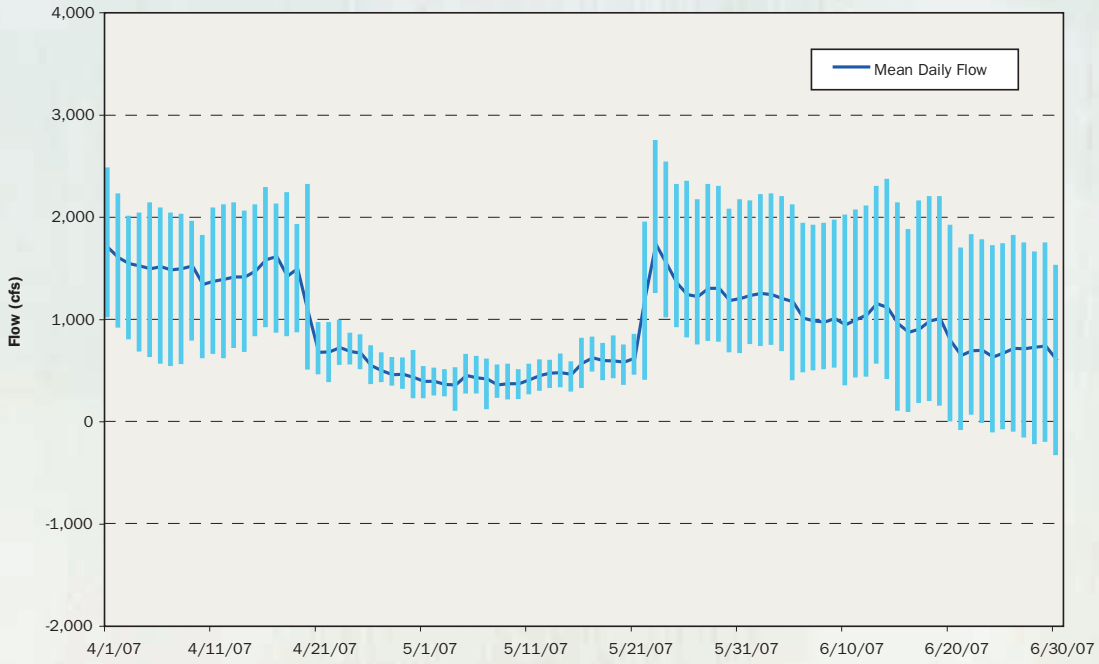


Figure 4-4
Daily Flow Range - San Joaquin River below Old River Gage

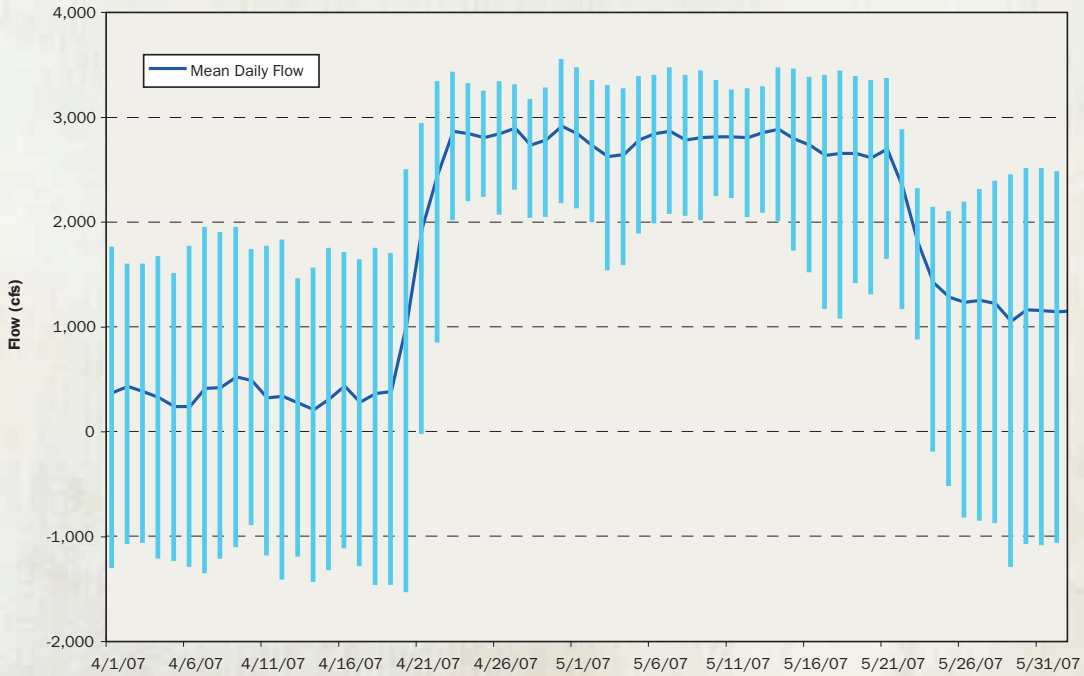


Figure 4-5
Daily Flow Range - San Joaquin River at Mossdale

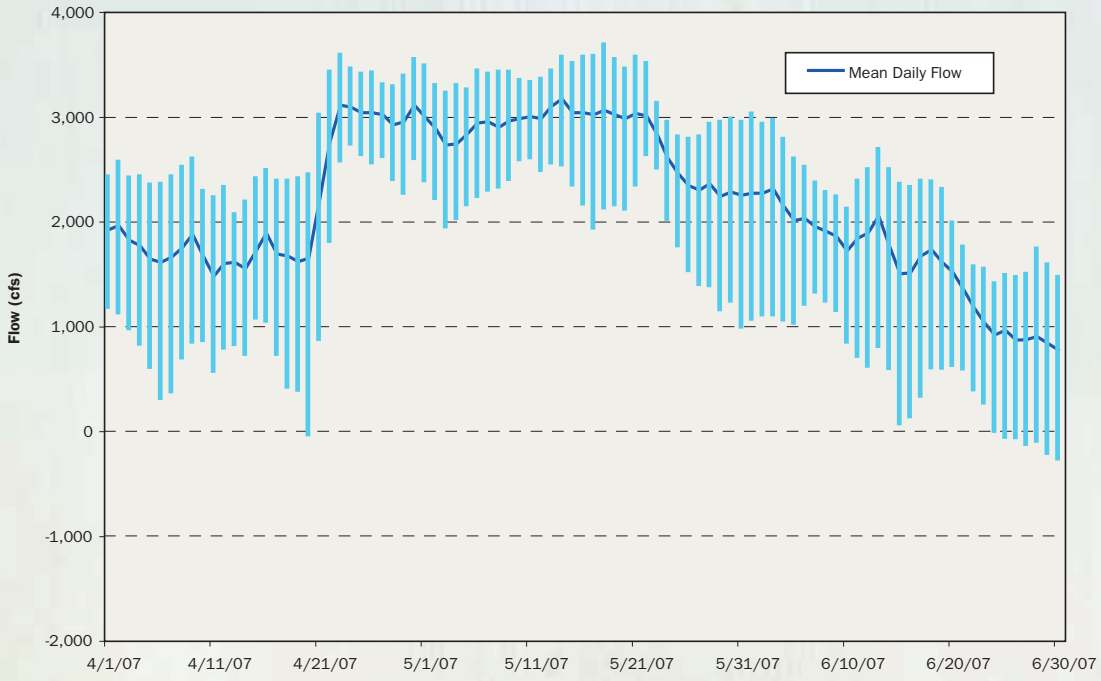


Figure 4-6
San Joaquin River Flow near Vernalis and at Mossdale

not screened, juvenile Chinook salmon and other fish species that pass near the culverts are vulnerable to entrainment. A fish monitoring program was designed and implemented by the DFG to evaluate and quantify fish entrainment at the HORB. Results from this fishery investigation are intended, in part, to provide information on the design and operation of a future permanent operable barrier at the head of Old River.

Materials and Methods

Fish entrained into the culverts were caught with fyke nets. The nets have a 48-inch cylindrical mouth tapering down to a 1-foot square cod-end, and are made of 1/2 inch braided mesh. Five of the six nets are 60 feet long and one net is 40 feet long. A live-box (15.5 x 19.5 x 36 inches), constructed of perforated aluminum sheet metal, was attached to the cod-end of each net. Each live-box has an aluminum baffle designed to reduce water velocities within the live-box and improve survival of captured fish. The culverts were numbered from 1 to 6 with number 1 located next to the shoreline (viewed from downstream) and number 6 located mid-channel (Figure 4-7). On April 27, fyke nets were attached to the downstream slide gate flanges of all six culverts. These gates were not lowered over the culverts at this time and thus, were not sampling. The slide gates on culvert numbers 1, 4 and 6, with attached nets and live boxes, were lowered over the culvert outfalls at 14:00 hours on Monday, April 29 to commence fish entrainment monitoring. Only culvert numbers 1, 4 and 6 were opened and remained opened throughout the monitoring period. On Friday, May 4, at 13:00, the nets were raised, checked, and then piled onto the frames. The nets did not fish over the weekend. The following Monday, at 13:00 hours, the nets for culvert numbers 1, 4 and 6 were lowered back into the water. All nets were removed at noon on Friday, May 11.

The fyke nets were checked at 01:00, 06:00, 13:00, and 20:00 hours Monday through Friday. The nets were checked by closing the culvert slides gate (upstream side) for about 20 minutes, enabling the live-boxes to be pulled onto a boat. Fish were removed from the live-boxes and placed into buckets. Once all the nets had been checked and reset, the collected fish were processed. All the fish were identified and counted. Salmon were checked for a clipped adipose fin and for the presence of a color-mark on the dorsal, anal, or caudal fin. Salmon that had a clipped adipose fin were saved for CWT processing. All salmon were measured (fork-lengths) to the nearest millimeter. Culvert number, date, time, water temperature, and diel-period were recorded for each net check. Except for adipose fin clipped salmon, all fish were released downstream of the HORB into Old River.

Figure 4-7
Culverts in the HORB were numbered from 1 to 6, with number 1 closest to shore. Culvert numbers 2, 3 and 5 were closed throughout the monitoring period.

Table 4-3. Flow in HORB Culverts

Date	Mean Daily Flow (cfs)				
	Measured				
	Culvert 1	Culvert 4	Culvert 6	Open Culverts	Total [1]
4/26/07 [2]	82	79	89	1,4,6	251
4/27/07	78	78	88	1,4,6	245
4/28/07	72	75	86	1,4,6	233
4/29/07	69	72	83	1,4,6	224
4/30/07	66	67	72	1,4,6	205
5/1/07	60	58	60	1,4,6	178
5/2/07	60	58	61	1,4,6	179
5/3/07	57	56	58	1,4,6	171
5/4/07	59	59	65	1,4,6	183
5/5/07	62	61	70	1,4,6	192
5/6/07	64	63	73	1,4,6	200
5/7/07	60	58	64	1,4,6	182
5/8/07	57	55	59	1,4,6	171
5/9/07	56	54	59	1,4,6	168
5/10/07	54	53	57	1,4,6	164
5/11/07	55	56	62	1,4,6	173
5/12/07	56	57	67	1,4,6	179
5/13/07	57	58	68	1,4,6	183
5/14/07	59	59	70	1,4,6	188
5/15/07	56	56	66	1,4,6	179
5/16/07 [3]	53	53	65	1,2,3,4,5,6	256
5/17/07	49	50	62	1,2,3,4,5,6	322
5/18/07	49	49	62	1,2,3,4,5,6	320
5/19/07	48	48	61	1,2,3,4,5,6	315
5/20/07	50	49	63	1,2,3,4,5,6	325
5/21/07 [4]	47	47	60	1,2,3,4,5,6	309

[1] Assumes average of measured flows for Culverts 2, 3 and 5 when open
[2] Partial day record of flow: 10:30 to 23:45
[3] Culverts 2, 3 and 5 were opened on May 16; estimate of total flow assumes these culverts were open for half of May 16.
[4] Partial day record of flow: 0:00 to 10:15

Unlike in previous years, there were no VAMP salmon releases upstream of the HORB at Mossdale or Durham Ferry. Consequently, no entrainment loss indices were calculated for 2007. Instead, an unmarked salmon average daily entrainment index (Entrainment Index) was generated from the HORB fish entrainment results to track relative changes in entrainment among years. For each year of entrainment monitoring, an Entrainment Index was calculated by dividing the total number of unmarked salmon caught by the number of days sampled. The index was not adjusted for the number of open culverts or the occasional lost entrainment samples due to gravel or debris. The Entrainment Index represents overall entrainment regardless of HORB culvert gate operation.

To track relative changes in unmarked salmon abundance just upstream of the barrier, salmon catch from the Mossdale Kodiak Trawl (MKT) was used to calculate an average 5 hour daily abundance index (Abundance Index). The Abundance Index was calculated by summing the daily catch of unmarked salmon (standardized to fifteen 20 minute tows) and dividing by the number of days sampled. The Abundance Index was calculated for the same days in which there was entrainment monitoring. Abundance and Entrainment Indices are calculated for a two to three week period during the VAMP test period. No indices were calculated for 2005 and 2006 because the HORB was not installed due to high San Joaquin River flows.

Fish catch was calculated for each culvert. Catch-Per-Unit-Effort (CPUE) for salmon comparison among years was calculated as the number of fish collected per hour per culvert. Standard deviation is used to describe the variability round the mean. DWR installed flow meters in culverts number 1, 4 and 6. Unmarked salmon entrainment density (fish/af) was calculated per culvert sampling period by dividing the catch by the amount of water that flowed through the culvert (mean flow (cfs) * sampling duration (s) * 43,560 (af/cf)).

Results

The HORB was closed on April 22; however, construction on the barrier continued for another four days. As mentioned previously, only culvert numbers 1, 4 and 6 were open during the fish monitoring period. The remaining culverts were opened May 16, after fish monitoring was completed. DFG monitored the HORB culverts over 10 days, for approximately 167 hours of sampling per culvert, and collected 95 samples. Two samples from culvert number 4 were loss due to the process of clearing the net of gravel and resetting the net at the next net check.

Table 4-4
The raw abundance and composition of fishes entrained at the HORB in 2007. Chinook salmon catch is divided into CWT salmon, unmarked salmon, color-marked salmon and radio-tagged salmon.

Species	Catch
White Catfish	185
Common Carp	85
Sacramento Sucker	81
Channel Catfish	29
Bluegill	12
Tule Perch	11
Redear Sunfish	3
Lamprey Spp.	2
Striped Bass	2
Prickly Sculpin	2
Green Sunfish	2
Golden Shiner	2
Brown Bullhead	1
Goldfish	1
Largemouth Bass	1
Threadfin Shad	1
Inland Silverside	1
Total Chinook Salmon	**51**
CWT Salmon	1
Unmarked Salmon	48
Color-Marked Salmon	0
Acoustically tagged Salmon	2
Total	**472**

Almost 500 fish were collected representing 17 species from 10 families of fish. No delta smelt (Hypomesus transpacificus), juvenile steelhead (Oncorhynchus mykiss), or splittail (Pogonichthys macrolepidotus) were collected in the fyke nets. The most abundant species was white catfish (Ictalurus catus), followed by common carp (Cyprinus carpio) (Table 4-4). Of the 51 salmon caught; 1 had a CWT; 46 were unmarked; and 2 were acoustically tagged. No color-marked salmon were caught this year. Overall, the number of salmon entrained per hour (0.1 ± 0.2) was lower than it was in previous years (0.7 in 2004, 3.4 in 2003, 2.5 in 2002, 1.4 in 2001). The mean fork length for unmarked salmon was 85 ± 7.6 mm and the one CWT salmon was 93 mm.

Unmarked salmon were caught throughout the monitoring period (Figure 4-8). The average unmarked salmon CPUE over the entire monitoring period was 0.1 ± 0.2 fish/hour/culvert. The highest unmarked salmon

Figure 4-8
The daily average number of unmarked salmon entrained per culvert hour at the HORB in 2007. The catch is separated by day and night. No sampling occurred on May 5 and 6.

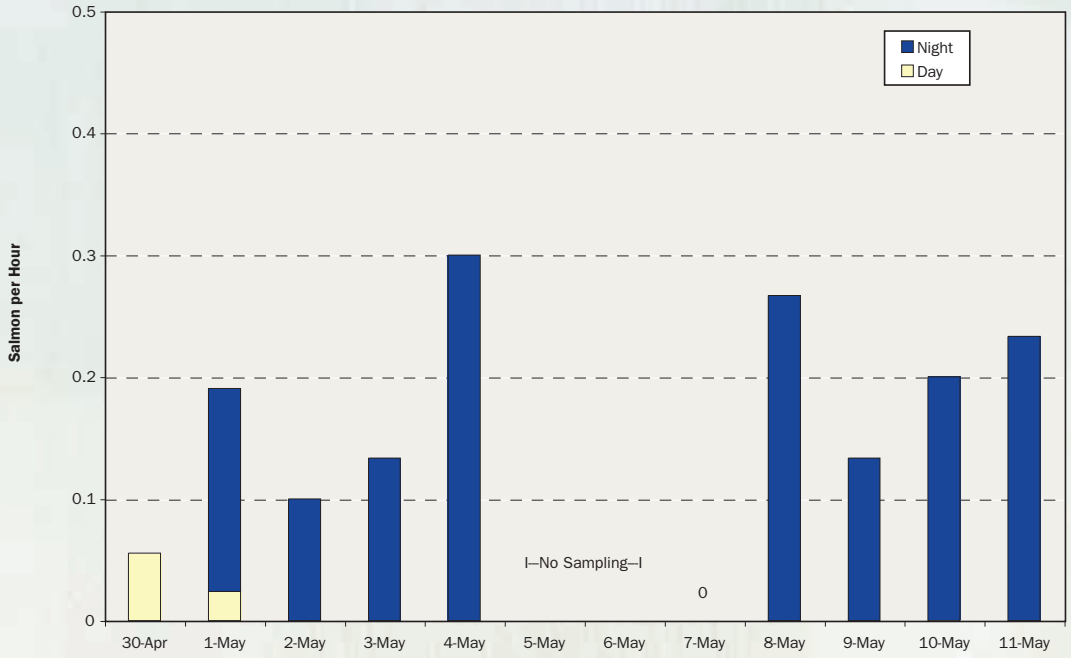


Figure 4-9
Mean unmarked salmon Abundance Index and Entrainment Index during the annual VAMP period when both Mossdale Kodiak Trawl and HORB entrainment monitoring were sampling. Indices were not calculated for 2005 and 2006 because the HORB was not installed due to high San Joaquin River flows. Mean San Joaquin River flow during VAMP was measured at Vernalis, CA.

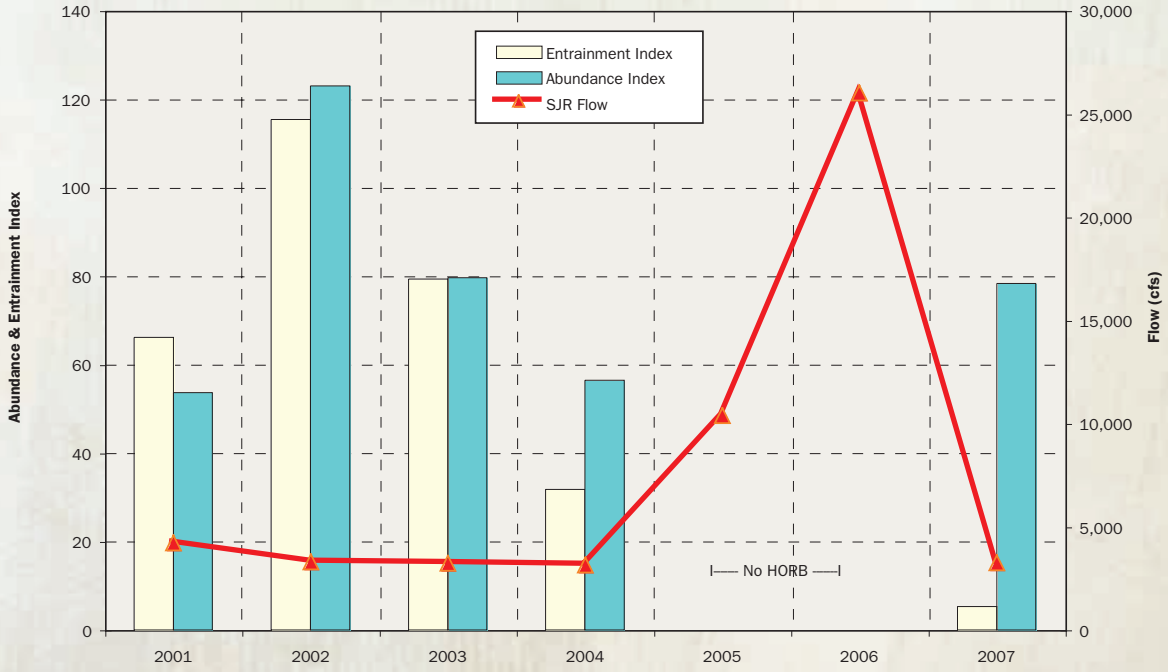


Table 4-5
The percentage of the total number of unmarked salmon caught by culvert and year, and 2007 culvert flow and entrainment fish density. Catch comparisons made only for time periods when culverts were fully operational and fyke nets were fishing. An "X" indicates the culvert was closed. Days indicate the number of days the culverts were compared in the given culvert operational status.

				Culvert Number					
	Year	Days		1	2	3	4	5	6
Catch									
	2001	6.2	Percent	3%	7%	7%	18%	20%	44%
	2002	11.0	Percent	10%	12%	16%	33%	16%	12%
	2003	19.7	Percent	X	X	X	17%	39%	45%
	2004	2.0	Percent	X	X	X	15%	39%	46%
	2004	5.9	Percent	22%	X	11%	0%	5%	62%
	2007	7.3	Percent	21%	X	X	24%	X	55%
Flow (cfs)									
	2007	7.3	Percent	33%	X	X	32%	X	34%
			Avg ± SD	59 ± 8.8	X	X	58 ± 8.5	X	61 ± 8.9
Density ((Fish/af)*100)									
	2007	7.3	Avg ± SD	1.2 ± 3.0			1.5 ± 2.9		3.0 ± 4.1

CPUE (0.8 fish/hour/culvert) occurred on May 4 and May 8. The average CWT salmon CPUE over the entire monitoring period was 0.002 ± 0.020 fish/hour/culvert. The highest CWT salmon CPUE (0.2 fish/hour/culvert) occurred on May 10.

In order to compare relative trends in unmarked salmon entrainment, an Entrainment Index and Abundance Index was calculated for each of the previous years in which we conducted entrainment monitoring. The 2007 Abundance Index was similar to the 2001, 2003 and 2004 Abundance indices (Figure 4-9). For the most part, the Entrainment Index tracked the Abundance Index, except in 2007. Although 2003 and 2007 had nearly identical Abundance Indices, the 2007 Entrainment Index was approximately 15 times lower. Both 2003 and 2007 had 3 open culverts. Although river flow can influence emigration patterns, San Joaquin River flow was similar among study years (2001-2004 and 2007) and flow probably had a negligible affect (Figure 4-4).

Unmarked salmon entrainment was highest in culvert number 6 and lowest in culvert number 1. Approximately half of the salmon entrained in 2007 were entrained through culvert number 6, which is similar to 2003 and 2004 (Table 4-5). Although 55 % of the entrained salmon went through culvert number 6, only 34 % of the water flowed through this culvert (Table 4-5). Salmon density for fish entrained through culvert number 6 was 0.03 fish/af, twice the density of culvert numbers 1 and 4.

Salmon entrainment differed greatly between diel periods. More unmarked salmon were entrained at night (47) than during the day (2). This year's nighttime entrainment is higher than in previous years when approximately 75% of the salmon were caught at night.

Discussion

The HORB is relatively effective in keeping salmon on the San Joaquin side of the barrier. Previous studies at the HORB indicate typically less than one percent of the VAMP CWT salmon released upstream of the HORB is entrained through the HORB culverts(SJRGA, 2001, 2002, 2003, 2004). Because there was no VAMP CWT salmon releases in 2007, we were unable to estimate the percentage of salmon entrained at the HORB. As an alternative to directly estimating entrainment using CWT salmon, entrainment and abundance indices were generated for unmarked salmon to compare relative changes in entrainment among years.

Total fish entrainment at the HORB was much lower this year than in previous years. Due to a staff shortage, the fyke nets were fished over a period of 10 days. Although the number of days sampled was reduced, the proportional decrease in overall salmon entrainment was much greater than expected, even when we account for the number of operational culverts. There was an 86% decrease in CPUE compared to 2004, the previous low. A large contributing factor for the overall decline in salmon entrainment was the practically non-existent CWT salmon catch. In previous years, CWT salmon can account for more than half of all the salmon entrained.

This year's single CWT salmon catch is by far the lowest on record.

Although CWT salmon typically account for a large percentage of the overall salmon entrainment, there was also a sharp decline in unmarked salmon entrainment. This decline in entrainment might be due to a decline in the number of outmigrating juvenile salmon. However, the unmarked salmon Abundance Index during the 2007 VAMP period was similar to previous years with a barrier. While we were sampling at the HORB, it appears there was no sharp decline in the number of unmarked salmon just upstream of the barrier.

The decline in the 2007 Entrainment Index might be related to culvert gate operation. In previous years when only three culverts were opened (2003 and part of 2004), the three culverts closest to the channel were opened and the three closest to shore were closed. This year, the culvert at the end, one in the middle, and the one closest to shore were open. The zone of entrainment might be higher with three adjacent open culverts. There is probably a larger draw of water at a fixed distance from an open culvert if the adjacent culverts are also open.

Over the years, we've noticed the culvert closest to the shore (number 1) typically entrains the fewest number of salmon. It was thought that the lower entrainment might be related to lower flows in culvert number 1. Visually, it appears less water flows through culvert number 1 compared to the other culverts. Theoretically, flows should be the same in all culverts since it's the head difference between upstream and downstream water levels that is responsible for flow. In 2002, a cursory check of flows among culverts using a hand held flowmeter suggested flow through culvert number 1 was about 10 cfs lower than flow through the other five culverts (SJRGA, 2002). However, in 2007, flowmeters in culvert numbers 1, 4 and 7 indicate flow was similar among culverts.

The position of outmigrating salmon in the water column probably is the biggest factor affecting entrainment. The proximity of culvert number 1 to the shore and culvert number 6 to the center of the channel, may account for the large entrainment discrepancies between the two culverts. Salmon entrainment densities suggest salmon are more abundant in the center of the channel. Juvenile salmon may prefer to migrate down the middle of the channel rather than along the shoreline. Predation might also be higher along the shore which would reduce the number of salmon vulnerable to entrainment at culvert number 1.

The data collected over the HORB monitoring years strongly suggests salmon are more vulnerable to entrainment at night. Salmon entrainment at night was higher in 2007 than in previous years. In 2004, 80% of the unmarked salmon were entrained at night. In 2007, approximately 95 % of the entrained unmarked salmon were caught at night. Although the MKT caught between 40 and 208 unmarked salmon per day (for a total of 678) just upstream of the barrier using surface tows, the HORB entrained between 0 and 1 salmon (for a total of two) during that same daylight timeframe. This suggests salmon are more surface oriented during the day than at night. Since the culverts are placed on the bottom of the channel, salmon are less likely to be entrained if they remain near the surface.

Although overall salmon entrainment was lower this year, it appears the approximately 400 acoustically tagged salmon released upstream of the HORB were entrained at a similar rate as VAMP CWT salmon from previous studies. Acoustically tagged salmon were released at Durham Ferry and Mossdale as part of juvenile migration study in the south Delta (see Chapter 5). No acoustically tagged juvenile salmon from the first set of releases and two acoustically tagged salmon from the second set of releases were entrained at the HORB. The overall entrainment loss for acoustically tagged salmon was 0.5 % which is similar to VAMP CWT entrainment losses at the HORB from 2001-2004. It appears the modified gate operation did not benefit acoustically tagged salmon to the degree that it benefited unmarked salmon. However, the acoustically tagged salmon releases were very small compared to the relatively large VAMP CWT salmon releases of previous years. A single acoustically tagged salmon has a bigger impact on the entrainment loss calculation than a single CWT salmon has on the VAMP CWT entrainment loss calculation.

As in previous years with a barrier, a large amount of gravel was caught in the nets which resulted in three loss samples. It is recommended that VAMP delay any future CWT salmon releases by at least 5 days beyond the closure of the HORB. The delay allows for completion of the barrier and minimizes the field crew's exposure to heavy equipment operation. It also allows time for any loose material near the barrier to pass through the culverts before the nets are attached. If keeping outmigrating salmon out of Old River and in the San Joaquin River is beneficial to their survival, then it might be prudent to only open culvert numbers 1, 4 and 6 during peak salmon migration. It might be possible to further reduce salmon entrainment by opening the culverts closest to shore and only open culverts during daylight hours. A possible experiment to further test culvert gate operations on salmon entrainment is to only open culvert numbers 1, 2 and 3 for the first VAMP CWT salmon release and only open culvert numbers 4, 5 and 6 for the second VAMP release.

CHAPTER 5

SALMON SMOLT SURVIVAL INVESTIGATIONS

Acoustic–Tagged Smolt Distribution Study

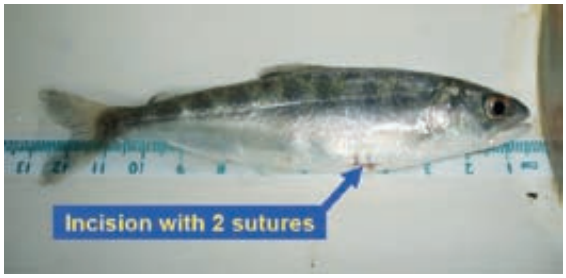
One of the primary objectives of the VAMP study, in addition to providing enhanced protection of juvenile Chinook salmon emigrating from the San Joaquin River system, is to determine the effects of San Joaquin River flows, SWP and CVP water exports, and HORB placement on survival of Chinook salmon smolts emigrating from the San Joaquin River through the Delta. Early in 2007, it was determined that Merced River Hatchery (MRH) would not meet their production needs. Thus production at the hatchery was not sufficient to provide study fish for a traditional VAMP coded-wire tag experiment. A fully supported coded-wire tag VAMP experiment would require 400,000 juvenile Chinook salmon from MRH. As an alternative, an acoustic-tag experiment using only 1,000 salmon was planned to estimate survival from Durham Ferry to Jersey Point and Chipps Island and look at mortality and distribution by reach within the San Joaquin River with the Head of Old River Barrier (HORB) in place. However, due to logistical constraints, acoustic receivers were not actually installed at Chipps Island and Jersey Point and survival was not estimated.

Introduction

A pilot acoustic-tagging salmon study was conducted in the south Delta during the spring of 2006. A summary of the results is available in the 2006 VAMP annual report (San Joaquin River Group Authority 2007). The 2006 study indicated that without the HORB in place and during high-flow conditions many (half or more) of the acoustic-tagged fish, released near Mossdale, migrated into Old River. Survival through the Delta could not be estimated in the spring of 2006 because receivers available were not effective in large channels (Chipps Island or Jersey Point). In 2007, we explored renting and deploying multi-hydrophone receivers in these large channels, however logistical problems prevented their installation in 2007.

Figure 5-1
Example acoustic transmitter, comparison to pen (Vogel 2006).

Figure 5-2
Chinook salmon smolt with implanted acoustic transmitter (Vogel 2006).



Fish Tagging

Fish used for the acoustic study were obtained from MRH. Originally, the plan was to tag and release 1,000 fish; 30 fewer fish than planned were released due to receipt of fewer tags for the experiments, tag failure, or fish mortality shortly after surgery. Ultimately, 970 juvenile Chinook salmon were surgically implanted (tagged) with Hydroacoustic Technology, Inc. (HTI) individually-identifiable acoustic transmitters (tags) and released for the experiments (Figures 1 and 2). Prior to tagging the fish at MRH, an extensive training session was conducted at Mokelumne River Fish Hatchery.

Because fish for training were unavailable at MRH, Mokelumne River Fish Hatchery provided 2,000 fish needed for training. Tagging personnel were trained by U.S. Geological Survey's Cook, Washington, Lab. Procedures for tagging followed a strict standard operating procedure (Appendix D). Tagging consisted of surgically implanting an acoustic tag in the fish's body cavity. Size and weight of fish for training were similar to those later used at MRH for the VAMP experiments. Four individuals were trained to surgical implant the tags and eight others were trained to assist and to record data. Training was conducted between April 16 and April 26.

Prior to surgical implantation, acoustic tags were weighed and programmed, and fish were weighed and measured. The duration of surgical procedure was also recorded and was usually less than 4 minutes. Tagging and support personnel began conducting actual surgical operations at MRH on April 30 and May 7. The fish were held at MRH for 48 hours prior to release. The Durham Ferry and Mossdale groups were tagged on April 30 and May 7 with the three remaining groups (upper Old River, Bowman Road, and Stockton) tagged on May 1 and May 8. Throughout the tagging process, some fish were tagged with non-operational "dummy" tags that were of a similar size and weight as the functional tags.

Fish Releases

The acoustic-tagged MRH Chinook salmon were released at four sites on the San Joaquin River and one site in Old River. The intent was to release approximately 100 fish at each location during each of two weeks of experiments. Release locations were:

- Durham Ferry
- Mossdale
- Upper Old River (downstream of the HORB)
- San Joaquin River at Bowman Road
- San Joaquin River near the Stockton Waste Water Treatment Facility (SWWTF) (Figure 3).

The fish releases were made twice over a two-week period for a total of 10 releases. The number of tagged fish released in the first week was 495. Releases were made at Durham Ferry and Mossdale on May 3 and in upper Old River, Bowman Road, and Stockton on May 4. The number of tagged fish for the second week of releases was 475. Releases were made at Durham Ferry and Mossdale on May 10 and in upper Old River, Bowman Road, and Stockton on May 11. (Table 1).

The tagged fish were acclimated for a short time prior to release. At each release location, two holding tubs, fitted with mesh covers, were filled with water from the hatchery vehicle. The groups of tagged fish were split approximately in half and transferred from the hatchery truck into the tubs. The temperature of the water from the hatchery was colder than that of the river; thus the fish were acclimated for approximately one hour prior to release. Once the fish were in the tubs and water temperatures measured, small amounts of river water were added to the tubs to slowly raise the temperature to the river temperature. Once the water temperature in the tubs was close to the river temperature (within a couple of degrees Fahrenheit), the fish were held for the balance of the hour prior to release. A GPS reading was taken at each of the five release sites.

Water Temperature Monitoring

Water temperature was monitored during the VAMP 2007 study using individual computerized temperature recorders (e.g., Onset Stowaway Temperature Monitoring/Data Loggers). Water temperatures were measured at locations along the longitudinal gradient of the San Joaquin River and interior Delta channels between Durham Ferry and Chipps Island – locations along the migratory pathway for the juvenile Chinook salmon released as part of these tests (Appendix C-1). As part of the 2007 VAMP monitoring program, additional temperature recorders were deployed in the south and central Delta (Appendix C-1) to provide geographic coverage for characterizing water temperature conditions while juvenile salmon emigrate from the lower San

Table 5-1
Release dates/times of acoustic-tagged juvenile Chinook salmon at each location during the first and second weeks of the 2007 VAMP experiments.

Release Location	First Release		Second Release	
	Date/Time	No. Fish	Date/Time	No. Fish
Durham Ferry	May 3, 2007 1130 hours	98	May 10, 2007 1140 hours	96
Mossdale	May 3, 2007 1300 hours	99	May 10, 2007 1230 hours	97
Old River (downstream of HORB)	May 4, 2007 1017 hours	99	May 11, 2007 1122 hours	95
Bowman Road	May 4, 2007 1215 hours	99	May 11, 2007 1205 hours	95
Stockton	May 4, 2007 1250-1253 hours	100	May 11, 2007 1243 hours	92

Figure 5-3
Fish release locations and acoustic receiver locations during the 2007 VAMP experiments.

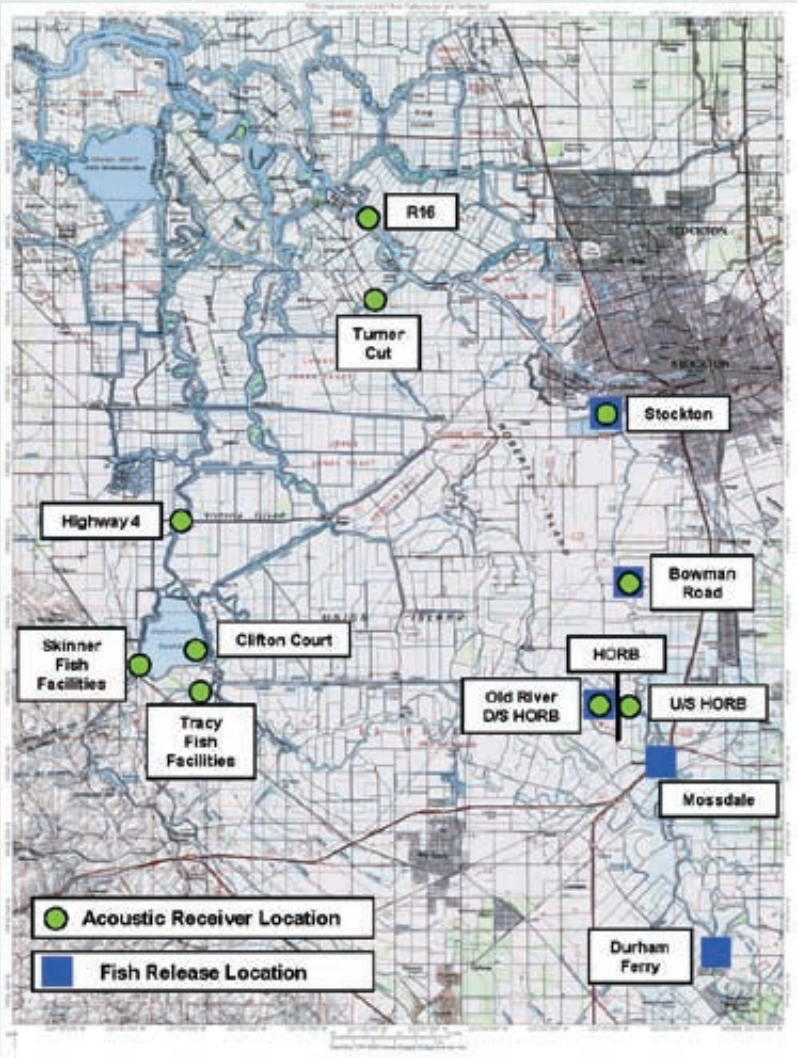
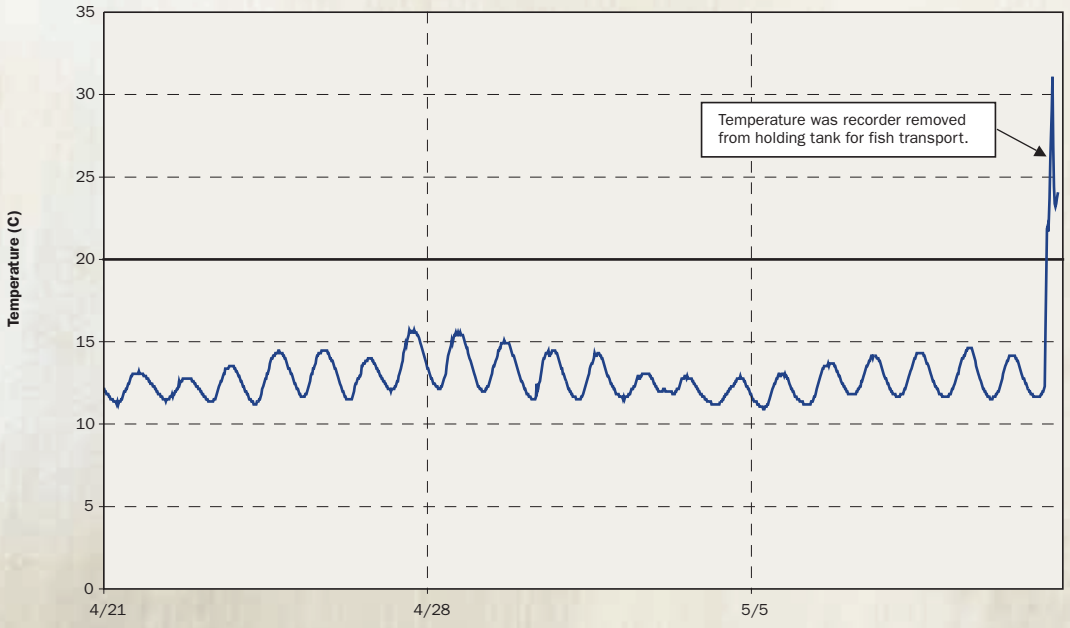


Figure 5-4
Hatchery 1, Water Temperature in Holding Tank



Joaquin River through the Delta. Water temperature was recorded at 24-minute intervals throughout the period of the VAMP 2007 investigations. Water temperatures were also recorded within the hatchery raceways at the MRH coincident with the period when juvenile Chinook salmon were being tagged and held (Appendix C-1).

A number of temperature recorders deployed as part of this year's VAMP temperature monitoring could not be relocated and were probably lost to vandalism or removed by recreational boaters.

Results of water temperature monitoring within the Merced River Hatchery showed that juvenile Chinook salmon were reared in, and acclimated to, water temperatures of approximately 11°- 16° C (52° - 61° F) prior to release into the lower San Joaquin River (Figures 5-4 and 5-5; Appendix C-2). Results of water temperature monitoring at Durham Ferry, Dos Reis, and Werner Cut, near Woodward Island, during the April-June fall-run Chinook salmon smolt emigration from the San Joaquin River through the Delta are shown in Figures 5-6, 5-7, and 5-8. Water temperature monitoring showed that water temperatures throughout the lower San Joaquin River and Delta (Appendix C-2) were higher than those at the hatchery during the spring months, which is consistent with results of temperature monitoring in all previous years of the VAMP tests. Water temperatures measured within the lower San Joaquin River and Delta (Figures 5-6, 5-7, and 5-8 ; Appendix C-2) were within a range considered to be suitable (typically < 20 C; 68 F) during April and May in the mainstem San Joaquin River (e.g., Durham Ferry, Old River at HORB, and Dos Reis (Appendix C-2) but exceeded 20 C (68 F) further downstream within the Delta (e.g., Old River/Indian Slough Confluence, Werner Cut – Channel above Woodward Isle; Appendix C-2). Results of the 2007 water temperature monitoring showed a longitudinal gradient of temperatures that generally increased as a function of distance downstream within the mainstem river and Delta. Water temperatures measured in the river during April-May would not be expected to result in adverse effects or reduced survival of emigrating juvenile Chinook salmon released as part of the VAMP 2007 investigations. Water temperatures measured downstream within the Delta during April and early May were within the general range considered to be suitable for juvenile fall-run Chinook salmon migration, however temperatures during the late May and June were within the range considered to be stressful for juvenile Chinook salmon.

Net Pen and Health Assessments

A fish health assessment was conducted to determine if delayed mortality would occur in the acoustically tagged fish. For the first set of releases, 10 fish tagged with "dummy" tags were held in net pens at both Mossdale and Durham Ferry. For the second release, 20 tagged fish were held at each of the same locations. Fish were transported similarly to the other tagged fish but instead of releasing them they were placed into a net pen, held for 48 hours and then assessed for condition.. After 48 hours, fish were removed from the net pens, euthanized and examined. Each fish was measured (fork length in millimeters) and examined for scale loss, color, fin hemorrhaging, eye condition and gill color. One fish from the first Mossdale release died during the 48 hour period. One other, from the second Mossdale release had caudal fin hemorrhaging. All other characteristics examined were normal (Appendix C-3).

Dummy-tagged fish were also held at the hatchery. One set of 10 fish were tagged during the first week of tagging, on 4/30 and a second set of 10 fish were tagged during the second week of tagging on 5/7. Both sets of fish were euthanized on May 14th and examined for the same parameters as above. No mortalities were observed from either of the two groups and the condition characteristics assessed were normal.

Health and Physiological Tests

Ten fish from the first Durham Ferry and Mossdale releases (five from each location) and the twenty fish from the hatchery were used to obtain kidney samples for histological examination by the USFWS California/ Nevada Fish Health Center. Prior VAMP studies using coded wire tag fish from Merced River Hatchery has regularly found infection by the parasite (*T. bryosalmonae*) that causes Proliferative kidney disease. Findings for the samples in 2007 indicated that all 30 fish examined were infected with *T. bryosalmonae* (Table 5-2). Kidney lesions were observed in 5 of the 30 infected kidney sections. Short term survival (<2 weeks) was not likely influenced by these infections; however, Proliferative Kidney Disease is progressive and can continue after fish enter the ocean.

Table 5-2
Incidence and severity of Tetracapsuloides bryosalmonae in VAMP dummy-tagged acoustic groups released in 2007.

Group	Infected	Clinical
MRH1	10-Oct	10-Feb
MRH2	10-Oct	10-Mar
Durham Ferry	5-May	0/5
Mossdale	5-May	0/5

Figure 5-5
Hatchery 2, Water Temperature in Holding Tank

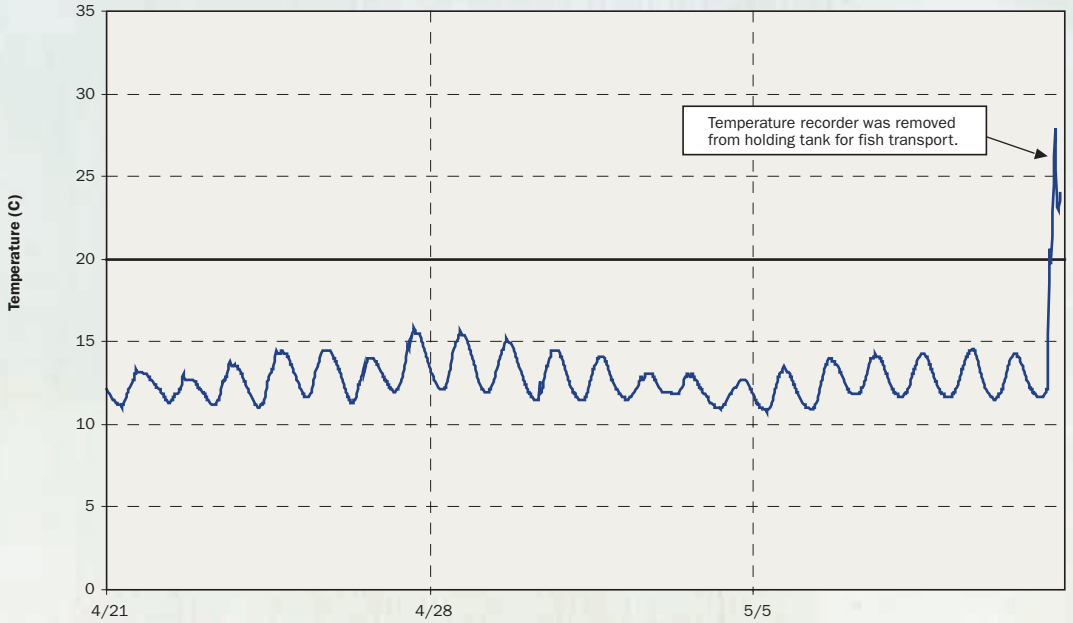


Figure 5-6
Water Temperature Monitoring at Durham Ferry

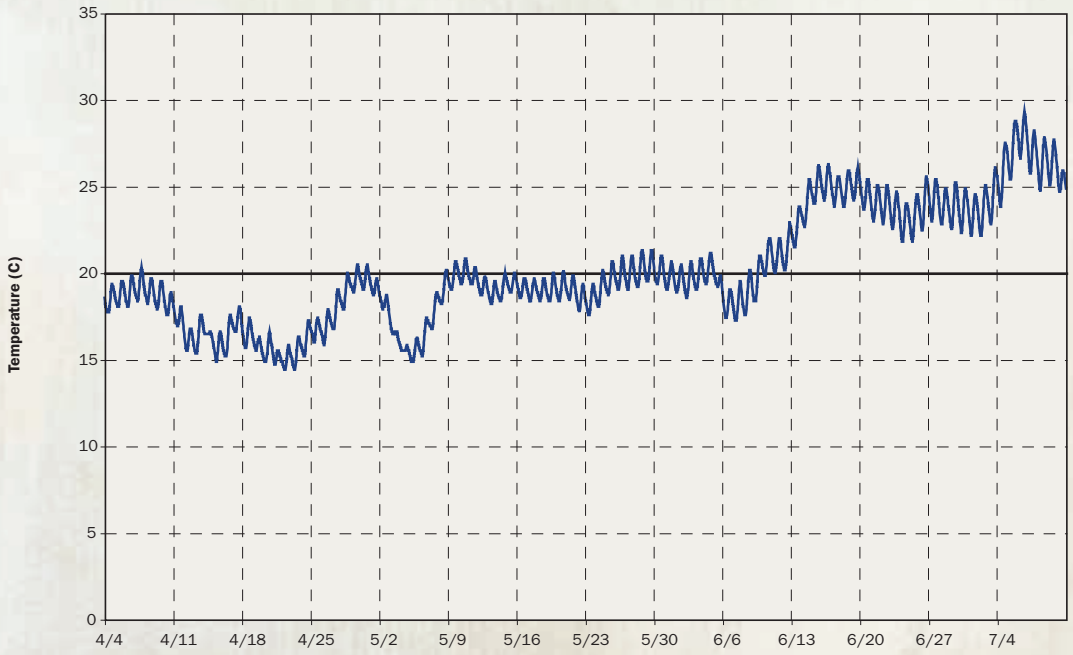


Figure 5-7
Water Temperature Monitoring at Dos Reis

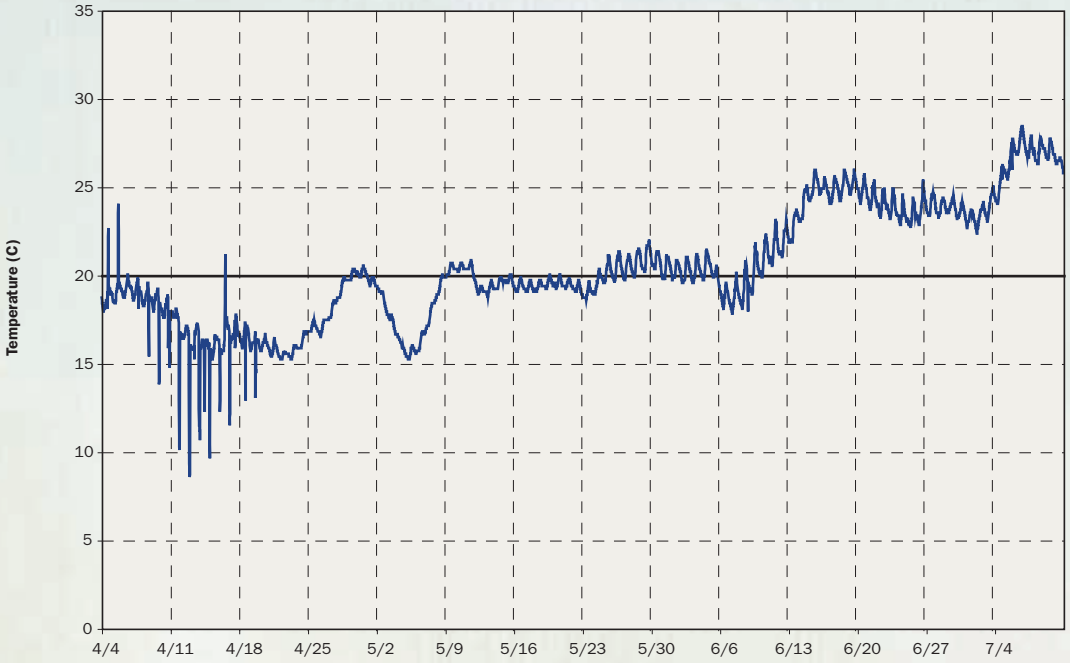


Figure 5-8
Water Temperature Monitoring at Werner Cut - Channel above Woodward Isle

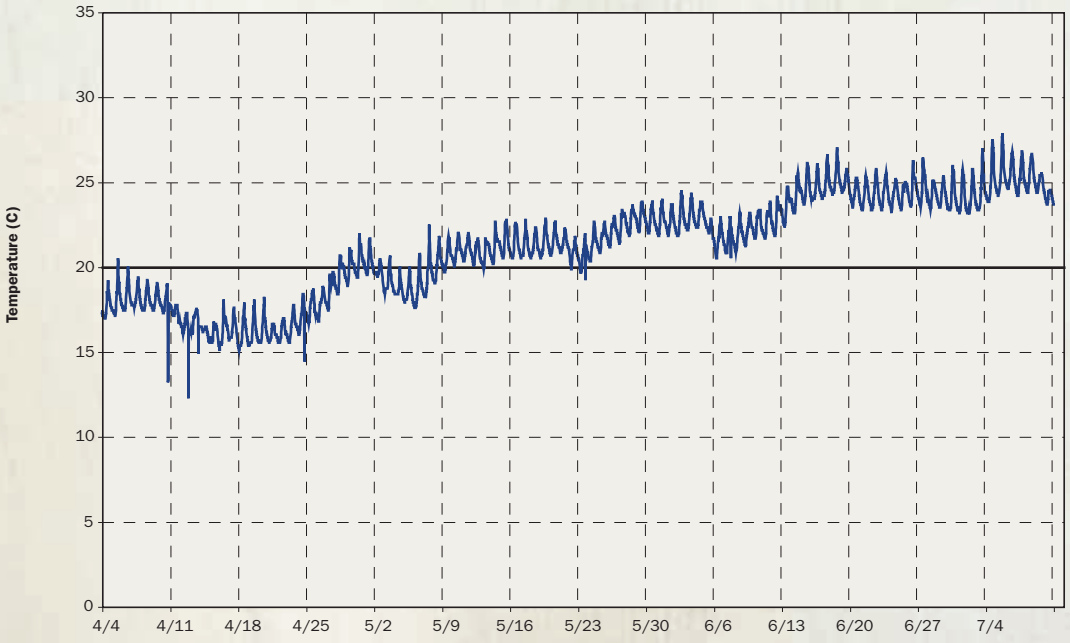


Figure 5-9
Typical deployment of acoustic receiver (Vogel 2006).

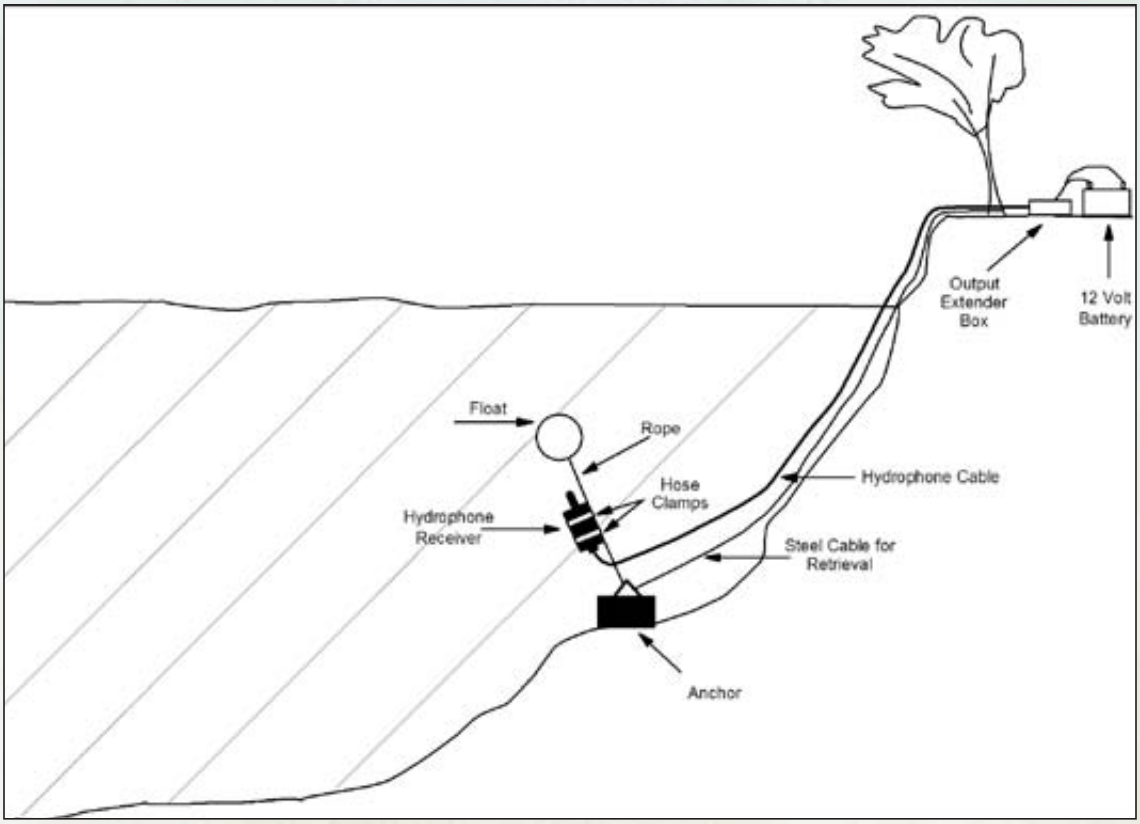
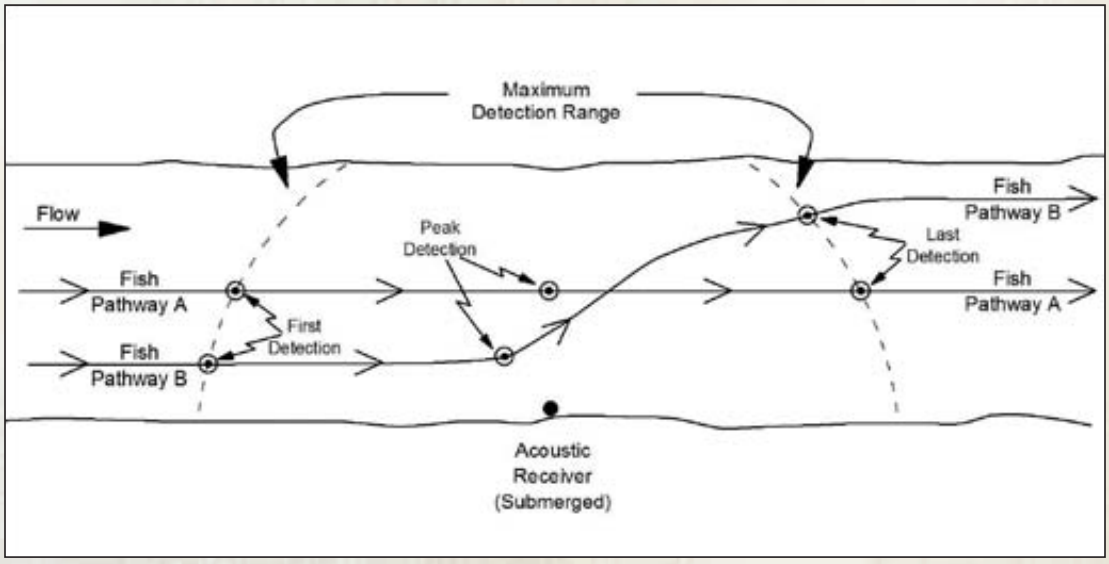


Figure 5-10
Typical acoustic receiver detection range (Vogel 2006).



Detection of Acoustic-Tagged Fish

Ten HTI acoustic receivers were distributed at various locations in the south and central Delta to detect acoustic-tagged fish as they migrated through the Delta (Figure 5-3). The fixed-station receivers electronically logged a time stamp when each individually-identifiable tag passed the sites. Figure 5-9 shows an example deployment of a receiver in the Delta. The receivers were positioned in the channel to provide coverage across the channel to detect acoustic-tagged salmon (Figure 5-10). As previously mentioned, additional receiver sites were planned for Chipps Island and Jersey Point although logistical constraints prevented equipment being deployed. The USGS's Acoustic Doppler Current Profiler (ADCP) created frequency interference at Jersey Point and debris at the bottom of the channel at Chipps Island created logistical obstacles of laying miles of cable that could not be overcome in the timeframe available.

The ten locations where receivers were deployed in 2007 were:

1) San Joaquin River near the head of the HORB (U/S HORB),
2) Old River just downstream of the HORB (D/S HORB),
3) San Joaquin River near Bowman Road,
4) San Joaquin River near the Stockton Waste Water Treatment Plant,
5) Turner Cut,
6) San Joaquin River downstream of Turner Cut (R16),
7) Old River north of Clifton Court Forebay (Highway 4),
8) Inlet to Clifton Court Forebay (CCF),
9) Skinner Fish Facility (FF), and
10) Tracy Fish Facility (FF) (Figure 5-3).

Fish releases at Old River, Bowman Road, and Stockton were made near the acoustic receivers (Figure 3) to verify that tags were functioning at the time of release. A mobile receiver was used at the Durham Ferry and Mossdale release sites to confirm that transmitters were functioning just prior to the fish release.

Fish Transit Time

Because each acoustic receiver recorded the detection time of acoustic-tagged salmon within reception range (Figure 5-10) and each acoustic transmitter was individually identifiable, transit times and migration rates from release locations to each receiver site could be calculated. These calculations used the time of first detection by a receiver and the estimated in-channel distances between sites. Actual average speed of fish in the water would likely be faster because fish may not

take the most-direct route between locations. Net fish migration rates in the San Joaquin River were more rapid in upstream reaches as compared to downstream reaches (Tables 5-3 and 5-4), a phenomenon attributed to tidal influence further downstream. Fish released at Durham Ferry generally took about one day to reach the Old River flow split, whereas fish released at Mossdale took only about four hours. Fish released at Mossdale and Durham Ferry took about one to two days to reach Stockton, respectively. Although the sample sizes were small in the downstream-most areas, fish released at Durham Ferry and Mossdale took about three to six days to reach the San Joaquin River near R16 or Turner Cut. Fish released at Bowman Road took about a day and a half to reach Stockton. Fish released at Stockton exhibited the slowest overall net migration rates due to the large tidal seiching effects on fish migration in the lower San Joaquin River. Fish released in Old River just downstream of the HORB exhibited much slower migration rates than fish released in the San Joaquin River, undoubtedly because of the lower flows and slower water in Old River, Grant Line Canal, and Fabian

Table 5-3
Average transit time in hours (h), standard deviation (in parentheses), range in times (h), and average migration rate (mph) from fish release location to fish detection location during the first week of fish releases (May 3 – 4, 2007).

Release Site	Detection Location				
	U/S HORB	Bowman Road	Stockton	Turner Cut	R16
Durham Ferry N = 98 fish	N = 69 fish 29.3 h (23.1 h) 12.2 h – 162.5 h 0.50 mph	N = 66 fish 35.6 h (18.0 h) 17.8 h – 98.9 h 0.58 mph	N = 25 fish 50.9 h (23.8 h) 26.2 h – 101.9 h 0.52 mph	N = 6 fish 78.9 h (20.5 h) 64.5 h – 115.0 h 0.47 mph	N = 9 fish 161.5 h (56.1 h) 123.4 h – 302.7 h 0.23 mph
Mossdale N = 99 fish	N = 97 fish 3.6 h (1.8 h) 1.8 h – 10.6 h 0.78 mph	N = 83 fish 14.5 h (7.9 h) 6.7 h – 44.9 h 0.60 mph	N = 33 fish 24.6 h (8.5 h) 19.4 h – 52.6 h 0.58 mph	N = 4 fish 72.4 h (32.4 h) 42.3 h – 105.8 h 0.35 mph	N = 9 fish 154.6 h (31.6 h) 122.6 h – 212.4 h 0.17 mph
Bowman Road N = 99 fish			N = 31 fish 34.4 h (14.4 h) 27.3 h – 81.1 h 0.16 mph	N = 2 fish 84.0 h (23.9) 67.1 h – 100.9 h 0.20 mph	N = 4 fish 136.8 h (13.2 h) 123.4 h – 151.0 h 0.12 mph
Stockton N = 100 fish				N = 3 fish 50.7 h (10.3 h) 43.5 h – 62.5 h 0.21 mph	N = 9 fish 112.9 h (15.9 h) 98.7 h – 149.8 h 0.10 mph

Table 5-4
Average transit time in hours (h), standard deviation (in parentheses), range in times (h), and average migration rate (mph) from fish release location to fish detection location during the second week of fish releases (May 10 – 11, 2007).

Release Site	Detection Location				
	U/S HORB	Bowman Road	Stockton	Turner Cut	R16
Durham Ferry N = 96 fish	N = 56 fish[1] 17.7 h (4.5 h) 9.8 h – 27.4 h 0.83 mph	N = 36 fish 25.7 h (4.8 h) 15.4 h – 34.9 h 0.80 mph	N = 9 fish 41.2 h (10.8 h) 27.0 h – 60.4 h 0.64 mph	N = 1 fish 68.4 h (N.A.) N.A. 0.54 mph	N = 8 fish 75.3 h (11.4 h) 55.4 h – 95.4 h 0.50 mph
Mossdale N = 97 fish	N = 95 fish 4.0 h (1.1 h) 2.5 h – 8.1 h 0.70 mph	N = 76 fish 12.2 h (13.0 h) 6.5 h – 103.3 h 0.72 mph	N = 32 fish 22.8 h (11.7 h) 14.4 h – 60.8 h 0.63 mph	N = 7 fish 71.4 h (28.4 h) 37.2 h – 124.9 h 0.35 mph	N = 13 fish 75.6 h (26.8 h) 29.8 h – 143.3 h 0.34 mph
Bowman Road N = 95 fish			N = 25 fish 34.0 h (49.2 h) 3.7 h – 201.7 h 0.17 mph	N = 2 fish 63.9 h (17.0) 51.9 h – 76.0 h 0.26 mph	N = 11 fish 48.7 h (14.6 h) 29.0 h – 80.3 h 0.35 mph
Stockton N = 92 fish				N = 2 fish 32.1 h (13.7 h) 22.4 h – 41.7 h 0.34 mph	N = 9 fish 44.1 h (15.5 h) 19.6 h – 69.7 h 0.26 mph

[1] The acoustic receiver U/S HORB was not operational from 1800 May 11 to 1400 May 14, 2007 so some of the Durham Ferry fish likely passed the site during that period. Therefore, the data shown is probably biased toward a rapid migration rate and average travel time and migration rate would likely be slower than shown here.

Table 5-5
Average transit time in hours (h), standard deviation (in parentheses), range in times (h), and average migration rate (mph) from fish release location to fish detection location during the first week of fish releases (May 3 – 4, 2007).

Release Site	Detection Location			
	Tracy FF	Clifton Court	Skinner FF	Highway 4
Downstream HORB N = 99 fish	N = 22 fish 101.8 h (62.2 h) 33.7 h – 294.5 h 0.15 mph	N = 19 fish 69.0 h (25.3 h) 40.2 h – 115.6 h 0.23 mph	N = 4 fish 96.5 h (31.8 h) 68.0 h – 129.9 h 0.19 mph	N = 23 fish 85.4 h (44.0 h) 50.1 h – 242.2 h 0.24 mph

and Bell Canal. It took about three-and-a-half to four-and-a-half days for fish released in Old River to reach the Tracy FF, CCF, Skinner FF, and Highway 4 (Tables 5-5 and 5-6).

Chinook Salmon Distribution and Survival

Tables 5-7 and 5-8 provide the numbers of acoustic-tagged salmon detected at each acoustic receiver site. During the course of the study there were receivers that either did not work properly during a specific period or were not placed in the river until after some of the tagged fish may have passed by. For instance, the acoustic receiver at U/S HORB was not operational between May 11, 1800 hrs and May 14, 1400 hours. In addition, the acoustic receiver in Clifton Court Forebay did not record data from May 11, 2100 hrs to May 14, 1000 hours. The acoustic receiver placed at the Stockton site had only partial channel coverage during the study and an operational acoustic receiver was not positioned at Channel Marker R16 until May 8 at 1500 hrs due to USGS boat problems. Although the probability of detecting an individual fish does not have to be 100% to estimate survival, it is necessary to have downstream receivers to determine the detection probability for an individual receiver.

The probability of detection of each receiver for each release was estimated using the formula:

$$\hat{p}_i = \frac{r_i}{r_i + z_i} \qquad (1)$$

where i = estimated probability of detection at site i, conditional on the fish being alive at site i.

r_i = the total number of fish detected downstream of site i of those detected at site i and

z_i = the total number of fish that were not detected at site i, but were detected downstream of the site i.

Although detection probabilities were estimated to be 100% or close to 100% for the acoustic receivers positioned just upstream of the HORB and at Bowman Road (Tables 5-9 and 5-10), we know this is incorrect, based on mobile monitoring conducted near Stockton (see later section of this report and Table 5-11). During mobile monitoring near Stockton on May 17 and 18 some tags from both Durham Ferry releases were detected that hadn't been detected previously at any of the stationary monitors upstream (U/S HORB, Bowman Rd., or Stockton). But because this mobile monitoring was not conducted systematically throughout the study period, we could not use these detections to help estimate detection efficiency. We can understand how some of the Durham Ferry fish from the second release likely missed detection at the U/S HORB receiver because it was not operational for three days after release (May 11, 1800 hours to May 14, 1400 hrs.). However, it's not clear how they would have been missed at the Bowman Road receiver or why two tags from the first Durham Ferry release were also not detected at any of the stationary receivers upstream. Given the questionable issues surrounding the Durham Ferry releases, survival estimates obtained using the Durham Ferry release groups are likely more uncertain that those using the Mossdale and Bowman Road release groups to estimate survival to Stockton. Even though the Stockton receiver only had partial coverage of the channel (and low probability of detection) we have tried to account for this limitation when estimating survival

Estimates of Survival

Survival in a reach is based on the number of tags detected and the probability of detection, and is calculated as shown in the following formula:

$$S = \frac{\#\ \text{detected}/(\#\ \text{released or observed upstream})}{\text{Detection probability}}.$$

Where possible, the survival of the acoustic fish by reach was estimated. Survival by reach is estimated using the proportion detected at the receiver at the end of the reach and the probability of detection by that receiver. Standard errors can also be generated.

The longest reach where survival could be estimated was between Durham Ferry and Stockton. Reaches within this larger reach could also be estimated – Durham Ferry and Mossdale to Upstream HORB, Bowman Road and Stockton. Stockton is the end point to where survival can be estimated because the most downstream receivers were at Turner Cut and R16 and were used to estimate the probability of detection of the Stockton receiver.

Survival down the San Joaquin River for three release groups (Durham Ferry, Mossdale and Bowman Road) was estimated and shown in Figures 5-11 through 5-16. Survival estimates for all reaches between Mossdale and Stockton were relatively high. Survival seemed lower between Durham Ferry and Mossdale. A survival estimate of greater than 1.0, was estimated for the reach between Bowman Road and Stockton for the second Bowman Road release and is likely due to the combination of high survival but low detection probability calculated for the Stockton receiver. Although to confidently make assessments of differences in survival between reaches, standard errors would need to be generated to determine if significant differences exist. For our purposes it is useful to understand how survival can be generated to help plan where to place receivers in 2008 for maximum coverage and for estimating survival by reach.

Table 5-6
Average transit time in hours (h), standard deviation (in parentheses), range in times (h), and average migration rate (mph) from fish release location to fish detection location during the first week of fish releases (May 10 – 11, 2007).

Release Site	Detection Location		
	Tracy FF	Skinner FF[1]	Highway 4
Downstream HORB N = 95 fish	N = 31 fish 69.4 h (31.2 h) 31.8 h – 174.2 h 0.23 mph	N = 3 fish 96.9 h (66.0 h) 52.6 h – 172.7 h 0.19 mph	N = 10 fish 64.6 h (10.3 h) 54.2 h – 82.3 h 0.32 mph

[1] The acoustic receiver at the entrance to CCF was not operational for part of the time during the second fish release and transit times from HORB to CCF could not be determined. However, three fish were detected at Skinner FF which undoubtedly entered CCF during the down time of the CCF receiver.

Table 5-7
Numbers of acoustic-tagged salmon released at five locations on May 3 – 4, 2007 and detected passing acoustic receiver sites[1] (see Figure 3).

Release Location	Location of Acoustic Receivers									
	U/S HORB	D/S HORB	Bowman Road	Stockton[2]	Turner Cut	R16[3]	Tracy FF	Clifton Court	Skinner FF	Hwy 4
Durham Ferry N = 98 fish	69	0	66	25	6	9	0	1	0	1
Mossdale N = 99 fish	97	0	83	33	4	9	1	0	0	1
Bowman Road N = 99 fish	0	0		31	2	4	0	0	0	0
Stockton N = 100 fish	0	0	0		3	9	0	0	0	0
D/S HORB N = 99 fish	1		0	0	0	0	22	19	4	23

[1, 2] The acoustic receiver placed at the Stockton site had only partial channel coverage during the study.

[3] An operational acoustic receiver was not positioned at Channel Marker R16 until May 8 at 1500 hrs due to boat problems.

Table 5-8
Numbers of acoustic-tagged salmon released at five locations on May 10 – 11, 2007 detected at acoustic receiver sites (see Figure 3).

Release Location	Location of Acoustic Receivers									
	U/S HORB[1]	D/S HORB	Bowman Road	Stockton	Turner Cut	R16	Tracy FF	Clifton Court[2]	Skinner FF	Hwy 4
Durham Ferry N = 96 fish	56	2	36	9	1	8	1	0	0	0
Mossdale N = 97 fish	95	0	76	32	7	13	1	0	0	1
Bowman Road N = 95 fish	0	0		25	2	11	0	0	0	0
Stockton N = 92 fish	0	0	0		2	9	1	0	0	0
D/S HORB N = 95 fish	0		0	0	0	0	31	6	3	10

[1] The acoustic receiver at Old River was not operational from 1800 hrs. May 11 to 1400 hrs. May 14, 2007. Based on travel times, some of the Durham Ferry fish likely passed the site during that period whereas all fish released at Mossdale and passing the Old River flow split were assumed to have been detected.

[2] Acoustic receiver did not record data from 2100 hrs. May 11 to 1000 hrs. May 14; fish entering CCF during this period would not have been detected.

Table 5-9
Detection probability for receivers during the first week of releases, May 3-4, 2007.

Release Locations	Receiver Locations		
	U/S HORB	Bowman Road	Stockton
Durham Ferry N = 98 fish	1	1	0.46
Mossdale N = 99 fish	1	1	0.38
Bowman Road N = 99 fish	–		0.5

Table 5-10
Detection probabilities for receivers during the second week of releases May 10-11, 2007.

Release	Receiver Locations		
Location	U/S HORB	Bowman Road	Stockton
Durham Ferry N = 96 fish	0.947	0.875	0.125
Mossdale N = 97 fish	1	0.976	0.35
Bowman Road N = 95 fish	–		0.18

Table 5-11
Number of acoustic transmitters detected in the San Joaquin River near the railroad bridge at Stockton on May 17 and 18, 2007. The number never detected elsewhere is included in parentheses.

Fish Release location	Release Date	Number of Acoustic Tags Detected
Durham Ferry	3-May-07	12 (2)
Mossdale	3-May-07	1 (0)
Bowman Road	4-May-07	5 (2)
Stockton	4-May-07	6 (6)
Durham Ferry	10-May-07	21 (7)
Mossdale	10-May-07	14 (0)
Bowman Road	11-May-07	26 (14)
Stockton	11-May-07	31 (31)

Most fish released at Durham Ferry and Mossdale migrated downstream via the San Joaquin River, although some were found to arrive at the Fish Facilities using multiple pathways. For instance, two individuals (3374, 3381) from the second Durham Ferry release presumably migrated into Old River through the HORB culverts, as they were detected at the receiver in Old River downstream of the HORB (Appendix C-6). One of these individuals (3374) was later detected at the Tracy Fish Facility. One additional individual from the first Durham Ferry release (3294) was detected at the U/S HORB, D/S Bowman Road and at Highway 4 receivers prior to being detected at the Clifton Court Forebay receiver, indicating that it had migrated down the San Joaquin River but turned south at one of the junctions downstream of Bowman Road. In addition, two fish released from Mossdale (3910 from the first release and 3801 from the second release) were detected at the Tracy Fish Facility, with both being detected at the receivers at U/S HORB, Bowman Road, Stockton and Turner Cut, (Appendices C-4 and C-6) One individual (3801) was observed at Hwy 4 after being observed at Tracy while another (3910) was observed at Hwy 4 prior to being detected at the Federal Fish Facility.

In at least one case, a fish released at Stockton also migrated to the Tracy Fish Facility. One individual from the second Stockton release (5978) was detected at the Tracy Fish Facility after being detected at R16 (Appendix C-6). These cases seem to show that not only do juvenile salmon migrate through the culverts of the HORB to arrive at the Fish Facilities, they also get there through Turner Cut or from other areas further downstream in the San Joaquin River.

Figure 5-11
Survival by reach for fish released at Durham Ferry during the first week of releases

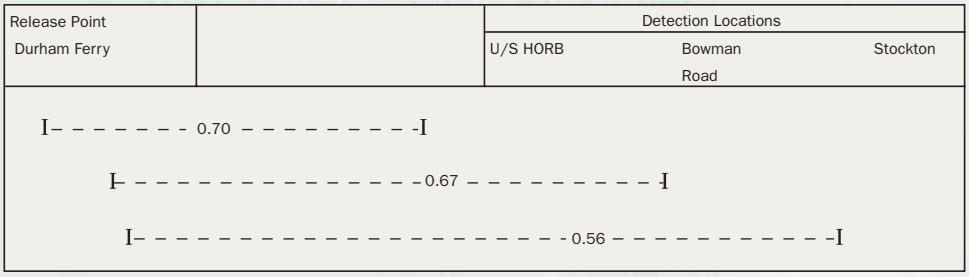


Figure 5-12
Survival by reach for fish released at Mossdale during the first week of releases

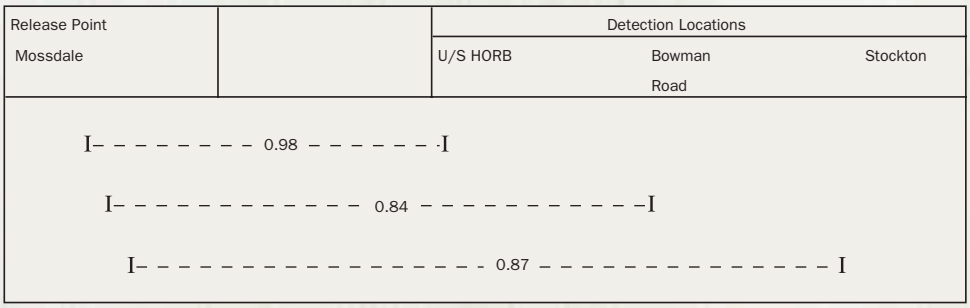


Figure 5-13
Survival by reach for fish released at Bowman Road during the first week of releases

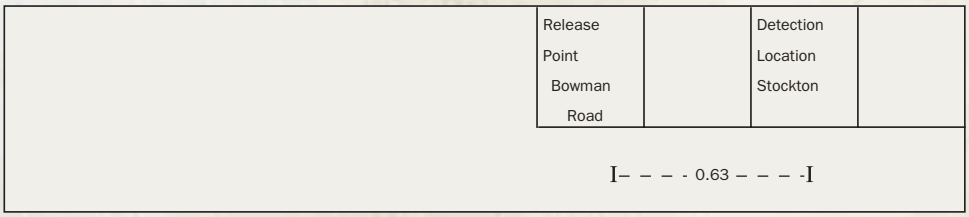


Figure 5-14
Survival by reach for fish released at Durham Ferry during the second week of releases

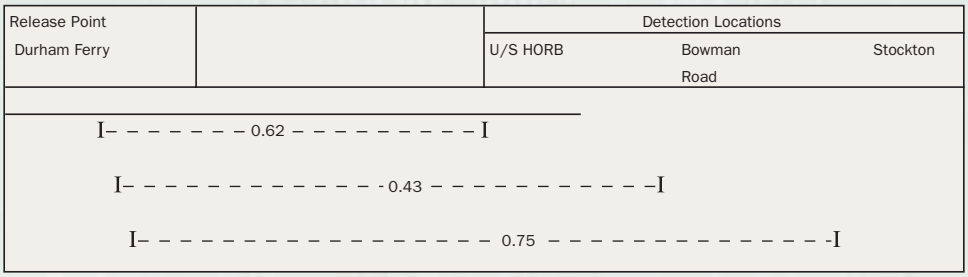


Figure 5-15
Survival by reach for fish released at Mossdale during the second week of releases

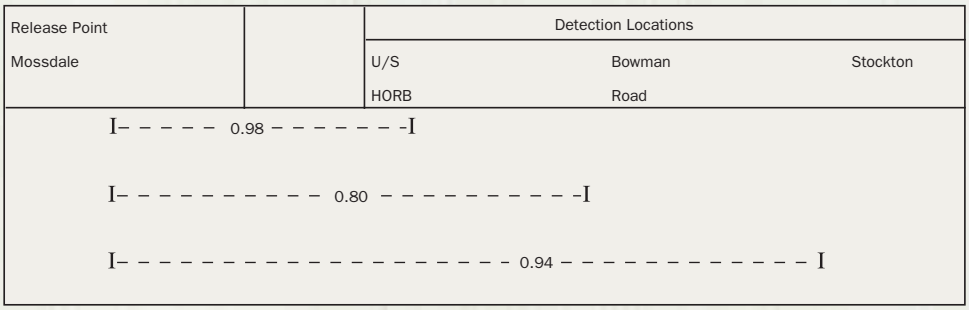


Figure 5-16
Survival by reach for fish released at Bowman Road during the second week of releases

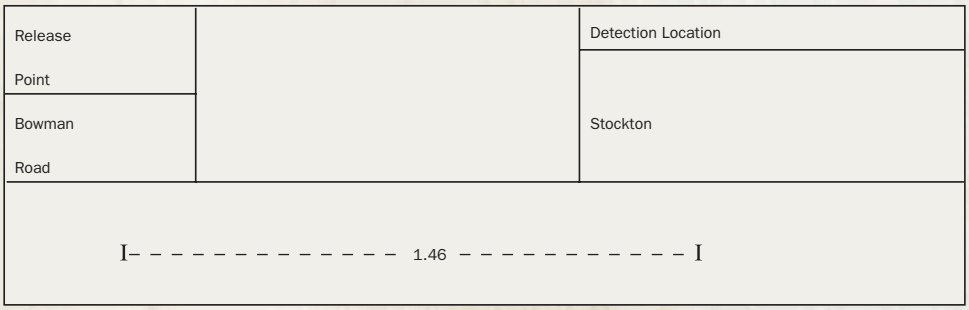


Figure 5-17
Lower San Jaoquin River near Stockton

Head Of Old River Barrier Releases

Survival was not estimated for the group of tagged fish released in Old River, downstream of HORB, because there were insufficient acoustic receivers to provide coverage in all channels where fish could subsequently migrate (e.g., Middle River, Victoria Canal). However, these fish were detected downstream at the Tracy Fish Facility near Tracy, at the entrance to Clifton Court Forebay (CCF), at the Skinner Fish Facility, and in Old River at the Highway 4 Bridge. Of the 99 fish released for the first release, 22 were detected at the Tracy FF, 19 at CCF, and 23 at Highway 4. Some of the fish were detected at more than one of the locations, with fish being detected at CCFB or Hwy 4 after being detected at Tracy or being detected at Tracy or CCFB after being detected at Hwy 4 (Appendix C-5). In one case, an individual (4673) was detected at Tracy after it had been detected in CCFB (perhaps inside a predator). If we assume the remaining 18 salmon detected in CCFB were in live salmon and stayed in CCFB, we can estimate survival through the Forebay. With four individuals detected at the Skinner FF, we estimate survival across Clifton Court Forebay to be 22% assuming 100% detection probability at both locations.

In addition, one of the individuals (4799) from the first release in Old River was detected at the U/S HORB receiver indicating that it had moved through the HORB culverts to the San Joaquin River. This tag was likely in a preditor as it would seem unusual for a salmon to move against the flow through a HORB culvert.

During the second week of fish releases in Old River, the CCF receiver did not record data a portion of the time when fish could have entered the Forebay. This was empirically documented when 3 fish detected at the Skinner FF were not detected by the CCF receiver (Appendix C-7). Of the 95 salmon released in Old River during the second week, 31 were detected at the Tracy FF and 10 at Highway 4. Again, some of these individuals were detected at more than one location (Appendix C-7). For instance, three fish detected at Tracy were also later detected at Skinner (4424) and at Hwy 4 (4515, 4760). One of these (4424) had also been detected previously at Hwy 4. One of the three fish detected in CCF (5096) had previously been detected at Tracy. For both weeks of fish releases in Old River, the numbers detected at the receivers in the south Delta were higher than we assumed; our assumption was that the numbers would have been very low because of slow water, longer exposure time to predators and unscreened diversions, and routes where fish could have migrated without detection.

Mobile Monitoring

A week after the last fish releases, a mobile acoustic receiver was used in several Delta channels in an attempt to locate non-moving transmitters. During mobile monitoring in the San Joaquin River from Mossdale to the Stockton Deep Water Ship Channel, a high number of acoustic transmitters were detected at a very small, localized site at Stockton. The area was approximately 0.75 miles downstream of the Highway 4 Bridge, 1.7 miles upstream of the Stockton Deep Water Ship Channel, and adjacent to a railroad bridge and the Stockton waste water treatment facilities (Figure 5-17). This site was just downstream of our stationary receiver and release site near the Stockton waste water treatment facility. A total of 116 tags were found at this site which included some fish from all of the releases made on the San Joaquin River during the two weeks of releases (Table 5-11). This may be a minimum number lost at that location as the mobile monitoring was done on May 17 and 18 after the battery life of some of the tags from the first week fish releases may have ended. These tags were motionless indicating the tags were either in dead fish or had been defecated by a predator. An investigation by the Regional Water Quality Control Board found that the waste water treatment facility was in compliance with discharge permit requirements. The cause of this high mortality remains unknown, but this area was apparently a hostile place for juvenile salmon in May.

The history of some of these individual tags was odd in that some had moved downstream past this site earlier and many of the others had never been detected upstream. For instance, three tags observed at this site from the first Durham Ferry release had been detected at R16, 9 -10 days earlier. In addition, a total of ten individuals detected in the mobile monitoring from the releases at Durham Ferry (3441, 3042, 3140, 3017, 3031, 3094, 3115, 3150, 3157, 3185), had never been detected at any of the receivers upstream (Table 5-11). Because the receiver at the HORB was not operating between May 11 and May 14, it is likely that some of the fish released on May 10 at Durham Ferry may have passed that receiver without being detected becausue it took about a day for the Durham Ferry fish to reach the HORB. However, it is unclear why they wouldn't have been detected at Bowman Road. It is also understandable that they weren't detected at receivers at Stockton, in Turner Cut and at R16 as the receivers weren't very efficient because they weren't covering the entire channel. In addition, two of the eight fish detected at R16 from the second release at Durham Ferry were also never detected upstream (Appendix C-6). It is noteworthy that these odd cases were restricted to fish released at Durham Ferry. All of the fish detected in the mobile monitoring at Stockton from the Mossdale releases had been detected at the upstream receivers (Appendices C-4 and C-6).

There were indications of piscivorous predation on some of the acoustic-tagged salmon during the study. Uncharacteristic behavior of an acoustic-tagged salmon compared to the majority of observed behavior patterns suggested some tagged fish were consumed by a predator and the transmitter inside the predator was subsequently detected passing a receiver. For example, there were instances where a transmitter was detected in a sequential downstream direction then eventually moved back upstream. Although predation could not be empirically confirmed in these cases, this behavior was considered unlikely for a salmon smolt. There were some instances where predation could be confirmed because of multiple predation events on acoustic-tagged salmon by a single predator (e.g., a predator eating two acoustic-tagged salmon). In one instance, one predator ate four acoustic-tagged salmon. This phenomenon can be observed during data processing which shows identical detailed movements of transmitters. Lastly, the acoustic receivers can determine if a transmitter remains motionless. In these latter cases, fish mortality was certain but the reason for the mortality could not be determined.

An additional site of relatively high fish mortality was located at the head of Old River flow split downstream of Mossdale. In 2006, five acoustic transmitters among 100 fish released at Mossdale were located at the same site. Based on observations of striped bass feeding activity in this area during the 2006 VAMP study, it was hypothesized that acoustic-tagged salmon were consumed by predatory fish and the transmitters were subsequently defecated and deposited on the bottom of the channel. A description of the unusual scour hole near the Old River flow split is provided in the 2006 VAMP Annual Report (SJRGA 2007). In 2007, it appeared that 19 acoustic-tagged salmon from both weeks of fish releases may have been preyed on in the same vicinity.

Numerous acoustic transmitters were also located in front of the trash racks just upstream of the Tracy FF. As with other sites where motionless transmitters were found or the transmitters exhibited unusual movements, it could not be determined where the acoustic-tagged salmon were preyed upon, only where the transmitters were found. For example, an acoustic-tagged salmon could have been eaten by a predator at another location and the predator subsequently swam to the Tracy FF trashracks where the tag was detected for long periods (anomalous behavior for a smolt at this location) or was defecated (motionless transmitter). Alternatively, the acoustic-tagged salmon may have followed the flow toward the Tracy FF but were eaten by predators residing in front of the trashracks. A total

Table 5-12
Absolute survival estimates and differential recovery rates based on Chipps Island, Antioch, or ocean recoveries of Merced River Hatchery salmon released as part of South Delta studies betweeen 1996 and 2006.

Release Year	San Joaquin River (Merced River origin) Tag Number	Release Number	Release Site	Release Date	Chipps Island Recovs.	Antioch Recovs.	Expanded Adult Ocean Recovs. (Age 1+ to 4+) Total	Chipps Island	Antioch	DRR or CDRR	Ocean DRR
		CWT Smolt Releases						Absolute Survival Estimates		Differential Recovery Rates	
1996	061110412	22,198	Dos Reis	1-May-96	2		3				
	061110413	25,414	Dos Reis	1-May-96	2		37				
	061110414	16,050	Dos Reis	1-May-96	1		8				
	061110415	31,208	Dos Reis	1-May-96	5		10				
	061110501	46,190	Jersey Point	3-May-96	39		186				
	Effective Release	94,870	Dos Reis		10		58	0.120		0.125	0.152
	Effective Release	46,190	Jersey Point		39		186				
1997	062545	48,973	Dos Reis	29-Apr-97	9		180				
	062546	53,483	Dos Reis	29-Apr-97	7		168				
	062547	51,576	Jersey Point	2-May-97	27		356				
	Effective Release	102,456	Dos Reis		16		348	0.290		0.298	0.492
	Effective Release	51,576	Jersey Point		27		356				
	062548	46,674	Dos Reis	8-May-97	5		90	0.300		0.283	0.477
	062549	47,534	Jersey Point	12-May-97	18		192				
1998	61110809	26,465	Mossdale	16-Apr-98	25		60				
	61110810	25,264	Mossdale	16-Apr-98	31		39				
	61110811	25,926	Mossdale	16-Apr-98	32		58				
	61110806	26,215	Dos Reis	17-Apr-98	34		48				
	61110807	26,366	Dos Reis	17-Apr-98	25		35				
	61110808	24,792	Dos Reis	17-Apr-98	34		62				
	61110812	24,598	Jersey Point	20-Apr-98	87		110				
	61110813	25,673	Jersey Point	20-Apr-98	100		91				
	Effective Release	77,655	Mossdale		88		157	0.300		0.305	0.506
	Effective Release	77,373	Dos Reis		93		145	0.320		0.323	0.469
	Effective Release	50,271	Jersey Point		187		201				
1999	062642	24,765	Mossdale	19-Apr-99	8		128				
	062643	24,773	Mossdale	19-Apr-99	15		135				
	062644	25,279	Mossdale	19-Apr-99	13		132				
	062645	25,014	Dos Reis	19-Apr-99	20		151				
	062646	24,841	Dos Reis	19-Apr-99	19		225				
	0601110815	25,101	Jersey Point	21-Apr-99	34		334				
	062647	24,359	Jersey Point	21-Apr-99	25		387				
	Effective Release	74,817	Mossdale		36		395	0.380		0.403	0.362
	Effective Release	49,855	Dos Reis		39		376	0.600		0.656	0.517
	Effective Release	49,460	Jersey Point		59		721				
2000	06-45-63	24,457	Durham Ferry	17-Apr-00	11	11	296				
	06-04-01	23,529	Durham Ferry	17-Apr-00	7	6	215				
	06-04-02	24,177	Durham Ferry	17-Apr-00	10	10	232				
	06-44-01	23,465	Mossdale	18-Apr-00	9	14	207				
	06-44-02	22,784	Mossdale	18-Apr-00	9	16	174				
	06-44-03	25,527	Jersey Point	20-Apr-00	24	50	649				
	06-44-04	25,824	Jersey Point	20-Apr-00	41	47	704				
	Effective Release	72,163	Durham Ferry		28	27	743	0.310	0.190	0.242	0.391
	Effective Release	46,249	Mossdale		18	30	381	0.310	0.330	0.329	0.313
	Effective Release	51,351	Jersey Point		65	97	1353				
	601060914	23,698	Durham Ferry	28-Apr-00	7	8	46				
	601060915	26,805	Durham Ferry	28-Apr-00	5	15	45				
	0601110814	23,889	Durham Ferry	28-Apr-00	10	8	70				
	0601061001	25,572	Durham Ferry	1-May-00	48	76	358				
	0601061002	24,661	Jersey Point	1-May-00	30	76	230				
	Effective Release	74,392	Durham Ferry		22	31	161	0.190	0.140	0.156	0.185
	Effective Release	50,233	Jersey Point		78	152	588				
2001	06-44-29	23,351	Durham Ferry	30-Apr-01	14	28	95				
	06-44-30	22,720	Durham Ferry	30-Apr-01	22	30	158				
	06-44-31	22,376	Durham Ferry	30-Apr-01	17	18	111				
	06-44-32	23,022	Mossdale	1-May-01	17	18	122				
	06-44-33	22,191	Mossdale	1-May-01	14	15	106				
	06-44-34	24,444	Jersey Point	4-May-01	50	156	470				
	06-44-35	24,993	Jersey Point	4-May-01	61	173	556				
	Effective Release	68,447	Durham Ferry		53	76	364	0.340	0.170	0.212	0.256
	Effective Release	45,213	Mossdale		31	33	228	0.310	0.110	0.159	0.243
	Effective Release	49,437	Jersey Point		111	329	1026				
	06-44-36	24,029	Durham Ferry	7-May-01	2	8	17				
	06-44-37	23,907	Durham Ferry	7-May-01	5	11	45				
	06-44-38	24,054	Durham Ferry	7-May-01	2	10	28				
	06-44-39	23,882	Mossdale	8-May-01	4	8	25				
	06-44-40	25,310	Mossdale	8-May-01	4	11	27				
	06-44-41	25,910	Jersey Point	11-May-01	17	43	243				
	06-44-42	25,466	Jersey Point	11-May-01	27	53	335				
	Effective Release	71,990	Durham Ferry		9	29	90	0.130	0.200	0.194	0.111
	Effective Release	49,192	Mossdale		8	19	52	0.190	0.180	0.201	0.094
	Effective Release	51,376	Jersey Point		44	96	578				
2002	06-44-71	23,920	Durham Ferry	18-Apr-02	4	11	33				
	06-44-72	25,176	Durham Ferry	18-Apr-02	9	20	96				
	06-44-73	23,872	Durham Ferry	18-Apr-02	4	12	74				
	06-44-74	24,747	Durham Ferry	18-Apr-02	4	20	67				
	06-44-57	25,515	Mossdale	19-Apr-02	6	13	76				
	06-44-58	25,272	Mossdale	19-Apr-02	7	29	69				
	06-44-59	24,802	Jersey Point	22-Apr-02	46	101	494				

Table 5-12
Absolute survival estimates and differential recovery rates based on Chipps Island, Antioch, or ocean recoveries of Merced River Hatchery salmon released as part of South Delta studies betweeen 1996 and 2006.

Release Year	San Joaquin River (Merced River origin) Tag Number	Release Number	Release Site	Release Date	Chipps Island Recovs.	Antioch Recovs.	Expanded Adult Ocean Recovs. (Age 1+ to 4+) Total	Chipps Island	Antioch	DRR or CDRR	Ocean DRR
		CWT Smolt Releases						Absolute Survival Estimates		Differential Recovery Rates	
	06-44-60	24,128	Jersey Point	22-Apr-02	37	89	456				
	Effective Release	97,715	Durham Ferry		21	63	270	0.130	0.160	0.154	0.142
	Effective Release	50,787	Mossdale		13	42	145	0.150	0.210	0.194	0.147
	Effective Release	48,930	Jersey Point		83	190	950				
2002	06-44-70	24,680	Durham Ferry	25-Apr-02	3	6	23				
	06-44-75	24,659	Durham Ferry	25-Apr-02	5	2	21				
	06-44-76	24,783	Durham Ferry	25-Apr-02	3	4	7				
	06-44-77	24,381	Durham Ferry	25-Apr-02	4	6	6				
	06-44-78	24,519	Mossdale	26-Apr-02	2	3	26				
	06-44-79	24,820	Mossdale	26-Apr-02	3	4	14				
	06-44-80	24,032	Jersey Point	30-Apr-02	18	43	307				
	06-44-81	22,880	Jersey Point	30-Apr-02	28	32	290				
	Effective Release	98,503	Durham Ferry		15	18	57	0.160	0.110	0.130	0.045
	Effective Release	49,339	Mossdale		5	7	40	0.110	0.090	0.094	0.064
	Effective Release	46,912	Jersey Point		46	75	597				
2003	06-02-82	24,453	Durham Ferry	21-Apr-03	0	1	9				
	06-02-83	25,927	Durham Ferry	21-Apr-03	2	4	0				
	06-27-42	24,069	Durham Ferry	21-Apr-03	1	1	10				
	06-27-48	24,471	Mossdale	22-Apr-03	2	2	3				
	06-27-43	25,212	Mossdale	22-Apr-03	3	2	5				
	06-27-44	24,414	Jersey Point	25-Apr-03	57	71	265				
	Effective Release	74,449	Durham Ferry		3	6	19	0.019	0.015	0.023	0.024
	Effective Release	49,683	Mossdale		5	4	8	0.048	0.015	0.035	0.015
	Effective Release	24,414	Jersey Point		57	71	265				
	06-27-45	24,685	Durham Ferry	28-Apr-03	0	0	6				
	06-27-46	25,189	Durham Ferry	28-Apr-03	0	0	0				
	06-27-47	24,628	Durham Ferry	28-Apr-03	0	0	4				
	06-27-49	24,180	Mossdale	29-Apr-03	0	0	5				
	06-27-50	24,346	Mossdale	29-Apr-03	1	0	0				
	06-27-51	25,692	Jersey Point	2-May-03	39	35	426				
	Effective Release	74,502	Durham Ferry		0	0	10			0.000	0.008
	Effective Release	48,526	Mossdale		1	0	5	0.010		0.007	0.006
	Effective Release	25,692	Jersey Point		39	35	426				
2004	06-27-52	23,440	Durham Ferry	22-Apr-04	0	1	3				
	06-27-53	21,714	Durham Ferry	22-Apr-04	1	1	0				
	06-27-54	23,328	Durham Ferry	22-Apr-04	1	0	0				
	06-27-55	23,783	Durham Ferry	22-Apr-04	1	0	0				
	06-46-70	25,319	Mossdale	23-Apr-04	0	1	0				
	06-45-82	23,586	Mossdale	23-Apr-04	1	0	0				
	06-45-83	24,803	Mossdale	23-Apr-04	2	0	2				
	06-45-80	22,911	Jersey Point	26-Apr-04	25	22	117				
	Effective Release	92,265	Durham Ferry		3	2	3	0.030	0.020	0.026	0.006
	Effective Release	73,708	Mossdale		3	1	2	0.040	0.010	0.026	0.005
	Effective Release	22,911	Jersey Point		25	22	117				
2005	06-46-72	23,414	Durham Ferry	2-May-05	5	0	0				
	06-46-73	23,193	Durham Ferry	2-May-05	2	2	0				
	06-46-74	23,660	Durham Ferry	2-May-05	4	3	3				
	06-46-75	23,567	Durham Ferry	2-May-05	1	1	0				
	06-46-97	22,302	Dos Reis	3-May-05	1	1	0				
	06-46-98	24,149	Dos Reis	3-May-05	1	3	0				
	06-45-91	22,675	Dos Reis	3-May-05	1	3	0				
	06-45-88	22,767	Jersey Point	6-May-05	32	31	3				
	Effective Release	93,834	Durham Ferry		12	6	3	0.099	0.049	0.069	0.243
	Effective Release	69,126	Dos Reis		3	7	0	0.035	0.110	0.052	0.000
	Effective Release	22,767	Jersey Point		32	31	3				
	06-45-84	22,777	Durham Ferry	9-May-05	2	1	0				
	06-45-85	22,968	Durham Ferry	9-May-05	1	1	0				
	06-45-86	23,012	Durham Ferry	9-May-05	3	3	0				
	06-45-87	22,806	Durham Ferry	9-May-05	0	2	0				
	06-45-89	21,443	Dos Reis	10-May-05	3	5	0				
	06-45-90	23,755	Dos Reis	10-May-05	2	2	0				
	06-46-99	23,448	Dos Reis	10-May-05	1	0	0				
	06-47-00	23,231	Jersey Point	13-May-05	38	27	14				
	Effective Release	91,563	Durham Ferry		6	7	0	0.044	0.094	0.051	0.000
	Effective Release	68,646	Dos Reis		6	7	0	0.058	0.127	0.068	0.000
	Effective Release	23,231	Jersey Point		38	27	14				
2006	06-47-13	24,703	Mossdale	4-May-06	7	5	0				
	06-47-14	24,315	Mossdale	4-May-06	2	4	0				
	06-47-16	25,602	Dos Reis	5-May-06	7	3	0				
	06-47-15	26,192	Jersey Point	8-May-06	58	26	0				
	Effective Release	49,018	Mossdale		9	9	0	0.080	0.180	0.115	
	Effective Release	25,602	Dos Reis		7	3	0	0.120	0.110	0.122	
	Effective Release	26,192	Jersey Point		58	26	0				
	06-47-21	25,105	Mossdale	19-May-06	2	0	0				
	06-47-22	24,008	Mossdale	19-May-06	0	0	0				
	06-47-24	23,980	Jersey Point	22-May-06	44	14	0				
	Effective Release	49,113	Mossdale		2	0	0	0.030	0.000	0.017	
	Effective Release	23,980	Jersey Point		44	14	0				

Note: Ocean recoveries are based on data through 2006

of 57 transmitters were detected just upstream of the Tracy FF trashracks and potentially had been consumed by predators. Fifty-three acoustic tagged fish were detected at the stationary receiver at the Tracy FF from the downstream of HORB release. Four of these were later detected at other locations (Skinner, CCFB or Hwy 4). Determining which acoustic tagged fish have been eaten with certainty is problematic.

A limitation of the acoustic tag methodology is the ability to determine whether a tag is still inside a live juvenile salmon. Without this assurance it is possible that survival is biased. Although some types of behavior do indicate the tagged fish has been eaten, or that the fish has died, there are probably some cases where fish are assumed to be live and they are not. Thus it is likely survival would be over-estimated using these methods. Traditional coded-wire tag VAMP studies did not have this limitation, although they had other technical challenges.

Comparison with Past Years

Ocean Recovery Information

Ocean recovery data of CWT salmon groups can provide an additional source of recoveries for estimating survival through the Delta. The ocean harvest data may be more reliable due to the greater number of CWT recoveries and the extended recovery period.

Adult ocean recovery data are gathered from commercial and sport ocean harvest checked at various ports by DFG. The Pacific States Marine Fisheries Commission database of ocean harvest CWT data was the source of recoveries through 2006. The ocean CWT recovery data accumulate over a one to four year period after the year a study release is made as nearly all of a given year-class of salmon have been either harvested or spawned by age five. Consequently, these data are essentially complete for releases made through 2002 and partially available for CWT releases made from 2003 to 2005 - no ocean recovery data is available yet for the 2006 releases. Differential recovery rates (DRR) based on Chipps Island or ocean recoveries and combined differential recovery rates (CDRR) based on both Antioch and Chipps Island recoveries for salmon produced at the MRH are shown in Table 5-12. Absolute survival estimates based on Chipps Island and Antioch survival indices are also included. The earlier releases were made as part of south Delta survival evaluations (1996-1999) with the later releases associated with VAMP (2000-2006). Releases have been made at several locations: Dos Reis, Mossdale, Durham Ferry, and Jersey Point. The Chipps Island and Antioch survival estimates and combined differential (Antioch and Chipps Island recoveries summed) or differential recovery rates (Chipps Island recoveries only) are graphed in relation to the differential recovery rate using the ocean recovery information in Figure 5-18.

Results of this comparative analysis of survival estimates and differential recovery rates for Chinook salmon produced in the MRH show: (1) there is general agreement between survival estimates and differential recovery rates based on juvenile CWT salmon recoveries at Chipps Island and adult recoveries from the ocean fishery (r^2=0.76), (2) there is less agreement with Antioch trawling which has fewer years of data, and (3) additional comparisons need to be made, as more data becomes available from VAMP releases for recoveries at Antioch, Chipps Island, and the ocean fishery.

San Joaquin River Salmon Protection

One of the VAMP objectives is to provide improved conditions to increase the survival of juvenile Chinook salmon smolts produced in the San Joaquin River tributaries during their downstream migration through the lower river and Delta. It is hypothesized that these actions to improve conditions for the juveniles will translate into greater adult abundance and escapement in future years than would otherwise occur without the actions.

To determine if VAMP has been successful in targeting the migration period of naturally produced juvenile salmon, catches of unmarked salmon at Mossdale and in salvage at the CVP and SWP facilities were compared prior to and during the VAMP period.

Unmarked and Marked Salmon Captured at Mossdale

The typical time period for VAMP (April 15 to May 15) was chosen based on historical data that indicated a high percentage of the juvenile salmon emigrating from the San Joaquin tributaries passed into the Delta at Mossdale during that time. The peak average catch per 10,000 cubic meters per day of unmarked juvenile salmon captured at Mossdale occurred on 23 Apr - densities may have been as high or higher on 21-22 Apr when no sampling was conducted at Mossdale and river flows were increasing. In 2007, the VAMP period was April 22 to May 22. The average daily density of unmarked juvenile salmon caught in Kodiak trawling at Mossdale during January through June is shown in Figure 5-19. Unmarked salmon do not have an adipose clip and can be juveniles from natural spawning or unmarked hatchery fish from the MRH. On May 15 a total of 35,756 unmarked smolts were released at MRH and this was the only release of unmarked hatchery smolts from MRH conducted during 2007. Peak density of unmarked juvenile salmon at Mossdale was observed on April 23 and immediately followed the leading edge of the VAMP

Figure 5-18
Comparison of Antioch and Chipps Island survival estimates and differential or combined differential recovery rates compared to differential ocean recovery rates for 1996-2006 CWT releases.

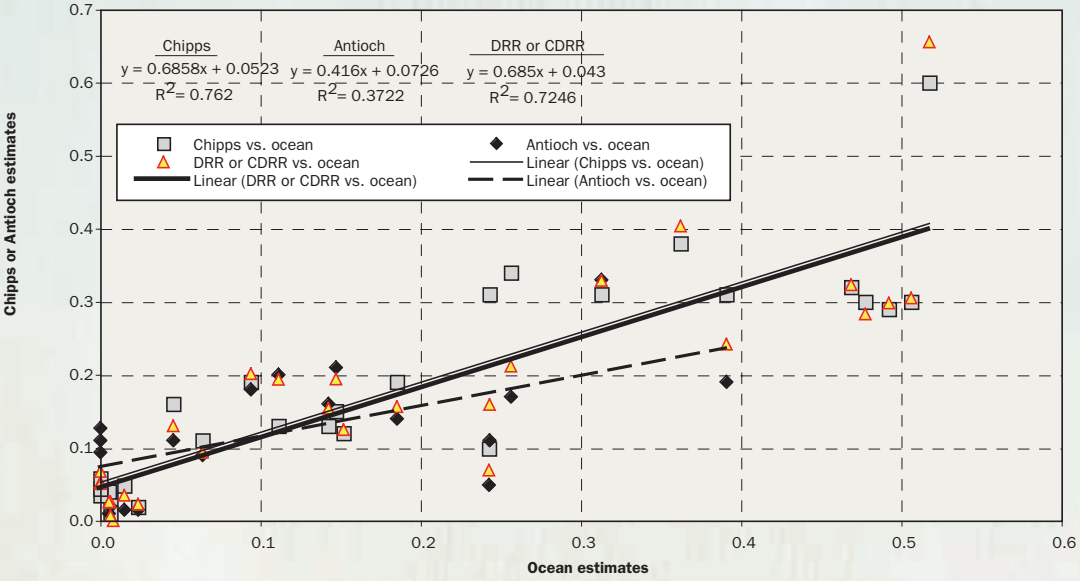
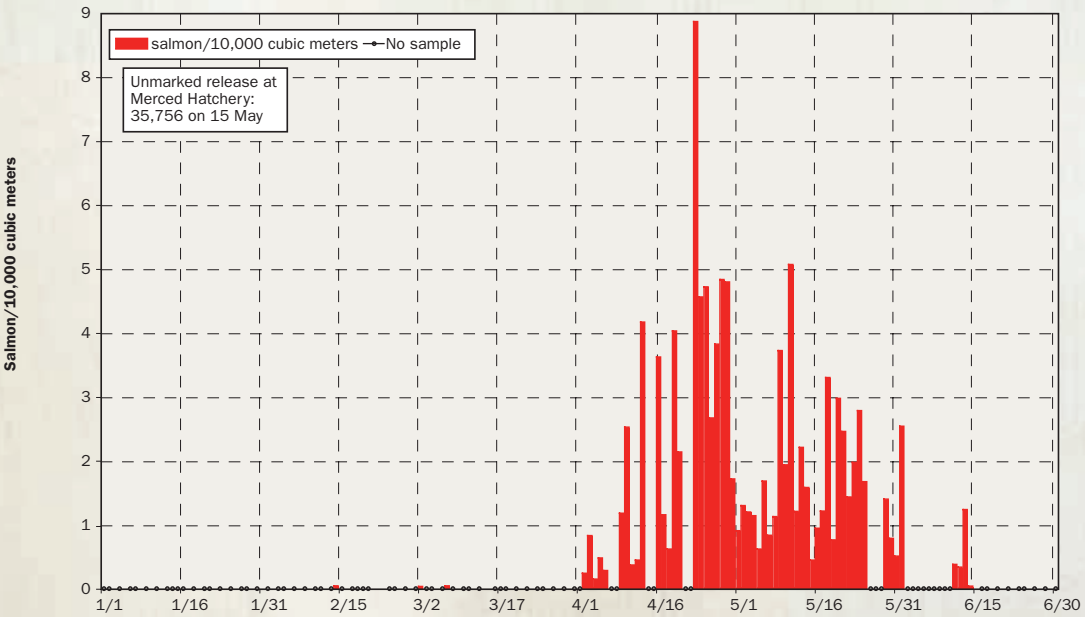


Figure 5-19
Average daily densities of unmarked salmon caught in the Mossdale Kodiak



pulse flow. (Figure 5-19). The size of the juvenile salmon captured in the Mossdale trawl during January through June is shown in Figure 5-20. Recaptures of adipose fin-clipped CWT salmon released at Merced River Hatchery on 20 Apr and 4 May and at Hatfield on 24-26 Apr and 08-09 May were prominent in the catch at Mossdale during 27-30 Apr and 9-13 May. The adipose fin clipped juvenile salmon captured at Mossdale on 04 April was a wild migrant captured and tagged on the Stanislaus River at Caswell.

Salmon Salvage and Losses at Delta Export Pumps

Fish salvage operations at the CVP and SWP export facilities capture juvenile salmon and transport them by tanker truck to release sites in the western Sacramento-San Joaquin Delta. The untagged salmon are potentially from any source in the Central Valley. It is not certain which unmarked salmon recovered are of San Joaquin basin origin, although the timing of salvage and fish size can be compared with Mossdale trawl data and CWT recovery data for MRH smolts at the salvage facilities to provide indications as to the origin of the unmarked fish.

The estimated salmon losses at the CVP and SWP facilities are based on expanded salvage and an estimate of screen efficiency and survival through the facility and salvage process. The CVP pumps divert directly from the Old River channel and direct losses are estimated to range from about 50 to 80% of the number salvaged. Four to five salmon are estimated to be lost per salvaged salmon at the SWP because of high predation rates in Clifton Court Forebay. The SWP loss estimates are therefore about six to eight times higher, per salvaged salmon, than for the CVP. The loss estimates do not include any indirect mortality in the Delta due to water export operations or additional mortality associated with post-release predation.

Density of salmon encountering both of the export and fish salvage facilities off Old River is represented by the combined salvage and loss estimated per acre-foot of water pumped. The DFG and DWR maintain a database of daily, weekly, and monthly salvage data. The number and density of juvenile salmon that migrated through the system, the placement of the HORB, and the amount of water pumped by each facility are some of the factors that influence the number of juvenile salmon salvaged and lost. Density is an indicator of when concentrations of juvenile salmon may be more susceptible to the export facilities and salvage system. Additionally, salvage efficiency is lower for smaller-sized salmon (fry and pre-smolts), so their salvage numbers and estimated losses are underrepresented.

The weekly data covering the period of April 23 to May 20 approximated the 2007 VAMP period. A review of weekly data for January through June indicates that the highest CVP salvage and losses occurred during the two weeks preceding the VAMP period, with lesser peaks during early March,(Figure 5-21). Highest SWP salvage and losses occurred during the week immediately preceding the VAMP period, with lesser peaks during early March and early April (Figure 5-22). Salmon densities based on combined salvage and loss estimates were highest at the CVP during the two weeks immediately preceding the VAMP period and during the three weeks immediately following the VAMP period, with a smaller peak during early March (Figure 5-23). At the SWP, salmon densities were highly variable with peak densities occurring immediately preceding the VAMP period, during the VAMP period, and late May into early June (Figure 5-23); lesser peaks were observed during early March and early April. The peak at both facilities during April preceding VAMP occurred when exports greatly exceeded Vernalis flow; the peaks observed after VAMP occurred during decreasing flow and export (Figure 5-24).

The size distribution of unmarked salmon during January through June in the Mossdale trawl (Figure 5-20) generally overlaps with the size distribution of those salvaged at the fish facilities (Figure 5-25, Source E. Chappell, DWR). Based on comparisons with Mossdale data, some salmon salvaged before, during, and after the VAMP period could have been from the San Joaquin basin (Figure 5-19).

The 2007 VAMP test period coincided with part of the peak period of San Joaquin River salmon smolt emigration. The highest daily density observed at Mossdale was on the second day of the VAMP period (April 23), and it is unfortunate that sampling was not conducted during the two days preceding the observed peak when flows were increasing. Smolt abundance and production estimates at Mossdale could be improved by ensuring that sampling is conducted daily when salmon smolts are emigrating. The most concentrated period of estimated losses in 2007 occurred in April prior to VAMP export reduction, as has been recorded in other years. Export curtailments may be more protective if based on real-time migration activity observed at Mossdale or observed salvage/density at the export facilities.

SEE USEFUL WEB PAGES

Figure 5-20
Mossdale Kodiak trawl individual daily forklengths of juvenile Chinook salmon, January through June 2007

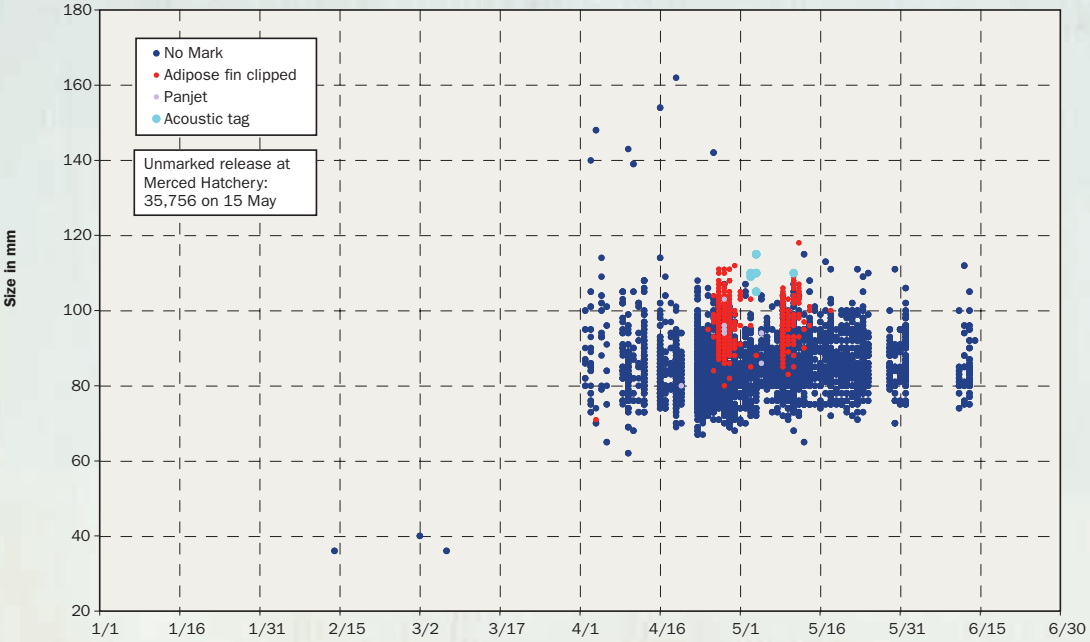


Figure 5-21
2007 CVP estimated salmon salvage and loss

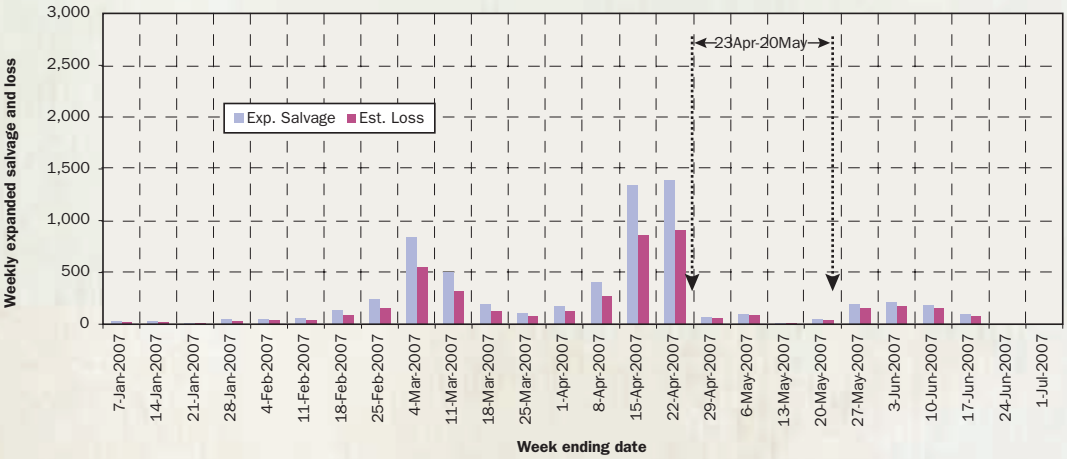


Figure 5-22
2007 SWP estimated salmon salvage and loss

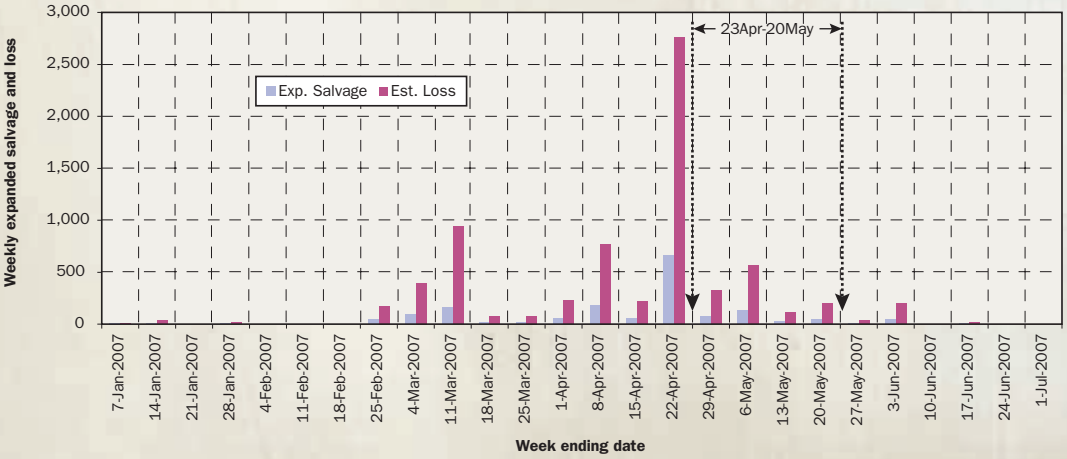


Figure 5-23
2007 SWP & CVP Combined salvage and loss density

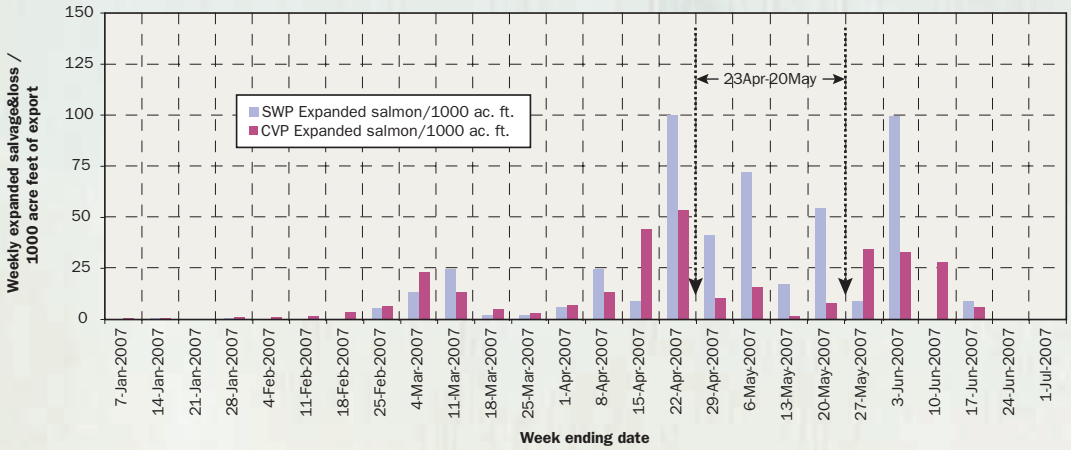


Figure 5-24
2007 weekly export rates and Vernalis flow

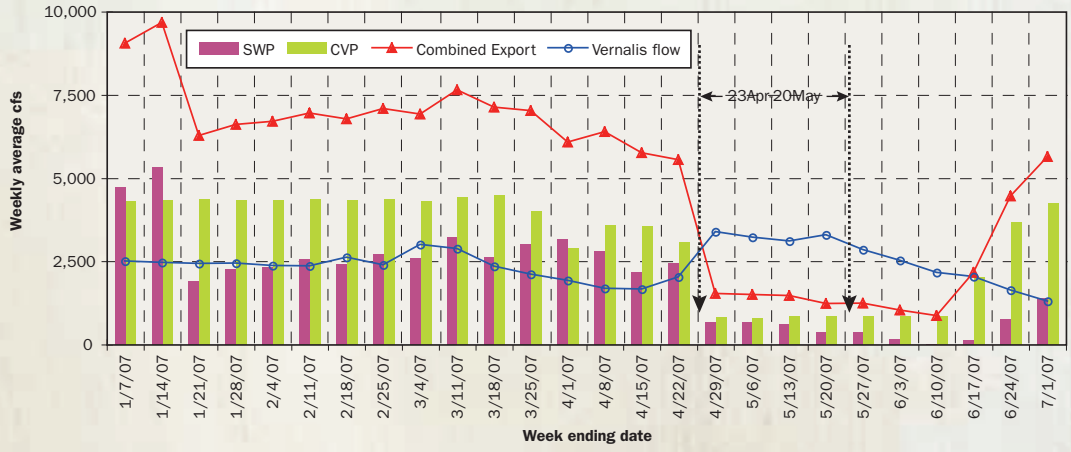
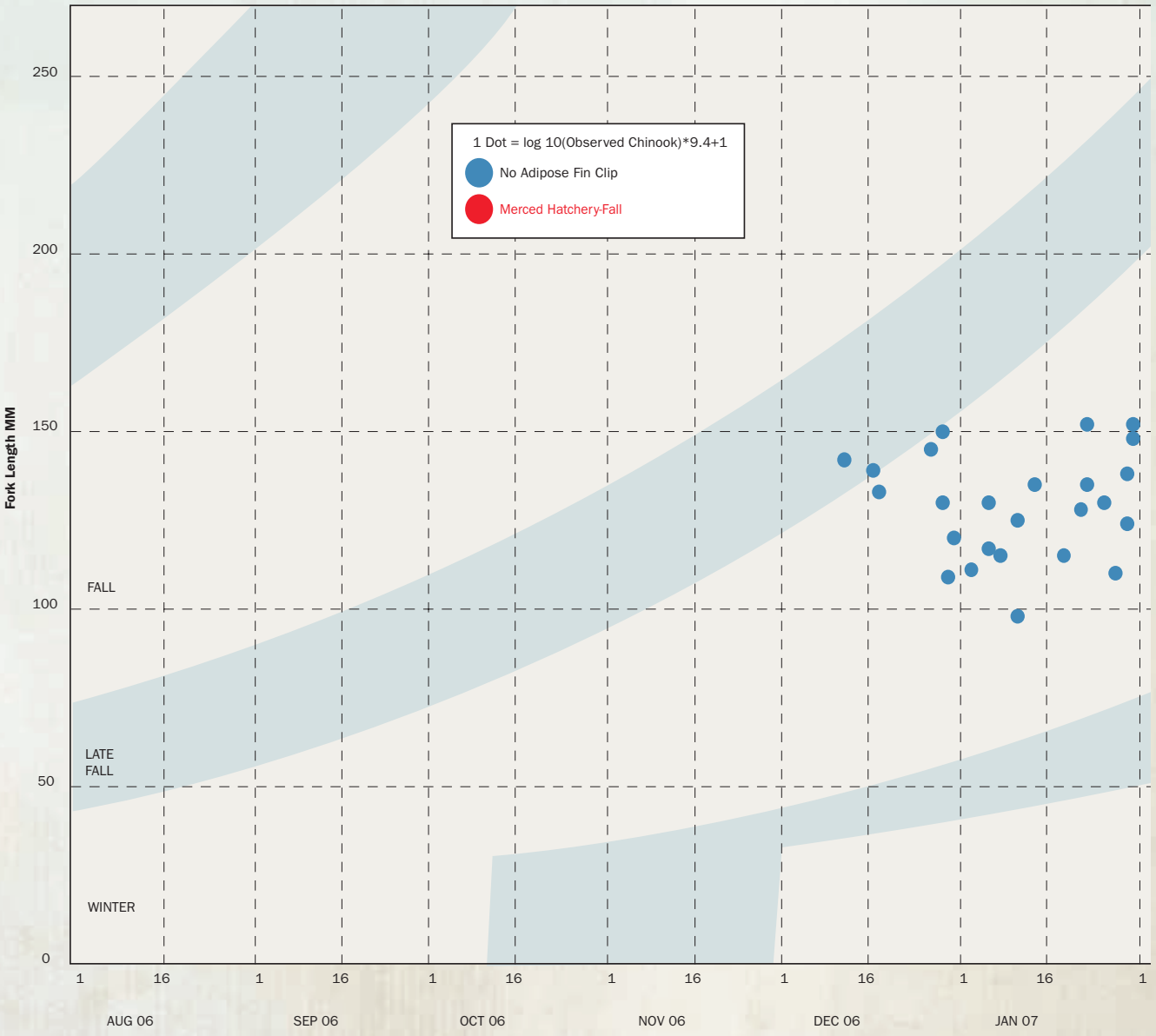
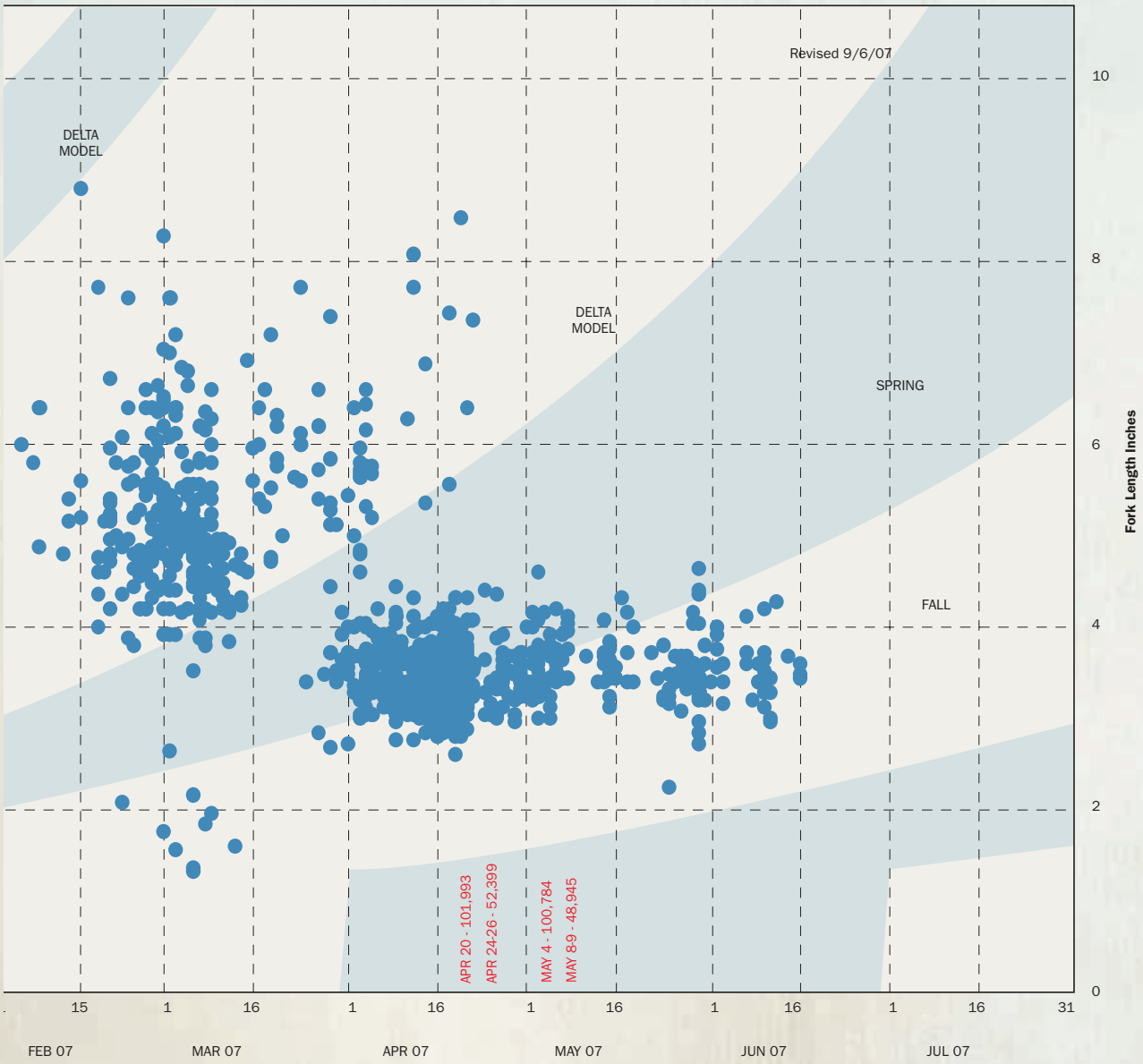


Figure 5-25
Observed Chinook Salvage at the SWP & CVP Delta Fish Facilities 8/1/06 Through 7/31/07




Revised 9/6/07
DELTA MODEL
DELTA MODEL
SPRING
FALL
APR 20 - 101,993
APR 24-26 - 52,399
MAY 4 - 100,784
MAY 8-9 - 48,945
Fork Length Inches
0
2
4
6
8
10
15
1
16
1
16
1
16
1
16
1
16
31
FEB 07
MAR 07
APR 07
MAY 07
JUN 07
JUL 07

CHAPTER 6

COMPLIMENTARY STUDIES RELATED TO THE VAMP

Throughout 2007 several fishery studies were conducted to advance the understanding of juvenile salmon abundance and survival in the San Joaquin River basin. Following are summary reports of the information developed in each study.

Review of Juvenile Salmon Data from the San Joaquin River Tributaries to the South Delta During January through June, 2007

Contributed by Tim Ford, Turlock and Modesto Irrigation Districts, and Andrea Fuller, FISHBIO Environmental

The VAMP includes protective measures for San Joaquin River (SJR) smolts during a 31-day period in April and May, and evaluations are conducted annually to determine how these measures (i.e., river flow and exports) relate to delta survival. However, juvenile salmon from the spawning areas of the Stanislaus, Tuolumne, and Merced rivers (referred to here as tributaries) can migrate to the SJR and delta over a longer season that may range from January to June. Their migration and rearing patterns vary among tributaries and among years in response to flow releases, runoff events, turbidity, and other factors.

During 2007, rotary screw trapping was conducted near the confluences of the Stanislaus, Tuolumne, and Merced Rivers with the SJR. Seining was also conducted in the SJR from below the HOR to upstream of the Tuolumne River confluence. This review presents data from those rotary screw traps (RST) and seining to identify the presence and movement of juvenile salmon from the tributaries into the mainstem San Joaquin River relative to observations at the Mossdale Trawl and in CVP and SWP salvage facilities. Stanislaus River RST monitoring was conducted at River Mile (RM) 9 (Caswell site) during 11 Jan – 22 Jun; Tuolumne River RST monitoring was conducted at RM 5 (Grayson site) during 23 Mar – 29 May; and Merced River RST monitoring was conducted at RM 2 (Hatfield site) during 25 Jan - 01 Jun. Weekly seining during Jan-Jun was done at up to 8 sites from River Mile 51 (Dos Reis) to River Mile 83 (North of Tuolumne River) and 2 other sites were seined every 2 weeks from mid-January to late May at River Mile 78 and 90. Trawling was conducted in the San Joaquin River at Mossdale near RM 54 (downstream of the tributaries, and just upstream of the Head of Old River) with a schedule of three days/week 03 Jan – 30 Mar; five days per week 02 Apr – 20 Apr; daily during 23 Apr – 25 May; and three to five days per week during 29 May – 30 Jun. Trawling was suspended during 02 Jun – 10 Jun due to Delta smelt concerns. Although salvage data of unmarked salmon does not distinguish which salmon originate from the San Joaquin tributaries, they can be compared to timing, abundance, and size of salmon collected in the San Joaquin basin monitoring. Flow and rainfall patterns in the basin are shown in Figure 6-1.

The seasonal peak catch of fry in the Stanislaus River RST (Figure 6-2) occurred on March 1 following increasing reservoir releases and rain events during 25 Feb – 01 Mar. The Merced River RST sampling suggests that fry did not migrate out of the Merced River during 2007 (Figure 6-3). RST sampling was not conducted during the fry outmigration season on the Tuolumne River, but Tuolumne seining recorded no salmon down to, or below, Modesto, where Dry Creek runoff enters the river, thus fry outmigration also likely did not occur in the Tuolumne River (Figure 6-4). Relatively few early fish were observed at the Mossdale trawl (Figure 6-5). It appears that peak fry migration from the Stanislaus River in 2007 was not detected at Mossdale indicating that the juveniles may have remained in the lower San Joaquin River above Mossdale and/or the relative efficiency of the trawl for fry-size salmon is less than at the rotary screw trap. However, high densities of fry at Mossdale have been detected by the Mossdale trawl in other years (SJRGA 2005). Seasonal peak catch occurred at Mossdale on 23 Apr (Figure 6-5), shortly after peak smolt catches on the Stanislaus River on 21 Apr (Figure 6-2) and coincident to the peak densities recorded at the salvage facilities (Figure 5-23). Many salmon may have also passed Mossdale undetected during 21-22 Apr as a result of no sampling effort on these days. Seasonal peak catches were observed on the Merced River on 24 Apr (Figure 6-3) and on the Tuolumne River during

Figure 6-1
San Joaquin Basin Flows and Rainfall

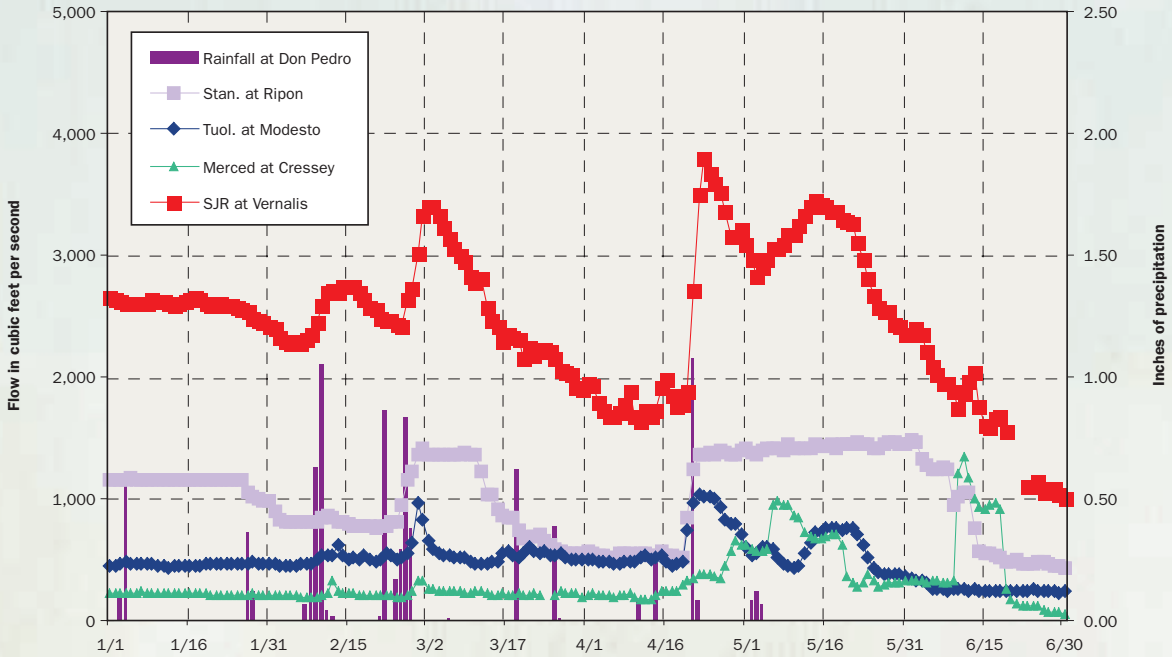


Figure 6-2
Stanislaus screw trap catch of unmarked juvenile Chinook salmon

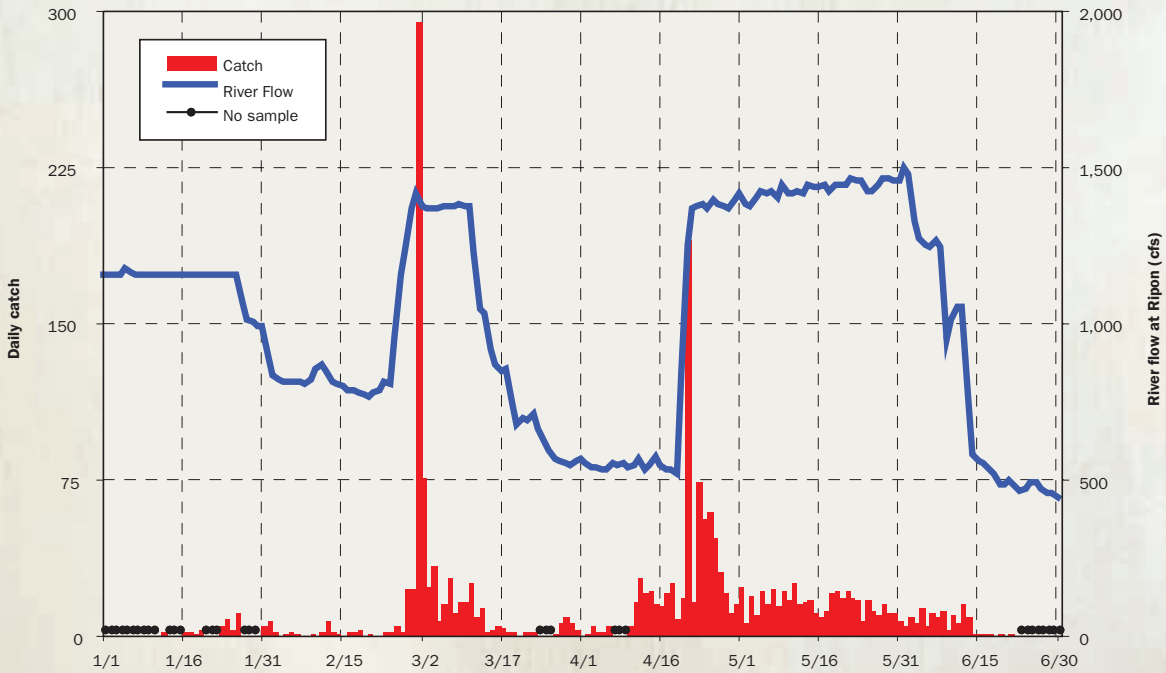
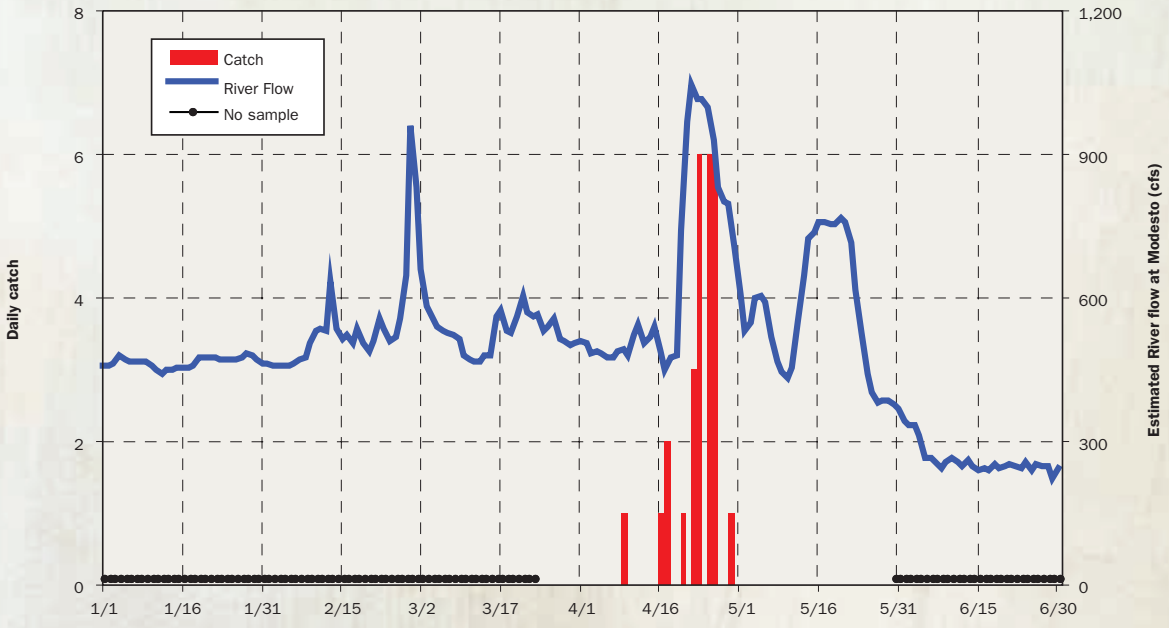


Figure 6-3
Merced screw trap catch of unmarked juvenile Chinook salmon

Figure 6-4
Tuolumne screw trap catch of unmarked juvenile Chinook salmon



23-26 Apr (Figure 6-4), and these peaks were detected at Mossdale during 28-29 Apr. Seining in the SJR only captured two salmon prior to VAMP: one yearling salmon (155 mm) captured at Sturgeon Bend (RM 74) on 01 Mar and one young-of-year salmon (56 mm) captured at Big Beach (RM 63) on 29 Mar.

Average size in RST and trawl catch and salvage (Figure 6-6) shows that most fish observed prior to mid-March averaged <50 mm fork length (FL). Both the trawl and salvage are relatively less effective at capture of fry (salmon less than 50 mm long). Average size at all locations typically increased by early April to >70 mm FL and to >80 mm FL by early May (Figure 6-6). Low abundance of juvenile salmon was observed by 01 May in the Tuolumne River, mid-May in the Merced River, and mid June in the Stanislaus River and at Mossdale. To obtain more useful information on salmon movement into the Delta, daily monitoring at the lower end of each of the three San Joaquin tributaries and at Mossdale for the entire season (January through June) is a high priority. Further evaluation of the trawl and salvage efficiency on smaller juvenile salmon is necessary. These data would help to refine existing protective measures for smolts, if warranted, and to identify alternative strategies that may protect a larger proportion of the juvenile salmon population migrating from the San Joaquin tributaries.

2007 Mossdale Trawl Summary

Contributed by Jason Guignard
California Department of Fish and Game

Introduction

Monitoring for the fall-run chinook salmon smolt out-migrant population, from the San Joaquin drainage, is conducted by CDFG two miles downstream of Mossdale Landing, County Park (river mile 56), and just upstream of the Old River confluence (Figure 6-7). This measurement of timing and production of the out-migrating fall-run Chinook salmon smolts has been performed at this location since 1988 in order to:

1) Determine annual salmon smolt production in the San Joaquin Basin,

2) Develop smolt production trend information,

3) Determine timing and magnitude of smolt out-migration into the Delta from the San Joaquin tributaries.

Methods

Sampling is performed with a 6 x 25 foot (1.87m x 7.6m) Kodiak trawl net. The Kodiak trawl uses two boats to pull a net equipped with spreader bars, wings, and a "belly" in the throat of the net (to improve capture vulnerability). The cod end of the trawl net is secured using a rope. The sampling intensity was 5 days a week from April 2 to April 20, and then increased into 7 days a week from April 23 to May 25. The sampling effort was reduced back to 5 days a week during May 29 to June 15, and sampling was actually suspended briefly from June 4 to June 8 due to delta smelt concerns. The entire sampling period was from April 2 to June 15, 2007 with a total of 57 sample days out of the study period of 75 days. All trawling occurred during daylight hours, starting around 0800 hours. A sampling day usually consisted of 15 tows at 20 minutes per tow, although the first three weeks and last four weeks of sampling had 10 tows per day. Sampling is also conducted 3 days per week between mid- June and April by the USFWS in Stockton.

Water temperature, turbidity, weather, and beginning tow time were recorded for each tow. Velocity was recorded by using a digital flow meter model 2030R that is made by General Oceanics Inc. A Garmin GPSMap 172c was used to map the location of all sampling tows. This mapping is being done to evaluate differences in catch rate throughout the sampling area (Figure 6-8). The mean daily river flow data that is used in this report were taken from the U.S. Geological Survey mean daily stream flow gauge at Vernalis.

All fish were identified to species and enumerated. The first 20 per tow of all species, except Chinook salmon, were also measured. Chinook salmon were checked for a clipped adipose fin and/or dye mark. All non-marked Chinook salmon were considered "natural" for the purpose of this study. All Chinook salmon were measured (fork length, mm). Chinook salmon that had a clipped adipose fin was measured, individually bagged, and labeled and saved for coded wire tag processing.

Analysis

The 2007 natural smolt production from the San Joaquin drainage was estimated by two different methods. The first method (smolt/ac-ft method) involves taking the actual number of non-marked Chinook salmon and dividing by the actual volume sampled to get Chinook/ac-ft. This number is then expanded by the daily mean flow recorded at Vernalis for a 5-hour index and expanded again for a 24-hour daily estimate. These daily average smolt densities are then expanded by multiplying by the daily mean flow recorded at Vernalis (Figure 6-9). Production for days not sampled within the study period were estimated by averaging smolt/ac-ft for the 2 days before and 2 days after the non-sampled period.

The second estimate (regression vulnerability method), which we believe to be a more accurate estimate, due to the uneven distribution of smolts in the channel, is determined based on the recapture rates of dye marked

Figure 6-5
Mossdale kodiak trawl catch of unmarked juvenile Chinook salmon

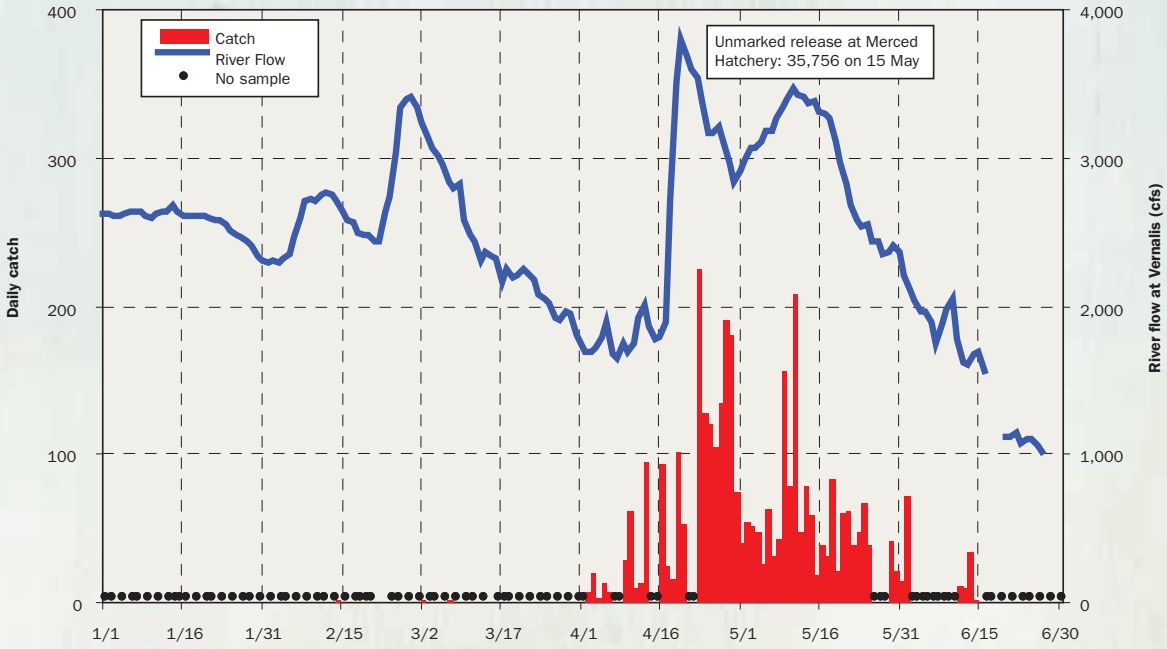


Figure 6-6
Daily average forklength of unmarked juvenile Chinook salmon

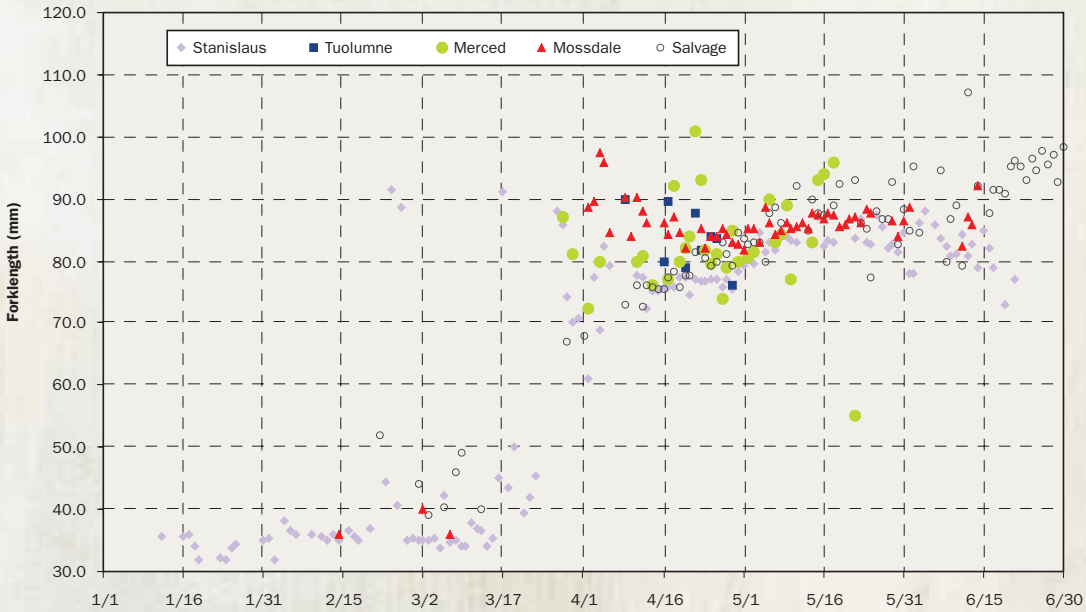


Figure 6-7
Tow Location, Mossdale to Old River

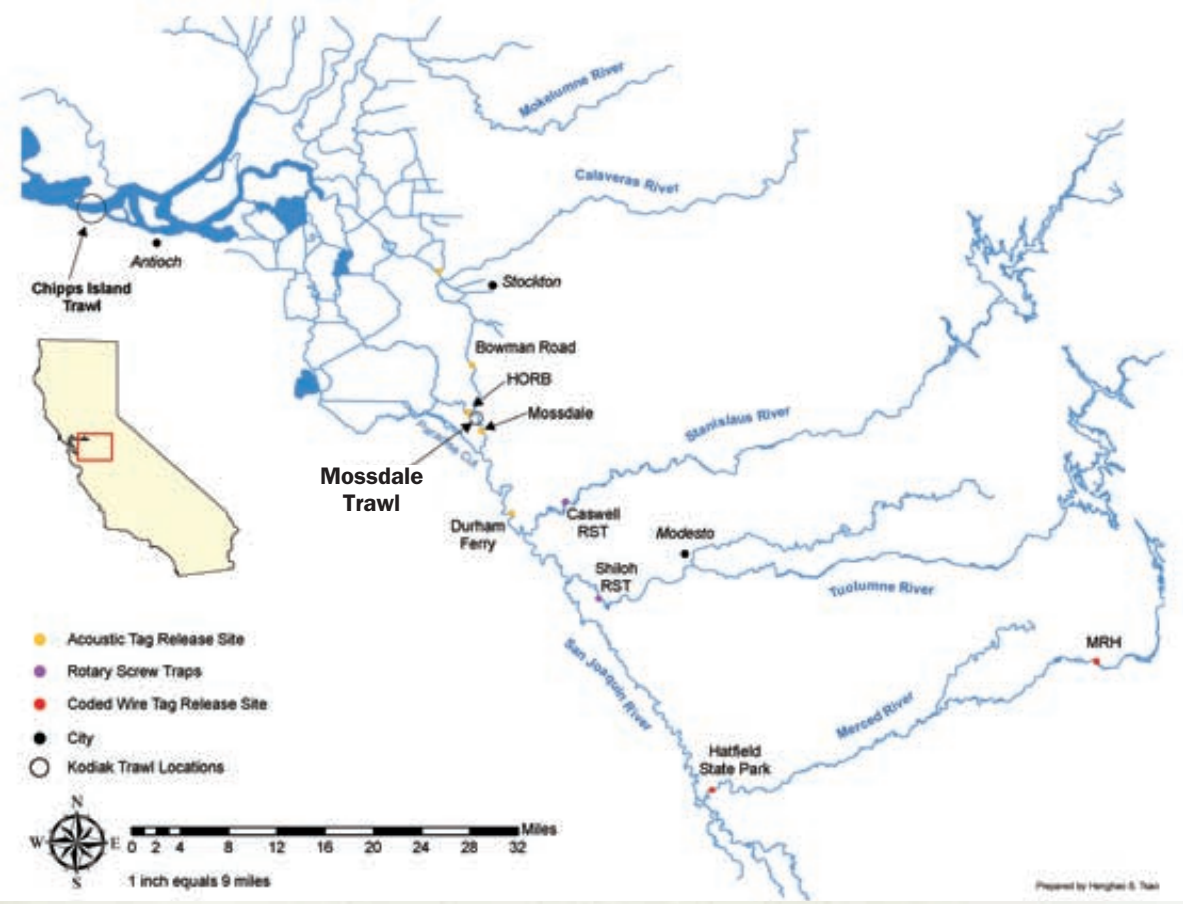


Figure 6-8
Mossdale Sampling Tows

Figure 6-9
Expanded daily catch of non-marked Chinook based on vulnerability estimates and flow at Vernalis

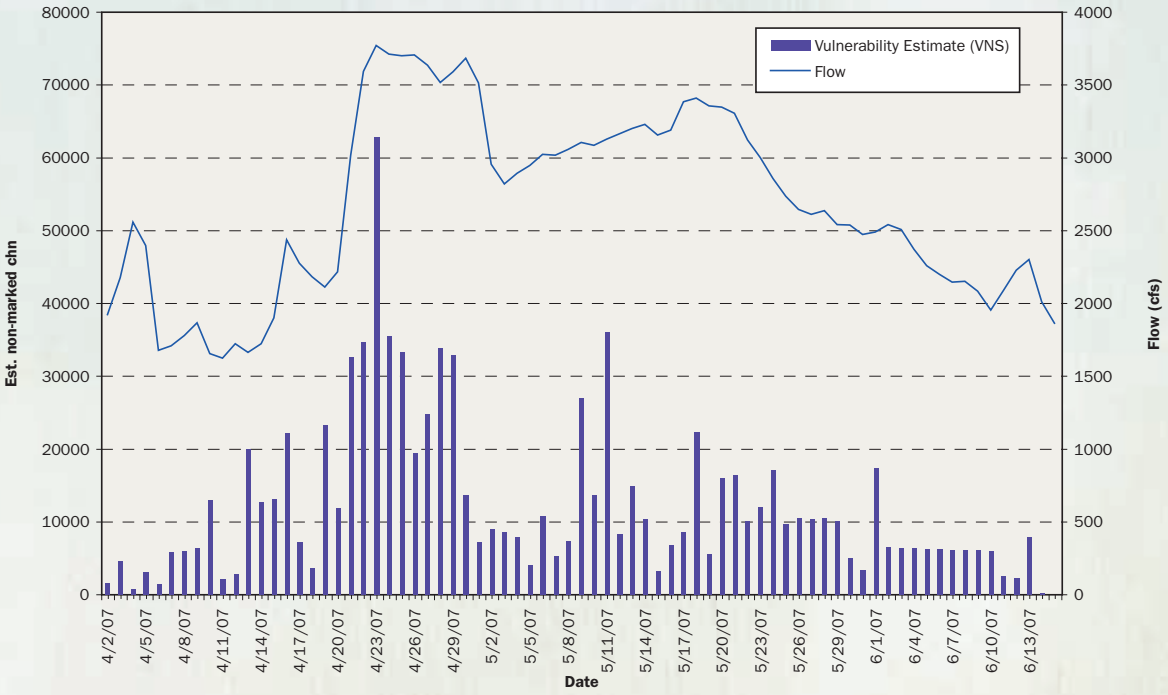
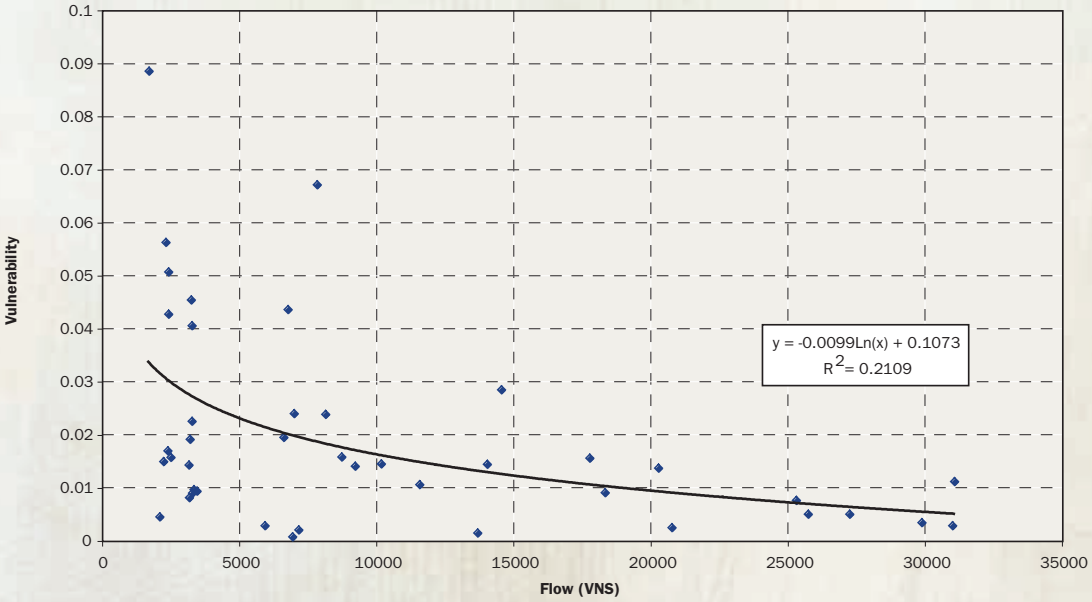


Figure 6-10
Natural log of 1989- 2006 efficiency estimates vs. flow at Vernalis.



vulnerability release groups. Due to the low number of smolts produced at Merced River Hatchery, there were no vulnerability tests performed during the 2007 sampling period. Instead, vulnerability was estimated based on the natural log of vulnerability versus flow at Vernalis from previous years tests (1989-2006) (Figure 6-10). This number is then extrapolated out to a 5-hour index and a 24-hour seasonal estimate. Production, for days not sampled within the study period was estimated based on the average smolt catch and minutes towed for the 2 days before and 2 days after the non-sampled period.

Smolt Production Index Calculation (Smolt/ac-ft Method):

The natural smolt index estimates (EI) are calculated as follow:

$$E_I = \sum_{i=1}^{n=75} \left[\left(\frac{C_i}{V_{Ti}} \right) \left(V_{Pi} \right) \left(\frac{24}{5} \right) \right]$$

Where:
n = days in the index period
C = daily non-marked Chinook catch
VT = daily volume of trawl sampled
VP = daily 5-hour volume of water passing Mossdale
i = ith Day

The 95% confidence interval around this index was calculated as +1.96 x the Standard Deviation of the mean smolt density (smolt/ac-ft) in the trawl catch over the 75 days.

Vulnerability Expansion Calculation (Regression Vulnerability Method):

$$E_V = \sum_{i+1}^{n=75} \left[\frac{\frac{C_i}{V_i}(60*24)}{T_i} \right]$$

Where:
n = days in the index period
C = daily non-marked Chinook catch
V= daily vulnerability estimate
T= minutes towed
i = ith Day

For the purpose of the analysis, vulnerability to the trawl was assumed from the beginning of the first tow detected to the end of the last tow detected on the day of release where marked fish were detected. Detection of marked fish subsequent to the day of release was not used in the analysis (this was less than 5 fish total for all releases). Travel time (from release point to trawl), time vulnerable to the trawl and the percent vulnerability as related to flow were determined for each test group.

Results

Between April 2 and June 15, 2007 3,392 non-marked Chinook salmon smolts were captured in the Mossdale trawl. Daily capture of non-marked salmon ranged from 0 – 225 individuals with an average of 61. Average forklength of non-marked Chinook was 85.2 millimeters (mm) and ranged from 62 - 162 mm. A total of 378 adipose fin clipped Chinook were captured between April 25 and May 18, 2007. The average forklength of marked Chinook was 96.4 mm and ranged from 80 – 118 mm.

Smolt production estimates for the San Joaquin basin ranged between 273,798 using the smolt/ac-ft estimate and 920,006 using the trawl vulnerability estimate (Table 6-1). The regression vulnerability estimate is thought to be more accurate than the smolt/ac-ft index method because it should account for an uneven distribution of migrating smolts in the river channel.

However we have assumed that the average vulnerability estimate applies to the catch in 2007. That may make the estimate of abundance using the trawl vulnerability method more uncertain than in past years where vulnerability was actually measured and applied.

Forty steelhead/ rainbow trout (RBT) were captured during the 2007 sampling period. All RBTs were measured and returned to the river. Forklength ranged from 200- 330 mm (238 mm average), and all samples exhibited advanced stages of the smoltification process. This is the highest number of steelhead captured since CDFG started sampling at Mossdale in 1988 (Figure 6-11).

Survival Estimated for CWT Releases Made in the Merced River

Contributed by Pat Brandes, U.S. Fish and Wildlife Service

Coded wire tagged salmon from the MRH were released in the Merced River between April 20 and May 8, 2007 as part of independent (complimentary to VAMP) fishery investigations. Releases were made in the upper and lower reaches of the Merced River (Merced River Hatchery and Hatfield State Park, respectively).

Survival indices to Chipps Island of lower Merced releases made at Hatfield State Park include mortality down the mainstem San Joaquin River, as well as, through the Delta (Figure 6-7). Chipps Island survival indices of the lower Merced River groups were 0.036 for the first group released on April 24. No recoveries were made at Chipps Island from the later group released on May 8th. Survival indices using Chipps Island recoveries in 2006 ranged between 0.019 – 0.106 for the groups released in the lower Merced River at Hatfield State Park. In past years survival has been similar for these groups to those released at Durham Ferry and Mossdale.

If sufficient numbers of fish are recovered in the Chipps Island trawl, survival indices can be generated for groups released on the upper Merced River (MRH). Comparison of survival indices of groups released upstream and downstream and recovered at Chipps Island provides an estimate of survival through the Merced River. This is accomplished by dividing the upstream group survival index by the downstream survival index. Unfortunately, insufficient numbers of fish were recovered from the first release group to generate survival extimates (i.e., only 1 fish from the upper Merced River and 2 fish from the lower Merced River.) No recoveries were made at Chipps Island for the second release groups from either the upper or lower Merced River release groups. Ocean recoveries will be available for these groups in future years and will provide an additional source of recoveries of which to use to estimate survival through the Merced River in 2007.

Recoveries at Chipps Island in 2007 were made prior to May 5, 2007. Sampling at Chipps Island was terminated on May 26, 2007 due to concerns related to the low population levels of delta smelt and the potential to catch some at Chipps Island.

Comparison of Lower Merced Releases with Sacramento River Delta Releases

Contributed by Pat Brandes, U.S. Fish and Wildlife Service

As in previous years, marked fish from the Feather River were released on the Sacramento River near West Sacramento in 2007. Three groups were released to index survival through the Delta for juvenile salmon originating in the Sacramento basin. Comparison of survival between the Sacramento released fish and those released in the lower Merced may provide some insight on the variation in survival between basins.

As mentioned previously, in late May of 2007, trawling at Chipps Island was suspended due to delta smelt concerns and affected the recoveries of some of the groups released at Sacramento. For instance there were no recoveries for the last group released at Sacramento on 5/14/07. The survival index for the first release on 4/16/07 at Sacramento was 0.369. This may index the true survival as it is likely most of the released fish had passed Chipps Island prior to the termination of sampling. The survival index for the second release made at Sacramento on 4/30 was 0.039. This group may have also been affected by the lack of sampling in late May. However, if we just restrict the comparison between the first Sacramento group and the first lower Merced River group, survival was much greater for the Sacramento group (0.369) than the lower Merced group (0.036).

Survival indices are typically higher for smolts migrating through the Delta from Sacramento than for smolts emigrating past Mossdale. It is unclear why this is the case although smolts entering the Delta from Mossdale are generally exposed to lower river flows than on the Sacramento River and smolts from the San Joaquin basin migrate in closer proximity to the CVP and SWP pumping plants. In 2007, samples taken from the acoustically tagged fish used in the VAMP studies had PKD as many of the VAMP fish have had in past years. All of these factors and others may result in the lower survival detected through the Delta for juvenile salmon originating from the San Joaquin basin.

Figure 6-11
Annual rainbow trout/steelhead catch and average foklength at Mossdale

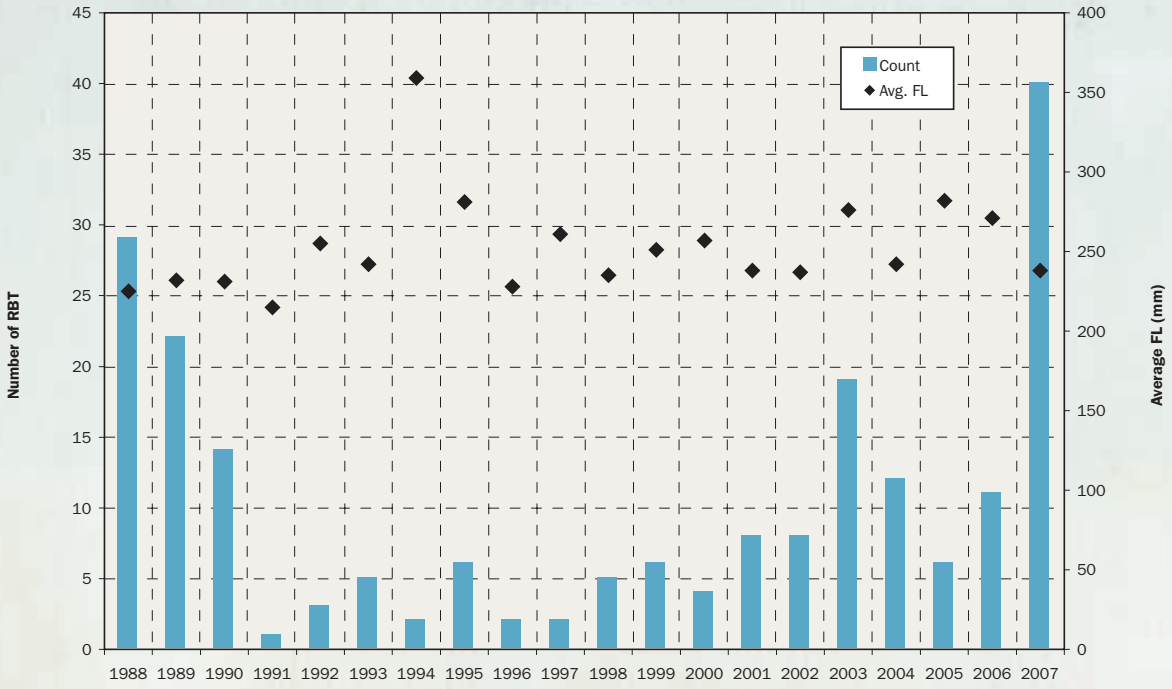


Table 6-1
Smolt production seasonal estimates and sampling period for the duration of the study.

Year	Sampling Period (Days)	Percentage of Days Sampled (%)	Smolt/ac-ft Estimate	Vulnerability Smolt Production Seasonal Estimate** (95% confidence range)
2007	75	76.0	273,798+ 7,490	920,006
2006	75	85.3	848,394 + 12,888	1,808,143 : (1,749,531- 1,866,755)
2005	89	80.9	363,800 + 14,700	621,403 : (388,884- 1,119,550)
2004	61	88.5	92,500 + 66,500	297,348 : (191,222- 665,160)
2003	88	80.7	107,500 + 60,300	368,424 : (277,626- 545,121)
2002	74	87.8	229,100 + 557,100	2,254,647 : (1,455,066- 5,179,591)
2001	103	78.6	279,800 + 286,000	928,996 : (586,790- 2,228,789)
2000	88	81.8	211,100 + 181,900	484,703
1999	119	71.4	146,900 + 63,500	438,979
1998	99	67.7	1,075,000 + 562,800	2,844,637
1997	92	69.6	168,600 + 89,400	635,517
1996	89	85.4	381,900 + 626,900	1,155,319
1995	60	78.3	1,108,900 + 2,640,000	3,361,384
1994	63	73.0	67,500 + 62,200	453,245
1993	83	61.4	54,200 + 21,800	269,035
1992	72	44.4	23,600 + 6,300	280,395
1991	59	66.1	*	538,005
1990	82	69.5	*	263,932
1989	54	100	*	4,241,862

*Data is currently being reevaluated.
**2001- 2006 production estimates based on the annual vulnerability tests, 1989-2000 estimates based on the natural log of all vulnerability tests (1989-2005).

CHAPTER 7

Conclusions and Recommendations

After some uncertainty regarding the HORB relative to Delta smelt it was installed on April 20, two days prior to the start of the VAMP pulse flow period of April 22 to May 22. The average Vernalis pulse flow was 3,260 cfs, varying between 2,830 cfs and 3,790 cfs. Combined exports averaged 1,486 cfs. Flow monitoring was conducted in the San Joaquin River downstream of the HOR and in the Old River. Kodiak trawling was conducted in the San Joaquin River between Mossdale and the Old River. An acoustic telemetry study was implemented in 2007 to estimate movement of tagged Chinook salmon smolts. Survival estimates across the Delta were not possible in 2007, however limited survival estimates to individual receiver sites were possible. Conclusions and recommendations have been developed, and summarized in Table 7-1. The conclusions and recommendations include both technical and policy/management issues that will affect the implementation of future VAMP operations and investigations.

From past VAMP releases, the relationship of salmon survival to San Joaquin River flow has shown that survival increases as flows increase, with the HORB in place (SJRGA 2007). The survival to flow relationship is statistically significant when recovery from all available sources both in the trawls and ocean (Antioch, Chipps Island, and ocean fishery) are combined (SJRGA 2007). However, in 2007 survival through the Delta could not be measured due to the lack of study fish for a coded wire tag study and the inability to install receivers at Jersey Point and Chipps Island for the acoustic study. Thus the role of survival to flow with the HORB in place could not be confirmed in 2007. However, the acoustic study results appeared to indicate that predation and possibly toxicity, may contribute to the mortality of migrating salmon smolts through the Delta. These factors will require further investigation in future years.

The relationship of survival to flow without the HORB is more variable especially when including data from 2005 and 2006 (SJRG 2007). Relationships of flow to adult escapement 2 1/2 years later, indicates these relationships are likely real and that survival is improved as flows and flows relative to exports increase.

The role of exports has been difficult to identify from past VAMP CWT studies because survival with the HORB has not been estimated at VAMP targets of 7,000 cfs flow with exports at 1,500 and 3,000 cfs.

The VAMP program provides increased flows at a wide range of flows along with corresponding decreased exports and likely increases the survival of migrating salmon through the Delta.

The VAMP study was forced to change in 2007 due to the study fish limitation. Acoustic telemetry was used in 2007, but for acoustic studies to measure survival through the Delta receivers must be deployed at Jersey Point and Chipps Island. While logistically challenging, it appears it can be done given enough time and resources to overcome the challenges. Acoustic telemetry is also more expensive than the traditional CWT studies, but if the downstream receivers can be successfully installed, the acoustic telemetry study can estimate survival with greater precision in addition to providing more detailed mortality information through-out the Delta. Further effort will be spent on these deployments in 2008 for the work to be completed prior to releasing the acoustically tagged fish. Without these key detector locations, survival cannot be measured through the Delta using acoustic telemetry. CWT studies no longer appear feasible due to the continued study fish limitation. If the deployment of the downstream acoustic receivers is successful then acoustic telemetry will allow additional measurements of survival to be made at the VAMP targets to continue the assessment of the relative roles of flow and exports on survival through the Delta with and without the HORB.

One additional complication for future VAMP studies is the recent court order to prevent the installation of the HORB in 2008 for the protection of delta smelt. It is uncertain how this court order will affect the installation of the HORB for VAMP studies and the protection of juvenile Chinook salmon migrating from the San Joaquin tributaries after 2008.

Table 7-1
Summary of VAMP 2007 conclusions and recommendations

Conclusions	Recommendations for 2008
Due to unforeseen physical and technical problems acoustic receivers could not be installed at Chipps Island and Jersey Point in 2007.	Acoustic receivers at Chipps Island and Jersey Point need to be installed to allow survival estimates through the Delta to be completed.
Observed ungaged flows (accretions, depletions) between upstream measurement points and Vernalis varied significantly from those forecasted resulting in differences in forecasted and required supplemental flows.	Hydrology committee to continue refining estimates of ungaged flow and develop a management scheme to accommodate variability.
The flow data collected in 2007 at San Joaquin River near Lathrop and the Old River at Head provided useful information on the flow split at the Head of Old River	The 2005 through 2007 flow data should be compared against DWR-DSM2 modeling results. Continue to calibrate the stage and flow monitoring at the San Joaquin River near Lathrop station.
Short-term survival (48-hours post-transport) was relatively high indicating that handling, transport, and release likely had no affect on short-term smolt survival.	Continue net pen studies and fish health inspections.
Smolt abundance and production estimates could be improved by ensuring that sampling is conducted daily at Mossdale when salmon smolt are emigating.	Maintain the Mossdale Kodiak trawl at existing or higher level of effort throughout the year.
Further evaluation of survival rate versus export rate is needed. The VAMP is limited by data at the target conditions of 7000 cfs flow with a HORB with exports at 1500 or 3000 cfs.	Evaluate the possibility of amending the San Joaquin River Agreement to achieve needed test conditions of 7000 cfs flow with a HORB at exports of 1500 or 3000 cfs. Prescribing target conditions will allow the most critical data to be obtained quickly so that the role of exports can be identified in the most efficient manner.
Complimentary studies to evaluate mechanisms affecting survival of fish from tributaries and through the Delta were conducted.	Encourage an expansion of complementary studies to provide additional information on factors and mechanisms affecting salmon survival.

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2007 Contributing Authors

MIKE ABIOULI
California Department of Water Resources, Sacramento

MICHAEL ARCHER
MBK Engineers, Sacramento

PATRICIA BRANDES
U.S. Fish and Wildlife Service, Stockton

TIM FORD
Modesto and Turlock Irrigation Districts, Modesto, Turlock

ANDREA FULLER
S.P Cramer and Associates

JASON GUIGNARD
California Department of Fish and Game, La Grange

CHARLES HANSON
Hanson Environmental, Inc., Walnut Creek

LOWELL PLOSS
San Joaquin River Group Authority, Modesto/Sacramento

ANDY ROCKRIVER
California Department of Fish and Game, Stockton

DAVE VOGEL
Natural Resource Scientist, Inc., Red Bluff

Signatories to The San Joaquin River Agreement

U.S. BUREAU OF RECLAMATION

U.S. FISH AND WILDLIFE SERVICE

CALIFORNIA DEPARTMENT OF WATER RESOURCES

CALIFORNIA DEPARTMENT OF FISH AND GAME

OAKDALE IRRIGATION DISTRICT*

SOUTH SAN JOAQUIN IRRIGATION DISTRICT*

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TURLOCK IRRIGATION DISCTICT*

MERCED IRRIGATION DISTRICT*

SAN JOAQUIN RIVER EXCHANGE

CONTRACTORS WATER AUTHORITY*
- Central California Irrigation District
- Firebaugh Canal Water District
- Columbia Canal Company
- Sal Luis Canal Company

FRIANT WATER USERS AUTHORITY*

PUBLIC UTILITIES COMMISSION OF THE CITY AND

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2007 Useful Web Pages

Page 3 San Joaquin River Agreement
www.sjrg.org/agreement.htm

Page 3 SWRCB Decision 1641
www.waterrights.ca.gov/hearings/Decisions.htm

Page 8 VAMP Annual Technical Reports
www.sjrg.org

Page 9 VAMP Experimental Design
www.sjrg.org/agreement.htm

Page 14 Operation Monitoring, CDEC Daily
http://cdec.water.ca.gov/cgi-progs/queryDgroups?s=fw2

Vernalis USGS Real-Time
http://waterdata.usgs.gov/ca/nwis/dv?format=pre&period=31&site_no=11303500

Vernalis, USGS Daily
http://waterdata.usgs.gov/nwis/uv?format=pre&period=1&site_no=11303500

Newman, USGS Daily
http://waterdata.usgs.gov/ca/nwis/dv?format=pre&period=31&site_no=11274000

LaGrange, USGS Daily
http://waterdata.usgs.gov/ca/nwis/dv?format=pre&period=31&site_no=11289650

Goodwin, USBR Daily
www.usbr.gov/mp/cvo/vungvari/gdwdop.pdf

Cressey, CDEC Daily
http://cdec.water.ca.gov/cgi-progs queryDgroups?s=fw2

Stevinson, CDEC Daily
http://cdec.water.ca.gov/cgi-progs queryDgroups?s=fw2

Page 27 Temporary Barrier Program
http://sdelta.water.ca.gov/web_pg/tempmesr.html

Page 31 Reclamation District 544 Seepage Monitoring Study
http://sdelta.water.ca.gov/web_pg/tempmesr.html

Page 60 CVP and SWP Salvage Data
www.iep.ca.gov

USFWS Stockton
www.delta.dfg.ca.gov/data/salvage

Pacifica States Marine Fisheries Commission
Regional Mark Information System
www.rmis.org

Common Acronyms and Abbreviations

ADCP	Acoustic Doppler Current Profiler
Bay-Delta	Sacramento and San Joaquin Rivers San Francisco Bay Delta
CDEC	California Data Exchange Center
CDRR	Combined Differential Recovery Rate
CFS	Cubic Feet Per Second
CPUE	Catch Per Unit Effort
CRR	Combined Recovery Rate
CVP	Central Valley Project
CWT	Coded-Wire Tagged
D-1641	Water Rights Decision 1641 of the SWRCB
DFG	California Department of Fish and Game
DWR	California Department of Water Resources
GLC	Grant Line Canal
HOR	Head of Old River
HORB	Head of Old River Barrier
Merced	Merced Irrigation District
MID	Modesto Irrigation District
MR	Middle River
MRH	Merced River Hatchery
MSL	Mean Sea Level
NOAA	National Oceanic and Atmospheric Administration Fisheries
OID	Oakdale Irrigation District
ORT	Old River at Tracy
PKD	Proliferative Kidney Disease
SDWA	South Delta Water Agency
SJRA	San Joaquin River Agreement
SJRECWA	San Joaquin River Exchange Contractors Water Authority
SJRGA	San Joaquin River Group Authority
SJRTC	San Joaquin River Technical Committee
SSJID	South San Joaquin Irrigation District
SWP	State Water Project
SWRCB	State Water Resources Control Board
TBP	Temporary Barriers Project
TID	Turlock Irrigation District
USBR	United States Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
VAMP	Vernalis Adaptive Management Plan
WQCP	Water Quality Control Plan for the Bay-Delta Estuary

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APPENDIX A

Appendix A-1, Table 1

2007 VAMP DAILY OPERATION PLAN — MARCH 21, 2007
(A1) DOUBLE-STEP; LOW UNGAGED FLOW
Target Flow Period: April 22 - May 22 • Flow Target: 4,450 cfs
Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,330**				**2,330**	**782**	**4**	**215**			**215**	**349**	**349**		**349**	**804**	**804**			**804**	
3/16/07	**2,210**				**2,210**	**753**	**23**	**228**			**228**	**348**	**348**		**348**	**806**	**806**			**806**	
3/17/07	**2,260**				**2,260**	**733**	**110**	**213**			**213**	**338**	**338**		**338**	**802**	**802**			**802**	
3/18/07	**2,230**				**2,230**	**723**	**108**	**212**			**212**	**338**	**338**		**338**	**687**	**687**			**687**	
3/19/07	**2,220**				**2,220**	**701**	**119**	**216**			**216**	**337**	**337**		**337**	**603**	**603**			**603**	
3/20/07	**2,060**				**2,060**	**794**	**99**	**208**			**208**	**337**	**337**		**337**	**609**	**609**			**609**	
3/21/07																					
3/22/07																					
3/23/07																					
3/24/07																					
3/25/07																					
3/26/07																					
3/27/07																					
3/28/07																					
3/29/07						588		250													
3/30/07						584		250				300	300			768	768				
3/31/07						580		250				300	300			768	768				
4/1/07	2,002					576	100	250			250	300	300		300	768	768			768	
4/2/07	1,998					572	100	250			250	300	300		300	768	768			768	
4/3/07	1,994					568	100	250			250	300	300		300	768	768			768	
4/4/07	1,990				1,990	564	100	250			250	300	300		300	768	768			768	
4/5/07	1,986				1,986	560	100	250			250	300	300		300	768	768			768	
4/6/07	1,982				1,982	556	100	250			250	300	300		300	768	768			768	
4/7/07	1,978				1,978	552	100	250			250	300	300		300	768	768			768	
4/8/07	1,974				1,974	548	100	250			250	300	300		300	768	768			768	
4/9/07	1,970				1,970	544	100	250			250	300	300		300	768	768			768	
4/10/07	1,966				1,966	540	100	250			250	300	300		300	768	768			768	
4/11/07	1,962				1,962	536	100	250			250	300	300		300	768	768			768	
4/12/07	1,958				1,958	532	100	250			250	300	300		300	768	768			768	
4/13/07	1,954	0			1,954	528	100	250			250	300	300		300	768	768			768	
4/14/07	1,950	0			1,950	524	100	250			250	300	300		300	768	768			768	
4/15/07	1,946	0	0	0.00	1,946	520	100	250			250	250	250		250	768	768			768	
4/16/07	1,942	0	0	0.00	1,942	516	100	250			250	250	250		250	768	768			768	
4/17/07	1,888	0	0	0.00	1,888	512	100	250			250	250	250		250	768	768			768	
4/18/07	1,884	0	0	0.00	1,884	508	100	250			250	250	250		250	768	768			768	
4/19/07	1,880	0	0	0.00	1,880	504	100	250	894	179	1,323	250	250		250	768	768			768	
4/20/07	1,876	0	0	0.00	1,876	500	100	250	894	179	1,323	650	650	358	1,008	768	768	358	374	1,500	
4/21/07	1,872	0	0	0.00	1,872	496	100	250	894	179	1,323	650	650	358	1,008	768	768	358	374	1,500	
4/22/07	2,268	1,789	374	3.55	4,431	491	100	250	894	179	1,323	650	650	358	1,008	768	768	358	374	1,500	
4/23/07	2,264	1,789	374	7.10	4,427	487	100	250	894	179	1,323	650	650	358	1,008	768	768	358	374	1,500	
4/24/07	2,259	1,789	374	10.65	4,422	483	100	250	894	179	1,323	650	650	358	1,008	768	768	358	374	1,500	
4/25/07	2,255	1,789	374	14.19	4,418	478	100	250	894	179	1,323	650	650	358	1,008	768	768	358	374	1,500	
4/26/07	2,251	1,789	374	17.74	4,414	474	100	250	894	179	1,323	650	650	358	1,008	768	768	358	374	1,500	
4/27/07	2,246	1,789	374	21.29	4,409	469	100	250	894	179	1,323	650	650	358	1,008	768	768	358	374	1,500	
4/28/07	2,242	1,789	374	24.84	4,405	465	100	250	894	179	1,323	650	650	358	1,008	768	768	358	374	1,500	
4/29/07	2,237	1,789	374	28.39	4,400	461	100	250	894	179	1,323	650	650	358	1,008	768	768	358	374	1,500	
4/30/07	2,233	1,789	374	31.94	4,396	456	100	250	894	179	1,323	650	650	358	1,008	768	768	358	374	1,500	
5/1/07	2,229	1,789	374	35.48	4,392	452	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/2/07	2,224	1,789	374	39.03	4,387	448	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/3/07	2,193	1,789	401	42.58	4,383	443	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/4/07	2,189	1,789	401	46.13	4,379	439	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/5/07	2,184	1,789	401	49.68	4,374	435	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/6/07	2,180	1,789	401	53.23	4,370	430	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/7/07	2,176	1,789	401	56.77	4,366	426	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/8/07	2,171	1,789	401	60.32	4,361	421	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/9/07	2,167	1,789	401	63.87	4,357	417	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/10/07	2,162	1,789	401	67.42	4,352	413	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/11/07	2,158	1,789	401	70.97	4,348	408	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/12/07	2,154	1,789	401	74.52	4,344	404	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/13/07	2,149	1,789	401	78.07	4,339	400	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/14/07	2,145	1,789	401	81.61	4,335	395	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/15/07	2,141	1,789	401	85.16	4,331	391	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/16/07	2,136	1,789	401	88.71	4,326	386	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/17/07	2,132	1,789	401	92.26	4,322	382	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/18/07	2,127	1,789	401	95.81	4,317	378	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/19/07	2,123	1,789	401	99.36	4,313	373	100	250	894	179	1,323	650	650	358	1,008	741	741	358	401	1,500	
5/20/07	2,119	1,789	401	102.90	4,309	369	100	250			250	550	550	358	908	741	741	358	401	1,500	
5/21/07	2,114	1,789	401	106.45	4,304	365	100	250			250	450	450		450	741	741			741	
5/22/07	2,010	1,789	401	110.00	4,200	361	100	250			250	350	350		350	741	741			741	
5/23/07	1,906	0	0		1,906	357	100	250			250	250	250		250	741	741			741	
5/24/07	1,802	0	0		1,802	353	100	250			250	150	150		150	741	741			741	
5/25/07	1,698	0	0		1,698	349	100	250			250	150	150		150	741	741			741	
5/26/07	1,594	0	0		1,594	345	100	250			250	150	150		150	741	741			741	
5/27/07	1,590	0	0		1,590	341	100	250			250	150	150		150	741	741			741	
5/28/07	1,586	0	0		1,586	337	100	250			250	150	150		150	741	741			741	
5/29/07	1,582	0	0		1,582	333	100	250			250	150	150		150	741	741			741	
5/30/07	1,578	0	0		1,578	329	100	250			250	150	150		150	741	741			741	
5/31/07	1,574	0	0		1,574	325	100	250			250	150	150		150	741	741			741	
								VAMP Period													
Avg. (cfs):	2,182	1,789			4,362	435	100	250	894	179	1,323	647	647	358	1,005	751	751	358	391	1,500	
Supplemental Water (TAF):				110.00							54.97	11.01				22.01				22.01	

VAMP flow operation period

Appendix A-1, Table 2

2007 VAMP DAILY OPERATION PLAN — MARCH 21, 2007
(A2) SINGLE-STEP; LOW UNGAGED FLOW
Target Flow Period: April 22 - May 22 • Flow Target: 3,200 cfs
Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,330**				**2,330**	**782**	**4**	**215**			**215**	**349**	**349**		**349**	**804**				**804**	
3/16/07	**2,210**				**2,210**	**753**	**23**	**228**			**228**	**348**	**348**		**348**	**806**				**806**	
3/17/07	**2,260**				**2,260**	**733**	**110**	**213**			**213**	**338**	**338**		**338**	**802**				**802**	
3/18/07	**2,230**				**2,230**	**723**	**108**	**212**			**212**	**338**	**338**		**338**	**687**				**687**	
3/19/07	**2,220**				**2,220**	**701**	**119**	**216**			**216**	**337**	**337**		**337**	**603**				**603**	
3/20/07	**2,060**				**2,060**	**794**	**99**	**208**			**208**	**337**	**337**		**337**	**609**				**609**	
3/21/07																					
3/22/07																					
3/23/07																					
3/24/07																					
3/25/07																					
3/26/07																					
3/27/07																					
3/28/07																					
3/29/07						588		250													
3/30/07						584		250				300	300			768	768				
3/31/07						580		250				300	300			768	768				
4/1/07	2,002					576	100	250			250	300	300		300	768	768			768	
4/2/07	1,998					572	100	250			250	300	300		300	768	768			768	
4/3/07	1,994					568	100	250			250	300	300		300	768	768			768	
4/4/07	1,990				1,990	564	100	250			250	300	300		300	768	768			768	
4/5/07	1,986				1,986	560	100	250			250	300	300		300	768	768			768	
4/6/07	1,982				1,982	556	100	250			250	300	300		300	768	768			768	
4/7/07	1,978				1,978	552	100	250			250	300	300		300	768	768			768	
4/8/07	1,974				1,974	548	100	250			250	300	300		300	768	768			768	
4/9/07	1,970				1,970	544	100	250			250	300	300		300	768	768			768	
4/10/07	1,966				1,966	540	100	250			250	300	300		300	768	768			768	
4/11/07	1,962				1,962	536	100	250			250	300	300		300	768	768			768	
4/12/07	1,958				1,958	532	100	250			250	300	300		300	768	768			768	
4/13/07	1,954	0			1,954	528	100	250			250	300	300		300	768	768			768	
4/14/07	1,950	0			1,950	524	100	250			250	300	300		300	768	768			768	
4/15/07	1,946	0	0	0.00	1,946	520	100	250			250	250	250		250	768	768			768	
4/16/07	1,942	0	0	0.00	1,942	516	100	250			250	250	250		250	768	768			768	
4/17/07	1,888	0	0	0.00	1,888	512	100	250			250	250	250		250	768	768			768	
4/18/07	1,884	0	0	0.00	1,884	508	100	250			250	250	250		250	768	768			768	
4/19/07	1,880	0	0	0.00	1,880	504	100	250	269	0	519	250	250		250	768	768			768	
4/20/07	1,876	0	0	0.00	1,876	500	100	250	269	0	519	650	650	0	650	768	768	0	732	1,500	
4/21/07	1,872	0	0	0.00	1,872	496	100	250	269	0	519	650	650	0	650	768	768	0	732	1,500	
4/22/07	2,268	269	732	0.53	3,269	491	100	250	269	0	519	650	650	0	650	768	768	0	732	1,500	
4/23/07	2,264	269	732	1.07	3,265	487	100	250	269	0	519	650	650	0	650	768	768	0	732	1,500	
4/24/07	2,259	269	732	1.60	3,260	483	100	250	269	0	519	650	650	0	650	768	768	0	732	1,500	
4/25/07	2,255	269	732	2.13	3,256	478	100	250	269	0	519	650	650	0	650	768	768	0	732	1,500	
4/26/07	2,251	269	732	2.67	3,252	474	100	250	269	0	519	650	650	0	650	768	768	0	732	1,500	
4/27/07	2,246	269	732	3.20	3,247	469	100	250	269	0	519	650	650	0	650	768	768	0	732	1,500	
4/28/07	2,242	269	732	3.73	3,243	465	100	250	269	0	519	650	650	0	650	768	768	0	732	1,500	
4/29/07	2,237	269	732	4.27	3,238	461	100	250	269	0	519	650	650	0	650	768	768	0	732	1,500	
4/30/07	2,233	269	732	4.80	3,234	456	100	250	269	0	519	650	650	0	650	768	768	0	732	1,500	
5/1/07	2,229	269	732	5.34	3,230	452	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/2/07	2,224	269	732	5.87	3,225	448	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/3/07	2,193	269	759	6.40	3,221	443	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/4/07	2,189	269	759	6.94	3,217	439	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/5/07	2,184	269	759	7.47	3,212	435	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/6/07	2,180	269	759	8.00	3,208	430	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/7/07	2,176	269	759	8.54	3,204	426	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/8/07	2,171	269	759	9.07	3,199	421	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/9/07	2,167	269	759	9.60	3,195	417	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/10/07	2,162	269	759	10.14	3,190	413	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/11/07	2,158	269	759	10.67	3,186	408	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/12/07	2,154	269	759	11.20	3,182	404	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/13/07	2,149	269	759	11.74	3,177	400	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/14/07	2,145	269	759	12.27	3,173	395	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/15/07	2,141	269	759	12.81	3,169	391	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/16/07	2,136	269	759	13.34	3,164	386	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/17/07	2,132	269	759	13.87	3,160	382	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/18/07	2,127	269	759	14.41	3,155	378	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/19/07	2,123	269	759	14.94	3,151	373	100	250	269	0	519	650	650	0	650	741	741	0	759	1,500	
5/20/07	2,119	269	759	15.47	3,147	369	100	250			250	550	550	0	550	741	741	0	759	1,500	
5/21/07	2,114	269	759	16.01	3,142	365	100	250			250	450	450		450	740	740			740	
5/22/07	2,010	269	759	16.54	3,038	361	100	250			250	350	350		350	740	740			740	
5/23/07	1,905	0	0		1,905	357	100	250			250	250	250		250	740	740			740	
5/24/07	1,801	0	0		1,801	353	100	250			250	150	150		150	740	740			740	
5/25/07	1,697	0	0		1,697	349	100	250			250	150	150		150	740	740			740	
5/26/07	1,593	0	0		1,593	345	100	250			250	150	150		150	740	740			740	
5/27/07	1,589	0	0		1,589	341	100	250			250	150	150		150	740	740			740	
5/28/07	1,585	0	0		1,585	337	100	250			250	150	150		150	740	740			740	
5/29/07	1,581	0	0		1,581	333	100	250			250	150	150		150	740	740			740	
5/30/07	1,577	0	0		1,577	329	100	250			250	150	150		150	740	740			740	
5/31/07	1,573	0	0		1,573	325	100	250			250	150	150		150	740	740			740	
										VAMP Period											
Avg. (cfs):	2,182	269			3,200	435	100	250	269	0	519	647	647	0	647	751	751	0	749	1,500	
Supplemental Water (TAF):				16.54							16.54	0.00				0.00				0.00	

VAMP flow operation period

Appendix A-1, Table 3

2007 VAMP DAILY OPERATION PLAN — MARCH 21, 2007
(B1) DOUBLE-STEP; HIGH UNGAGED FLOW
Target Flow Period: April 22 - May 22 • Flow Target: 4,450 cfs
Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,330**				**2,330**	**782**	**4**	**215**			**215**	**349**	**349**		**349**	**804**				**804**	
3/16/07	**2,210**				**2,210**	**753**	**23**	**228**			**228**	**348**	**348**		**348**	**806**				**806**	
3/17/07	**2,260**				**2,260**	**733**	**110**	**213**			**213**	**338**	**338**		**338**	**802**				**802**	
3/18/07	**2,230**				**2,230**	**723**	**108**	**212**			**212**	**338**	**338**		**338**	**687**				**687**	
3/19/07	**2,220**				**2,220**	**701**	**119**	**216**			**216**	**337**	**337**		**337**	**603**				**603**	
3/20/07																					
3/21/07																					
3/22/07																					
3/23/07																					
3/24/07																					
3/25/07																					
3/26/07																					
3/27/07																					
3/28/07																					
3/29/07						588		250													
3/30/07						584		250				300	300			768	768				
3/31/07						580		250				300	300			768	768				
4/1/07	2,402					576	500	250			250	300	300		300	768	768			768	
4/2/07	2,398					572	500	250			250	300	300		300	768	768			768	
4/3/07	2,394					568	500	250			250	300	300		300	768	768			768	
4/4/07	2,390				2,390	564	500	250			250	300	300		300	768	768			768	
4/5/07	2,386				2,386	560	500	250			250	300	300		300	768	768			768	
4/6/07	2,382				2,382	556	500	250			250	300	300		300	768	768			768	
4/7/07	2,378				2,378	552	500	250			250	300	300		300	768	768			768	
4/8/07	2,374				2,374	548	500	250			250	300	300		300	768	768			768	
4/9/07	2,370				2,370	544	500	250			250	300	300		300	768	768			768	
4/10/07	2,366				2,366	540	500	250			250	300	300		300	768	768			768	
4/11/07	2,362				2,362	536	500	250			250	300	300		300	768	768			768	
4/12/07	2,358				2,358	532	500	250			250	300	300		300	768	768			768	
4/13/07	2,354	0			2,354	528	500	250			250	300	300		300	768	768			768	
4/14/07	2,350	0			2,350	524	500	250			250	300	300		300	768	768			768	
4/15/07	2,346	0	0	0.00	2,346	520	500	250			250	250	250		250	768	768			768	
4/16/07	2,342	0	0	0.00	2,342	516	500	250			250	250	250		250	768	768			768	
4/17/07	2,288	0	0	0.00	2,288	512	500	250			250	250	250		250	768	768			768	
4/18/07	2,284	0	0	0.00	2,284	508	500	250			250	250	250		250	768	768			768	
4/19/07	2,280	0	0	0.00	2,280	504	500	250	732	146	1,128	250	250		250	768	768			768	
4/20/07	2,276	0	0	0.00	2,276	500	500	250	732	146	1,128	650	650	241	891	768	768	293	439	1,500	
4/21/07	2,272	0	0	0.00	2,272	496	500	250	732	146	1,128	650	650	241	891	768	768	293	439	1,500	
4/22/07	2,668	1,412	439	2.80	4,519	491	500	250	732	146	1,128	650	650	241	891	768	768	293	439	1,500	
4/23/07	2,664	1,412	439	5.60	4,515	487	500	250	732	146	1,128	650	650	241	891	768	768	293	439	1,500	
4/24/07	2,659	1,412	439	8.40	4,510	483	500	250	732	146	1,128	650	650	241	891	768	768	293	439	1,500	
4/25/07	2,655	1,412	439	11.20	4,506	478	500	250	732	146	1,128	650	650	241	891	768	768	293	439	1,500	
4/26/07	2,651	1,412	439	14.00	4,502	474	500	250	732	146	1,128	650	650	241	891	768	768	293	439	1,500	
4/27/07	2,646	1,412	439	16.80	4,497	469	500	250	732	146	1,128	650	650	241	891	768	768	293	439	1,500	
4/28/07	2,642	1,412	439	19.60	4,493	465	500	250	732	146	1,128	650	650	241	891	768	768	293	439	1,500	
4/29/07	2,637	1,412	439	22.41	4,488	461	500	250	732	146	1,128	650	650	241	891	768	768	293	439	1,500	
4/30/07	2,633	1,412	439	25.21	4,484	456	500	250	732	146	1,128	650	650	241	891	768	768	293	439	1,500	
5/1/07	2,629	1,412	439	28.01	4,480	452	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/2/07	2,624	1,412	439	30.81	4,475	448	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/3/07	2,593	1,412	466	33.61	4,471	443	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/4/07	2,589	1,412	466	36.41	4,467	439	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/5/07	2,584	1,412	466	39.21	4,462	435	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/6/07	2,580	1,412	466	42.01	4,458	430	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/7/07	2,576	1,412	466	44.81	4,454	426	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/8/07	2,571	1,412	466	47.61	4,449	421	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/9/07	2,567	1,412	466	50.41	4,445	417	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/10/07	2,562	1,412	466	53.21	4,440	413	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/11/07	2,558	1,412	466	56.01	4,436	408	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/12/07	2,554	1,412	466	58.81	4,432	404	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/13/07	2,549	1,412	466	61.61	4,427	400	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/14/07	2,545	1,412	466	64.42	4,423	395	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/15/07	2,541	1,412	466	67.22	4,419	391	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/16/07	2,536	1,412	466	70.02	4,414	386	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/17/07	2,532	1,412	466	72.82	4,410	382	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/18/07	2,527	1,412	466	75.62	4,405	378	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/19/07	2,523	1,412	466	78.42	4,401	373	500	250	732	146	1,128	650	650	241	891	741	741	293	466	1,500	
5/20/07	2,519	1,412	466	81.22	4,397	369	500	250			250	550	550	241	791	741	741	293	466	1,500	
5/21/07	2,514	1,412	466	84.02	4,392	365	500	250			250	450	450		450	740	740			740	
5/22/07	2,410	1,412	466	86.82	4,288	361	500	250			250	350	350		350	740	740			740	
5/23/07	2,305	0	0		2,305	357	500	250			250	250	250		250	740	740			740	
5/24/07	2,201	0	0		2,201	353	500	250			250	150	150		150	740	740			740	
5/25/07	2,097	0	0		2,097	349	500	250			250	150	150		150	740	740			740	
5/26/07	1,993	0	0		1,993	345	500	250			250	150	150		150	740	740			740	
5/27/07	1,989	0	0		1,989	341	500	250			250	150	150		150	740	740			740	
5/28/07	1,985	0	0		1,985	337	500	250			250	150	150		150	740	740			740	
5/29/07	1,981	0	0		1,981	333	500	250			250	150	150		150	740	740			740	
5/30/07	1,977	0	0		1,977	329	500	250			250	150	150		150	740	740			740	
5/31/07	1,973	0	0		1,973	325	500	250			250	150	150		150	740	740			740	
										VAMP Period											
Avg. (cfs):	2,582	1,412			4,450	435	500	250	732	146	1,128	647	647	241	888	751	751	293	456	1,500	
Supplemental Water (TAF):				86.82							45.01	8.98				14.82				18.02	

VAMP flow operation period

Appendix A-1, Table 4

2007 VAMP DAILY OPERATION PLAN — MARCH 21, 2007
(B2) SINGLE-STEP; HIGH UNGAGED FLOW
Target Flow Period: April 22 - May 22 * Flow Target: 3,200 cfs
Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,330**				**2,330**	**782**	**4**	**215**			**215**	**349**	**349**		**349**	**804**				**804**	
3/16/07	**2,210**				**2,210**	**753**	**23**	**228**			**228**	**348**	**348**		**348**	**806**				**806**	
3/17/07	**2,260**				**2,260**	**733**	**110**	**213**			**213**	**338**	**338**		**338**	**802**				**802**	
3/18/07	**2,230**				**2,230**	**723**	**108**	**212**			**212**	**338**	**338**		**338**	**687**				**687**	
3/19/07	**2,220**				**2,220**	**701**	**119**	**216**			**216**	**337**	**337**		**337**	**603**				**603**	
3/20/07																					
3/21/07																					
3/22/07																					
3/23/07																					
3/24/07																					
3/25/07																					
3/26/07																					
3/27/07																					
3/28/07																					
3/29/07						588		250													
3/30/07						584		250				300	300			768	768				
3/31/07						580		250				300	300			768	768				
4/1/07	2,402					576	500	250			250	300	300		300	768	768			768	
4/2/07	2,398					572	500	250			250	300	300		300	768	768			768	
4/3/07	2,394					568	500	250			250	300	300		300	768	768			768	
4/4/07	2,390				2,390	564	500	250			250	300	300		300	768	768			768	
4/5/07	2,386				2,386	560	500	250			250	300	300		300	768	768			768	
4/6/07	2,382				2,382	556	500	250			250	300	300		300	768	768			768	
4/7/07	2,378				2,378	552	500	250			250	300	300		300	768	768			768	
4/8/07	2,374				2,374	548	500	250			250	300	300		300	768	768			768	
4/9/07	2,370				2,370	544	500	250			250	300	300		300	768	768			768	
4/10/07	2,366				2,366	540	500	250			250	300	300		300	768	768			768	
4/11/07	2,362				2,362	536	500	250			250	300	300		300	768	768			768	
4/12/07	2,358				2,358	532	500	250			250	300	300		300	768	768			768	
4/13/07	2,354	0			2,354	528	500	250			250	300	300		300	768	768			768	
4/14/07	2,350	0			2,350	524	500	250			250	300	300		300	768	768			768	
4/15/07	2,346	0	0	0.00	2,346	520	500	250			250	250	250		250	768	768			768	
4/16/07	2,342	0	0	0.00	2,342	516	500	250			250	250	250		250	768	768			768	
4/17/07	2,288	0	0	0.00	2,288	512	500	250			250	250	250		250	768	768			768	
4/18/07	2,284	0	0	0.00	2,284	508	500	250			250	250	250		250	768	768			768	
4/19/07	2,280	0	0	0.00	2,280	504	500	250	0	0	250	250	250		250	768	768			768	
4/20/07	2,276	0	0	0.00	2,276	500	500	250	0	0	250	650	650	0	650	768	768	0	732	1,500	
4/21/07	2,272	0	0	0.00	2,272	496	500	250	0	0	250	650	650	0	650	768	768	0	732	1,500	
4/22/07	2,668	0	732	0.00	3,400	491	500	250	0	0	250	650	650	0	650	768	768	0	732	1,500	
4/23/07	2,664	0	732	0.00	3,396	487	500	250	0	0	250	650	650	0	650	768	768	0	732	1,500	
4/24/07	2,659	0	732	0.00	3,391	483	500	250	0	0	250	650	650	0	650	768	768	0	732	1,500	
4/25/07	2,655	0	732	0.00	3,387	478	500	250	0	0	250	650	650	0	650	768	768	0	732	1,500	
4/26/07	2,651	0	732	0.00	3,383	474	500	250	0	0	250	650	650	0	650	768	768	0	732	1,500	
4/27/07	2,646	0	732	0.00	3,378	469	500	250	0	0	250	650	650	0	650	768	768	0	732	1,500	
4/28/07	2,642	0	732	0.00	3,374	465	500	250	0	0	250	650	650	0	650	768	768	0	732	1,500	
4/29/07	2,637	0	732	0.00	3,369	461	500	250	0	0	250	650	650	0	650	768	768	0	732	1,500	
4/30/07	2,633	0	732	0.00	3,365	456	500	250	0	0	250	650	650	0	650	768	768	0	732	1,500	
5/1/07	2,629	0	732	0.00	3,361	452	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/2/07	2,624	0	732	0.00	3,356	448	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/3/07	2,593	0	759	0.00	3,352	443	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/4/07	2,589	0	759	0.00	3,348	439	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/5/07	2,584	0	759	0.00	3,343	435	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/6/07	2,580	0	759	0.00	3,339	430	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/7/07	2,576	0	759	0.00	3,335	426	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/8/07	2,571	0	759	0.00	3,330	421	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/9/07	2,567	0	759	0.00	3,326	417	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/10/07	2,562	0	759	0.00	3,321	413	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/11/07	2,558	0	759	0.00	3,317	408	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/12/07	2,554	0	759	0.00	3,313	404	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/13/07	2,549	0	759	0.00	3,308	400	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/14/07	2,545	0	759	0.00	3,304	395	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/15/07	2,541	0	759	0.00	3,300	391	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/16/07	2,536	0	759		3,295	386	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/17/07	2,532	0	759		3,291	382	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/18/07	2,527	0	759		3,286	378	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/19/07	2,523	0	759		3,282	373	500	250	0	0	250	650	650	0	650	741	741	0	759	1,500	
5/20/07	2,519	0	759		3,278	369	500	250			250	550	550	0	550	741	741	0	759	1,500	
5/21/07	2,514	0	759		3,273	365	500	250			250	450	450		450	740	740			740	
5/22/07	2,410	0	759		3,169	361	500	250			250	350	350		350	740	740			740	
5/23/07	2,305	0	0		2,305	357	500	250			250	250	250		250	740	740			740	
5/24/07	2,201	0	0		2,201	353	500	250			250	150	150		150	740	740			740	
5/25/07	2,097	0	0		2,097	349	500	250			250	150	150		150	740	740			740	
5/26/07	1,993	0	0		1,993	345	500	250			250	150	150		150	740	740			740	
5/27/07	1,989	0	0		1,989	341	500	250			250	150	150		150	740	740			740	
5/28/07	1,985	0	0		1,985	337	500	250			250	150	150		150	740	740			740	
5/29/07	1,981	0	0		1,981	333	500	250			250	150	150		150	740	740			740	
5/30/07	1,977	0	0		1,977	329	500	250			250	150	150		150	740	740			740	
5/31/07	1,973	0	0		1,973	325	500	250			250	150	150		150	740	740			740	
										VAMP Period											
Avg. (cfs):	2,582	0			3,331	435	500	250	0	0	250	647	647	0	647	751	751	0	749	1,500	
Supplemental Water (TAF):				0.00							0.00	0.00				0.00				0.00	

VAMP flow operation period

Appendix A-1, Table 5

2007 VAMP DAILY OPERATION PLAN — APRIL 6, 2007
(A) SINGLE-STEP; HIGH UNGAGED FLOW; NO STANISLAUS b(2) WATER
Target Flow Period: April 22 - May 22 • Flow Target: 3,200 cfs
Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,420**				**2,420**	**870**	**10**	**215**			**215**	**349**	**349**		**349**	**804**	**804**			**804**	
3/16/07	**2,290**				**2,290**	**840**	**17**	**228**			**228**	**348**	**348**		**348**	**806**	**806**			**806**	
3/17/07	**2,350**				**2,350**	**820**	**112**	**213**			**213**	**338**	**338**		**338**	**802**	**802**			**802**	
3/18/07	**2,320**				**2,320**	**813**	**111**	**212**			**212**	**338**	**338**		**338**	**687**	**687**			**687**	
3/19/07	**2,310**				**2,310**	**791**	**122**	**216**			**216**	**337**	**337**		**337**	**603**	**603**			**603**	
3/20/07	**2,150**				**2,150**	**782**	**99**	**208**			**208**	**337**	**337**		**337**	**609**	**609**			**609**	
3/21/07	**2,240**				**2,240**	**744**	**297**	**215**			**215**	**334**	**334**		**334**	**607**	**607**			**607**	
3/22/07	**2,180**				**2,180**	**741**	**236**	**223**			**223**	**335**	**335**		**335**	**604**	**604**			**604**	
3/23/07	**2,200**				**2,200**	**703**	**307**	**212**			**212**	**334**	**334**		**334**	**547**	**547**			**547**	
3/24/07	**2,230**				**2,230**	**630**	**335**	**213**			**213**	**335**	**335**		**335**	**504**	**504**			**504**	
3/25/07	**2,210**				**2,210**	**563**	**403**	**214**			**214**	**336**	**336**		**336**	**502**	**502**			**502**	
3/26/07	**2,160**				**2,160**	**546**	**479**	**215**			**215**	**335**	**335**		**335**	**509**	**509**			**509**	
3/27/07	**2,050**				**2,050**	**545**	**436**	**234**			**234**	**335**	**335**		**335**	**503**	**503**			**503**	
3/28/07	**2,030**				**2,030**	**534**	**426**	**229**			**229**	**335**	**335**		**335**	**505**	**505**			**505**	
3/29/07	**2,000**				**2,000**	**516**	**402**	**229**			**229**	**337**	**337**		**337**	**503**	**503**			**503**	
3/30/07	**1,910**				**1,910**	**518**	**302**	**223**			**223**	**337**	**337**		**337**	**503**	**503**			**503**	
3/31/07	**1,880**				**1,880**	**494**	**295**	**198**			**198**	**338**	**338**		**338**	**501**	**501**			**501**	
4/1/07	**1,950**				**1,950**	**472**	**363**	**202**			**202**	**339**	**339**		**339**	**500**	**500**			**500**	
4/2/07	**1,920**				**1,920**	**465**	**364**	**221**			**221**	**338**	**338**		**338**	**502**	**502**			**502**	
4/3/07	**1,790**				**1,790**	**421**	**281**	**214**			**214**	**337**	**337**		**337**	**509**	**509**			**509**	
4/4/07	**1,720**				**1,720**	**414**	**213**	**213**			**213**	**337**	**337**		**337**	**503**	**503**			**503**	
4/5/07	**1,670**				**1,670**	**383**	**182**	**206**			**206**	**337**	**337**		**337**	**500**	**500**			**500**	
4/6/07	1,698				1,698	376	230	250			250	300	300		300	768	768			768	
4/7/07	1,733				1,733	369	300	250			250	300	300		300	768	768			768	
4/8/07	1,950				1,950	362	300	250			250	300	300		300	768	768			768	
4/9/07	1,987				1,987	355	300	250			250	300	300		300	768	768			768	
4/10/07	1,980				1,980	348	300	250			250	300	300		300	768	768			768	
4/11/07	1,973				1,973	341	300	250			250	300	300		300	768	768			768	
4/12/07	1,966				1,966	334	300	250			250	300	300		300	768	768			768	
4/13/07	1,959	0			1,959	327	300	250			250	300	300		300	768	768			768	
4/14/07	1,952	0			1,952	320	300	250			250	300	300		300	768	768			768	
4/15/07	1,945	0	0	0.00	1,945	313	300	250			250	250	250		250	768	768			768	
4/16/07	1,938	0	0	0.00	1,938	306	300	250			250	250	250		250	768	768			768	
4/17/07	1,881	0	0	0.00	1,881	299	300	250			250	250	250		250	768	768			768	
4/18/07	1,874	0	0	0.00	1,874	292	300	250			250	250	250		250	768	768			768	
4/19/07	1,867	0	0	0.00	1,867	307	300	250	0	0	250	250	250		250	768	768			768	
4/20/07	1,860	0	0	0.00	1,860	300	300	250	50	0	300	537	680	170	850	768	1,000	500	0	1,500	
4/21/07	1,875	0	0	0.00	1,875	296	300	250	50	0	300	537	680	170	850	768	1,000	500	0	1,500	
4/22/07	2,530	670	0	1.33	3,200	292	300	250	50	0	300	537	680	170	850	768	1,000	500	0	1,500	
4/23/07	2,526	720	0	2.76	3,246	288	300	250	50	0	300	537	680	170	850	768	1,000	500	0	1,500	
4/24/07	2,522	720	0	4.19	3,242	284	300	250	50	0	300	537	680	170	850	768	1,000	500	0	1,500	
4/25/07	2,518	720	0	5.61	3,238	280	300	250	50	0	300	537	680	170	850	768	1,000	500	0	1,500	
4/26/07	2,514	720	0	7.04	3,234	276	300	250	50	0	300	537	680	170	850	768	1,000	500	0	1,500	
4/27/07	2,510	720	0	8.47	3,230	272	300	250	50	0	300	537	680	170	850	768	1,000	500	0	1,500	
4/28/07	2,506	720	0	9.90	3,226	268	300	250	50	0	300	537	680	170	850	768	1,000	500	0	1,500	
4/29/07	2,502	720	0	11.33	3,222	264	300	250	200	0	450	537	680	170	850	768	1,000	500	0	1,500	
4/30/07	2,498	720	0	12.75	3,218	260	300	250	450	0	700	537	530	170	700	768	1,000	500	0	1,500	
5/1/07	2,494	720	0	14.18	3,214	256	300	250	880	0	1,130	537	330	170	500	741	800	700	0	1,500	
5/2/07	2,340	870	0	15.91	3,210	252	300	250	1,120	330	1,700	537	330	170	500	741	440	460	0	900	
5/3/07	1,936	1,320	0	18.53	3,256	248	300	250	1,120	330	1,700	537	320	170	490	741	500	0	0	500	
5/4/07	1,572	1,510	0	21.52	3,082	244	300	250	1,120	330	1,700	537	320	170	490	741	500	0	0	500	
5/5/07	1,618	1,620	0	24.73	3,238	240	300	250	1,110	340	1,700	537	320	170	490	741	500	0	0	500	
5/6/07	1,614	1,620	0	27.95	3,234	237	300	250	1,110	340	1,700	537	320	170	490	741	500	0	0	500	
5/7/07	1,610	1,620	0	31.16	3,230	234	300	250	1,110	340	1,700	537	320	170	490	741	500	0	0	500	
5/8/07	1,607	1,620	0	34.37	3,227	231	300	250	1,110	340	1,700	537	320	170	490	741	500	0	0	500	
5/9/07	1,604	1,620	0	37.59	3,224	228	300	250	1,110	340	1,700	537	320	170	490	741	500	0	0	500	
5/10/07	1,601	1,620	0	40.80	3,221	225	300	250	1,120	330	1,700	537	320	170	490	741	500	0	0	500	
5/11/07	1,598	1,620	0	44.01	3,218	222	300	250	1,120	330	1,700	537	320	170	490	741	500	0	0	500	
5/12/07	1,595	1,620	0	47.23	3,215	219	300	250	1,120	330	1,700	537	320	170	490	741	500	0	0	500	
5/13/07	1,592	1,620	0	50.44	3,212	216	300	250	950	0	1,200	537	320	170	490	741	500	0	0	500	
5/14/07	1,589	1,620	0	53.65	3,209	213	300	250	600	0	850	537	680	170	850	741	610	100	0	710	
5/15/07	1,586	1,620	0	56.87	3,206	210	300	250	600	0	850	537	810	170	980	741	820	100	0	920	
5/16/07	2,053	1,220	0	59.29	3,273	207	300	250	600	0	850	537	810	170	980	741	820	100	0	920	
5/17/07	2,390	870	0	61.01	3,260	204	300	250	600	0	850	537	810	170	980	741	820	100	0	920	
5/18/07	2,387	870	0	62.74	3,257	201	300	250	550	0	800	537	810	170	980	741	820	100	0	920	
5/19/07	2,384	870	0	64.46	3,254	198	300	250	250	0	500	537	810	170	980	741	820	100	0	920	
5/20/07	2,381	870	0	66.19	3,251	195	300	250			250	537	400	140	540	741	820	100	0	920	
5/21/07	2,378	820	0	67.81	3,198	192	300	250			250	250	250		250	741	741			741	
5/22/07	1,965	490	0	68.79	2,455	189	300	250			250	200	200		200	741	741			741	
5/23/07	1,733	0	0		1,733	186	300	250			250	200	200		200	741	741			741	
5/24/07	1,680	0	0		1,680	183	300	250			250	150	150		150	741	741			741	
5/25/07	1,677	0	0		1,677	180	300	250			250	150	150		150	741	741			741	
5/26/07	1,624	0	0		1,624	177	300	250			250	150	150		150	741	741			741	
5/27/07	1,621	0	0		1,621	174	300	250			250	150	150		150	741	741			741	
5/28/07	1,618	0	0		1,618	171	300	250			250	150	150		150	741	741			741	
5/29/07	1,615	0	0		1,615	168	300	250			250	150	150		150	741	741			741	
5/30/07	1,612	0	0		1,612	165	300	250			250	135	135		135	741	741			741	
5/31/07	1,609	0	0		1,609	162	300	250			250	120	120		120	741	741			741	
										VAMP Period											
Avg. (cfs):	2,081	1,119			3,200	244	300	250	594	119	962	537	537	169	706	751	751	237	0	988	
Supplemental Water (TAF):				68.79							36.50	7.30				10.39				14.60	

VAMP flow operation period

Appendix A-1, Table 6

2007 VAMP DAILY OPERATION PLAN — APRIL 6, 2007
(B) SINGLE-STEP; HIGH UNGAGED FLOW; STANISLAUS b(2) WATER
Target Flow Period: April 22 - May 22 * Flow Target: 3,200 cfs
Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,420**				**2,420**	**870**	**10**	**215**			**215**	**349**	**349**		**349**	**804**	**804**			**804**	
3/16/07	**2,290**				**2,290**	**840**	**17**	**228**			**228**	**348**	**348**		**348**	**806**	**806**			**806**	
3/17/07	**2,350**				**2,350**	**820**	**112**	**213**			**213**	**338**	**338**		**338**	**802**	**802**			**802**	
3/18/07	**2,320**				**2,320**	**813**	**111**	**212**			**212**	**338**	**338**		**338**	**687**	**687**			**687**	
3/19/07	**2,310**				**2,310**	**791**	**122**	**216**			**216**	**337**	**337**		**337**	**603**	**603**			**603**	
3/20/07	**2,150**				**2,150**	**782**	**99**	**208**			**208**	**337**	**337**		**337**	**609**	**609**			**609**	
3/21/07	**2,240**				**2,240**	**744**	**297**	**215**			**215**	**334**	**334**		**334**	**607**	**607**			**607**	
3/22/07	**2,180**				**2,180**	**741**	**236**	**223**			**223**	**335**	**335**		**335**	**604**	**604**			**604**	
3/23/07	**2,200**				**2,200**	**703**	**307**	**212**			**212**	**334**	**334**		**334**	**547**	**547**			**547**	
3/24/07	**2,230**				**2,230**	**630**	**335**	**213**			**213**	**335**	**335**		**335**	**504**	**504**			**504**	
3/25/07	**2,210**				**2,210**	**563**	**403**	**214**			**214**	**336**	**336**		**336**	**502**	**502**			**502**	
3/26/07	**2,160**				**2,160**	**546**	**479**	**215**			**215**	**335**	**335**		**335**	**509**	**509**			**509**	
3/27/07	**2,050**				**2,050**	**545**	**436**	**234**			**234**	**335**	**335**		**335**	**503**	**503**			**503**	
3/28/07	**2,030**				**2,030**	**534**	**426**	**229**			**229**	**335**	**335**		**335**	**505**	**505**			**505**	
3/29/07	**2,000**				**2,000**	**516**	**402**	**229**			**229**	**337**	**337**		**337**	**503**	**503**			**503**	
3/30/07	**1,910**				**1,910**	**518**	**302**	**223**			**223**	**337**	**337**		**337**	**503**	**503**			**503**	
3/31/07	**1,880**				**1,880**	**494**	**295**	**198**			**198**	**338**	**338**		**338**	**501**	**501**			**501**	
4/1/07	**1,950**				**1,950**	**472**	**363**	**202**			**202**	**339**	**339**		**339**	**500**	**500**			**500**	
4/2/07	**1,920**				**1,920**	**465**	**364**	**221**			**221**	**338**	**338**		**338**	**502**	**502**			**502**	
4/3/07	**1,790**				**1,790**	**421**	**281**	**214**			**214**	**337**	**337**		**337**	**509**	**509**			**509**	
4/4/07	**1,720**				**1,720**	**414**	**213**	**213**			**213**	**337**	**337**		**337**	**503**	**503**			**503**	
4/5/07	**1,670**				**1,670**	**383**	**182**	**206**			**206**	**337**	**337**		**337**	**500**	**500**			**500**	
4/6/07	1,698				1,698	376	230	250			250	300	300		300	768	768			768	
4/7/07	1,733				1,733	369	300	250			250	300	300		300	768	768			768	
4/8/07	1,950				1,950	362	300	250			250	300	300		300	768	768			768	
4/9/07	1,987				1,987	355	300	250			250	300	300		300	768	768			768	
4/10/07	1,980				1,980	348	300	250			250	300	300		300	768	768			768	
4/11/07	1,973				1,973	341	300	250			250	300	300		300	768	768			768	
4/12/07	1,966				1,966	334	300	250			250	300	300		300	768	768			768	
4/13/07	1,959	0			1,959	327	300	250			250	300	300		300	768	768			768	
4/14/07	1,952	0			1,952	320	300	250			250	300	300		300	768	768			768	
4/15/07	1,945	0	0	0.00	1,945	313	300	250			250	250	250		250	768	768			768	
4/16/07	1,938	0	0	0.00	1,938	306	300	250			250	250	250		250	768	768			768	
4/17/07	1,881	0	0	0.00	1,881	299	300	250			250	250	250		250	768	768			768	
4/18/07	1,874	0	0	0.00	1,874	292	300	250			250	250	250		250	768	768			768	
4/19/07	1,867	0	0	0.00	1,867	307	300	250	250	0	500	250	250		250	768	768			768	
4/20/07	1,860	0	0	0.00	1,860	300	300	250	250	0	500	537	600	0	600	768	768	0	732	1,500	
4/21/07	1,875	0	0	0.00	1,875	296	300	250	250	0	500	537	640	0	640	768	768	0	732	1,500	
4/22/07	2,218	250	732	0.50	3,200	292	300	250	250	0	500	537	640	0	640	768	768	0	732	1,500	
4/23/07	2,254	250	732	0.99	3,236	288	300	250	250	0	500	537	640	0	640	768	768	0	732	1,500	
4/24/07	2,250	250	732	1.49	3,232	284	300	250	250	0	500	537	640	0	640	768	768	0	732	1,500	
4/25/07	2,246	250	732	1.98	3,228	280	300	250	250	0	500	537	640	0	640	768	768	0	732	1,500	
4/26/07	2,242	250	732	2.48	3,224	276	300	250	250	0	500	537	640	0	640	768	768	0	732	1,500	
4/27/07	2,238	250	732	2.98	3,220	272	300	250	250	0	500	537	640	0	640	768	768	0	732	1,500	
4/28/07	2,234	250	732	3.47	3,216	268	300	250	250	0	500	537	640	0	640	768	768	0	732	1,500	
4/29/07	2,230	250	732	3.97	3,212	264	300	250	250	0	500	537	640	0	640	768	768	0	732	1,500	
4/30/07	2,226	250	732	4.46	3,208	260	300	250	250	0	500	537	640	0	640	768	768	0	732	1,500	
5/1/07	2,222	250	732	4.96	3,204	256	300	250	250	0	500	537	640	0	640	741	741	0	759	1,500	
5/2/07	2,218	250	732	5.45	3,200	252	300	250	500	0	750	537	640	0	640	741	741	0	759	1,500	
5/3/07	2,187	250	759	5.95	3,196	248	300	250	600	0	850	537	380	0	380	741	741	0	759	1,500	
5/4/07	2,183	250	759	6.45	3,192	244	300	250	600	0	850	537	320	0	320	741	741	0	759	1,500	
5/5/07	1,919	500	759	7.44	3,178	240	300	250	600	0	850	537	320	0	320	741	741	0	759	1,500	
5/6/07	1,855	600	759	8.63	3,214	237	300	250	600	0	850	537	320	0	320	741	741	0	759	1,500	
5/7/07	1,851	600	759	9.82	3,210	234	300	250	600	0	850	537	320	0	320	741	741	0	759	1,500	
5/8/07	1,848	600	759	11.01	3,207	231	300	250	600	0	850	537	320	0	320	741	741	0	759	1,500	
5/9/07	1,845	600	759	12.20	3,204	228	300	250	600	0	850	537	320	0	320	741	741	0	759	1,500	
5/10/07	1,842	600	759	13.39	3,201	225	300	250	600	0	850	537	320	0	320	741	741	0	759	1,500	
5/11/07	1,839	600	759	14.58	3,198	222	300	250	600	0	850	537	320	0	320	741	741	0	759	1,500	
5/12/07	1,836	600	759	15.77	3,195	219	300	250	530	0	780	537	320	0	320	741	741	0	759	1,500	
5/13/07	1,833	600	759	16.96	3,192	216	300	250	250	0	500	537	420	0	420	741	741	0	759	1,500	
5/14/07	1,830	600	759	18.15	3,189	213	300	250	250	0	500	537	700	0	700	741	741	0	759	1,500	
5/15/07	1,927	530	759	19.20	3,216	210	300	250	250	0	500	537	700	0	700	741	741	0	759	1,500	
5/16/07	2,204	250	759	19.70	3,213	207	300	250	250	0	500	537	700	0	700	741	741	0	759	1,500	
5/17/07	2,201	250	759	20.19	3,210	204	300	250	250	0	500	537	700	0	700	741	741	0	759	1,500	
5/18/07	2,198	250	759	20.69	3,207	201	300	250	250	0	500	537	700	0	700	741	741	0	759	1,500	
5/19/07	2,195	250	759	21.18	3,204	198	300	250	250	0	500	537	700	0	700	741	741	0	759	1,500	
5/20/07	2,192	250	759	21.68	3,201	195	300	250			250	537	500	0	500	741	741	0	759	1,500	
5/21/07	2,189	250	759	22.18	3,198	192	300	250			250	250	250		250	741	741			741	
5/22/07	1,986	250	759	22.67	2,995	189	300	250			250	200	200		200	741	741			741	
5/23/07	1,733	0	0		1,733	186	300	250			250	200	200		200	741	741			741	
5/24/07	1,680	0	0		1,680	183	300	250			250	150	150		150	741	741			741	
5/25/07	1,677	0	0		1,677	180	300	250			250	150	150		150	741	741			741	
5/26/07	1,624	0	0		1,624	177	300	250			250	150	150		150	741	741			741	
5/27/07	1,621	0	0		1,621	174	300	250			250	150	150		150	741	741			741	
5/28/07	1,618	0	0		1,618	171	300	250			250	150	150		150	741	741			741	
5/29/07	1,615	0	0		1,615	168	300	250			250	150	150		150	741	741			741	
5/30/07	1,612	0	0		1,612	165	300	250			250	135	135		135	741	741			741	
5/31/07	1,609	0	0		1,609	162	300	250			250	120	120		120	741	741			741	
										VAMP Period											
Avg. (cfs):	2,082	369			3,200	244	300	250	369	0	619	537	537	0	537	751	751	0	749	1,500	
Supplemental Water (TAF):				22.67							22.67	0.00				0.00				0.00	

VAMP flow operation period

Appendix A-1, Table 7

2007 VAMP DAILY OPERATION PLAN — APRIL 6, 2007
(C) SINGLE-STEP; LOW UNGAGED FLOW; NO STANISLAUS b(2) WATER
Target Flow Period: April 22 - May 22 • Flow Target: 3,200 cfs
Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,420**				**2,420**	**870**	**10**	**215**			**215**	**349**	**349**		**349**	**804**	**804**			**804**	
3/16/07	**2,290**				**2,290**	**840**	**17**	**228**			**228**	**348**	**348**		**348**	**806**	**806**			**806**	
3/17/07	**2,350**				**2,350**	**820**	**112**	**213**			**213**	**338**	**338**		**338**	**802**	**802**			**802**	
3/18/07	**2,320**				**2,320**	**813**	**111**	**212**			**212**	**338**	**338**		**338**	**687**	**687**			**687**	
3/19/07	**2,310**				**2,310**	**791**	**122**	**216**			**216**	**337**	**337**		**337**	**603**	**603**			**603**	
3/20/07	**2,150**				**2,150**	**782**	**99**	**208**			**208**	**337**	**337**		**337**	**609**	**609**			**609**	
3/21/07	**2,240**				**2,240**	**744**	**297**	**215**			**215**	**334**	**334**		**334**	**607**	**607**			**607**	
3/22/07	**2,180**				**2,180**	**741**	**236**	**223**			**223**	**335**	**335**		**335**	**604**	**604**			**604**	
3/23/07	**2,200**				**2,200**	**703**	**307**	**212**			**212**	**334**	**334**		**334**	**547**	**547**			**547**	
3/24/07	**2,230**				**2,230**	**630**	**335**	**213**			**213**	**335**	**335**		**335**	**504**	**504**			**504**	
3/25/07	**2,210**				**2,210**	**563**	**403**	**214**			**214**	**336**	**336**		**336**	**502**	**502**			**502**	
3/26/07	**2,160**				**2,160**	**546**	**479**	**215**			**215**	**335**	**335**		**335**	**509**	**509**			**509**	
3/27/07	**2,050**				**2,050**	**545**	**436**	**234**			**234**	**335**	**335**		**335**	**503**	**503**			**503**	
3/28/07	**2,030**				**2,030**	**534**	**426**	**229**			**229**	**335**	**335**		**335**	**505**	**505**			**505**	
3/29/07	**2,000**				**2,000**	**516**	**402**	**229**			**229**	**337**	**337**		**337**	**503**	**503**			**503**	
3/30/07	**1,910**				**1,910**	**518**	**302**	**223**			**223**	**337**	**337**		**337**	**503**	**503**			**503**	
3/31/07	**1,880**				**1,880**	**494**	**295**	**198**			**198**	**338**	**338**		**338**	**501**	**501**			**501**	
4/1/07	**1,950**				**1,950**	**472**	**363**	**202**			**202**	**339**	**339**		**339**	**500**	**500**			**500**	
4/2/07	**1,920**				**1,920**	**465**	**364**	**221**			**221**	**338**	**338**		**338**	**502**	**502**			**502**	
4/3/07	**1,790**				**1,790**	**421**	**281**	**214**			**214**	**337**	**337**		**337**	**509**	**509**			**509**	
4/4/07	**1,720**				**1,720**	**414**	**213**	**213**			**213**	**337**	**337**		**337**	**503**	**503**			**503**	
4/5/07	**1,670**				**1,670**	**383**	**182**	**206**			**206**	**337**	**337**		**337**	**500**	**500**			**500**	
4/6/07	1,698				1,698	376	230	250			250	300	300		300	768	768			768	
4/7/07	1,653				1,653	369	220	250			250	300	300		300	768	768			768	
4/8/07	1,860				1,860	362	210	250			250	300	300		300	768	768			768	
4/9/07	1,887				1,887	355	200	250			250	300	300		300	768	768			768	
4/10/07	1,870				1,870	348	190	250			250	300	300		300	768	768			768	
4/11/07	1,853				1,853	341	180	250			250	300	300		300	768	768			768	
4/12/07	1,836				1,836	334	170	250			250	300	300		300	768	768			768	
4/13/07	1,819	0			1,819	327	160	250			250	300	300		300	768	768			768	
4/14/07	1,752	0			1,752	320	100	250			250	300	300		300	768	768			768	
4/15/07	1,745	0	0	0.00	1,745	313	100	250			250	250	250		250	768	768			768	
4/16/07	1,738	0	0	0.00	1,738	306	100	250			250	250	250		250	768	768			768	
4/17/07	1,681	0	0	0.00	1,681	299	100	250			250	250	250		250	768	768			768	
4/18/07	1,674	0	0	0.00	1,674	292	100	250			250	250	250		250	768	768			768	
4/19/07	1,667	0	0	0.00	1,667	307	100	250	119	0	369	250	250		250	768	768			768	
4/20/07	1,660	0	0	0.00	1,660	300	100	250	119	0	369	537	703	0	703	768	768	0	0	768	
4/21/07	1,675	0	0	0.00	1,675	296	100	250	119	0	369	537	703	0	703	768	768	0	0	768	
4/22/07	2,121	119	0	0.24	2,240	292	100	250	119	0	369	537	703	0	703	768	768	0	0	768	
4/23/07	2,117	119	0	0.47	2,236	288	100	250	119	0	369	537	703	0	703	768	768	0	0	768	
4/24/07	2,113	119	0	0.71	2,232	284	100	250	119	0	369	537	703	0	703	768	768	0	0	768	
4/25/07	2,109	119	0	0.94	2,228	280	100	250	119	0	369	537	703	0	703	768	768	0	0	768	
4/26/07	2,105	119	0	1.18	2,224	276	100	250	119	0	369	537	593	0	593	768	768	0	0	768	
4/27/07	2,101	119	0	1.42	2,220	272	100	250	119	0	369	537	482	0	482	768	768	0	0	768	
4/28/07	1,987	119	0	1.65	2,106	268	100	250	119	0	369	537	390	0	390	768	768	0	0	768	
4/29/07	1,872	119	0	1.89	1,991	264	100	250	119	0	369	537	390	0	390	768	768	0	0	768	
4/30/07	1,776	119	0	2.12	1,895	260	100	250	119	0	369	537	390	0	390	768	768	0	0	768	
5/1/07	1,772	119	0	2.36	1,891	256	100	250	119	0	369	537	390	0	390	741	741	0	0	741	
5/2/07	1,768	119	0	2.60	1,887	252	100	250	119	0	369	537	390	0	390	741	741	0	0	741	
5/3/07	1,737	119	0	2.83	1,856	248	100	250	119	0	369	537	390	0	390	741	741	0	0	741	
5/4/07	1,733	119	0	3.07	1,852	244	100	250	119	0	369	537	390	0	390	741	741	0	0	741	
5/5/07	1,729	119	0	3.30	1,848	240	100	250	119	0	369	537	482	0	482	741	741	0	0	741	
5/6/07	1,725	119	0	3.54	1,844	237	100	250	119	0	369	537	593	0	593	741	741	0	0	741	
5/7/07	1,813	119	0	3.78	1,932	234	100	250	119	0	369	537	703	0	703	741	741	0	0	741	
5/8/07	1,921	119	0	4.01	2,040	231	100	250	119	0	369	537	703	0	703	741	741	0	0	741	
5/9/07	2,028	119	0	4.25	2,147	228	100	250	119	0	369	537	703	0	703	741	741	0	0	741	
5/10/07	2,025	119	0	4.48	2,144	225	100	250	119	0	369	537	703	0	703	741	741	0	0	741	
5/11/07	2,022	119	0	4.72	2,141	222	100	250	119	0	369	537	703	0	703	741	741	0	0	741	
5/12/07	2,019	119	0	4.96	2,138	219	100	250	119	0	369	537	703	0	703	741	741	0	0	741	
5/13/07	2,016	119	0	5.19	2,135	216	100	250	119	0	369	537	593	0	593	741	741	0	0	741	
5/14/07	2,013	119	0	5.43	2,132	213	100	250	119	0	369	537	482	0	482	741	741	0	0	741	
5/15/07	1,900	119	0	5.66	2,019	210	100	250	119	0	369	537	390	0	390	741	741	0	0	741	
5/16/07	1,786	119	0	5.90	1,905	207	100	250	119	0	369	537	390	0	390	741	741	0	0	741	
5/17/07	1,691	119	0	6.14	1,810	204	100	250	119	0	369	537	390	0	390	741	741	0	0	741	
5/18/07	1,688	119	0	6.37	1,807	201	100	250	119	0	369	537	390	0	390	741	741	0	0	741	
5/19/07	1,685	119	0	6.61	1,804	198	100	250	119	0	369	537	390	0	390	741	741	0	0	741	
5/20/07	1,682	119	0	6.84	1,801	195	100	250			250	537	300	0	300	741	741	0	0	741	
5/21/07	1,679	119	0	7.08	1,798	192	100	250			250	250	250		250	741	741			741	
5/22/07	1,586	119	0	7.32	1,705	189	100	250			250	200	200		200	741	741			741	
5/23/07	1,533	0	0		1,533	186	100	250			250	200	200		200	741	741			741	
5/24/07	1,480	0	0		1,480	183	100	250			250	150	150		150	741	741			741	
5/25/07	1,477	0	0		1,477	180	100	250			250	150	150		150	741	741			741	
5/26/07	1,424	0	0		1,424	177	100	250			250	150	150		150	741	741			741	
5/27/07	1,421	0	0		1,421	174	100	250			250	150	150		150	741	741			741	
5/28/07	1,418	0	0		1,418	171	100	250			250	150	150		150	741	741			741	
5/29/07	1,415	0	0		1,415	168	100	250			250	150	150		150	741	741			741	
5/30/07	1,412	0	0		1,412	165	100	250			250	135	135		135	741	741			741	
5/31/07	1,409	0	0		1,409	162	100	250			250	120	120		120	741	741			741	
								VAMP Period													
Avg. (cfs):	1,881	119			2,000	244	100	250	119	0	369	537	537	0	537	751	751	0	0	751	
Supplemental Water (TAF):				7.32							7.32	0.00				0.00				0.00	

VAMP flow operation period

Appendix A-1, Table 8

2007 VAMP DAILY OPERATION PLAN — APRIL 6, 2007
(D) SINGLE-STEP; LOW UNGAGED FLOW; STANISLAUS b(2) WATER
Target Flow Period: April 22 - May 22 • Flow Target: 3,200 cfs
Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,420**				**2,420**	**870**	**10**	**215**			**215**	**349**	**349**		**349**	**804**	**804**			**804**	
3/16/07	**2,290**				**2,290**	**840**	**17**	**228**			**228**	**348**	**348**		**348**	**806**	**806**			**806**	
3/17/07	**2,350**				**2,350**	**820**	**112**	**213**			**213**	**338**	**338**		**338**	**802**	**802**			**802**	
3/18/07	**2,320**				**2,320**	**813**	**111**	**212**			**212**	**338**	**338**		**338**	**687**	**687**			**687**	
3/19/07	**2,310**				**2,310**	**791**	**122**	**216**			**216**	**337**	**337**		**337**	**603**	**603**			**603**	
3/20/07	**2,150**				**2,150**	**782**	**99**	**208**			**208**	**337**	**337**		**337**	**609**	**609**			**609**	
3/21/07	**2,240**				**2,240**	**744**	**297**	**215**			**215**	**334**	**334**		**334**	**607**	**607**			**607**	
3/22/07	**2,180**				**2,180**	**741**	**236**	**223**			**223**	**335**	**335**		**335**	**604**	**604**			**604**	
3/23/07	**2,200**				**2,200**	**703**	**307**	**212**			**212**	**334**	**334**		**334**	**547**	**547**			**547**	
3/24/07	**2,230**				**2,230**	**630**	**335**	**213**			**213**	**335**	**335**		**335**	**504**	**504**			**504**	
3/25/07	**2,210**				**2,210**	**563**	**403**	**214**			**214**	**336**	**336**		**336**	**502**	**502**			**502**	
3/26/07	**2,160**				**2,160**	**546**	**479**	**215**			**215**	**335**	**335**		**335**	**509**	**509**			**509**	
3/27/07	**2,050**				**2,050**	**545**	**436**	**234**			**234**	**335**	**335**		**335**	**503**	**503**			**503**	
3/28/07	**2,030**				**2,030**	**534**	**426**	**229**			**229**	**335**	**335**		**335**	**505**	**505**			**505**	
3/29/07	**2,000**				**2,000**	**516**	**402**	**229**			**229**	**337**	**337**		**337**	**503**	**503**			**503**	
3/30/07	**1,910**				**1,910**	**518**	**302**	**223**			**223**	**337**	**337**		**337**	**503**	**503**			**503**	
3/31/07	**1,880**				**1,880**	**494**	**295**	**198**			**198**	**338**	**338**		**338**	**501**	**501**			**501**	
4/1/07	**1,950**				**1,950**	**472**	**363**	**202**			**202**	**339**	**339**		**339**	**500**	**500**			**500**	
4/2/07	**1,920**				**1,920**	**465**	**364**	**221**			**221**	**338**	**338**		**338**	**502**	**502**			**502**	
4/3/07	**1,790**				**1,790**	**421**	**281**	**214**			**214**	**337**	**337**		**337**	**509**	**509**			**509**	
4/4/07	**1,720**				**1,720**	**414**	**213**	**213**			**213**	**337**	**337**		**337**	**503**	**503**			**503**	
4/5/07	**1,670**				**1,670**	**383**	**182**	**206**			**206**	**337**	**337**		**337**	**500**	**500**			**500**	
4/6/07	1,698				1,698	376	230	250			250	300	300		300	768	768			768	
4/7/07	1,653				1,653	369	220	250			250	300	300		300	768	768			768	
4/8/07	1,860				1,860	362	210	250			250	300	300		300	768	768			768	
4/9/07	1,887				1,887	355	200	250			250	300	300		300	768	768			768	
4/10/07	1,870				1,870	348	190	250			250	300	300		300	768	768			768	
4/11/07	1,853				1,853	341	180	250			250	300	300		300	768	768			768	
4/12/07	1,836				1,836	334	170	250			250	300	300		300	768	768			768	
4/13/07	1,819	0			1,819	327	160	250			250	300	300		300	768	768			768	
4/14/07	1,752	0			1,752	320	100	250			250	300	300		300	768	768			768	
4/15/07	1,745	0	0	0.00	1,745	313	100	250			250	250	250		250	768	768			768	
4/16/07	1,738	0	0	0.00	1,738	306	100	250			250	250	250		250	768	768			768	
4/17/07	1,681	0	0	0.00	1,681	299	100	250			250	250	250		250	768	768			768	
4/18/07	1,674	0	0	0.00	1,674	292	100	250			250	250	250		250	768	768			768	
4/19/07	1,667	0	0	0.00	1,667	307	100	250	0	0	250	250	250		250	768	768			768	
4/20/07	1,660	0	0	0.00	1,660	300	100	250	0	0	250	537	703	0	703	768	768	0	732	1,500	
4/21/07	1,675	0	0	0.00	1,675	296	100	250	0	0	250	537	703	0	703	768	768	0	732	1,500	
4/22/07	2,121	0	732	0.00	2,853	292	100	250	0	0	250	537	703	0	703	768	768	0	732	1,500	
4/23/07	2,117	0	732	0.00	2,849	288	100	250	0	0	250	537	703	0	703	768	768	0	732	1,500	
4/24/07	2,113	0	732	0.00	2,845	284	100	250	0	0	250	537	703	0	703	768	768	0	732	1,500	
4/25/07	2,109	0	732	0.00	2,841	280	100	250	0	0	250	537	703	0	703	768	768	0	732	1,500	
4/26/07	2,105	0	732	0.00	2,837	276	100	250	0	0	250	537	593	0	593	768	768	0	732	1,500	
4/27/07	2,101	0	732	0.00	2,833	272	100	250	0	0	250	537	482	0	482	768	768	0	732	1,500	
4/28/07	1,987	0	732	0.00	2,719	268	100	250	0	0	250	537	390	0	390	768	768	0	732	1,500	
4/29/07	1,872	0	732	0.00	2,604	264	100	250	0	0	250	537	390	0	390	768	768	0	732	1,500	
4/30/07	1,776	0	732	0.00	2,508	260	100	250	0	0	250	537	390	0	390	768	768	0	732	1,500	
5/1/07	1,772	0	732	0.00	2,504	256	100	250	0	0	250	537	390	0	390	741	741	0	759	1,500	
5/2/07	1,768	0	732	0.00	2,500	252	100	250	0	0	250	537	390	0	390	741	741	0	759	1,500	
5/3/07	1,737	0	759	0.00	2,496	248	100	250	0	0	250	537	390	0	390	741	741	0	759	1,500	
5/4/07	1,733	0	759	0.00	2,492	244	100	250	0	0	250	537	390	0	390	741	741	0	759	1,500	
5/5/07	1,729	0	759	0.00	2,488	240	100	250	0	0	250	537	482	0	482	741	741	0	759	1,500	
5/6/07	1,725	0	759	0.00	2,484	237	100	250	0	0	250	537	593	0	593	741	741	0	759	1,500	
5/7/07	1,813	0	759	0.00	2,572	234	100	250	0	0	250	537	703	0	703	741	741	0	759	1,500	
5/8/07	1,921	0	759	0.00	2,680	231	100	250	0	0	250	537	703	0	703	741	741	0	759	1,500	
5/9/07	2,028	0	759	0.00	2,787	228	100	250	0	0	250	537	703	0	703	741	741	0	759	1,500	
5/10/07	2,025	0	759	0.00	2,784	225	100	250	0	0	250	537	703	0	703	741	741	0	759	1,500	
5/11/07	2,022	0	759	0.00	2,781	222	100	250	0	0	250	537	703	0	703	741	741	0	759	1,500	
5/12/07	2,019	0	759	0.00	2,778	219	100	250	0	0	250	537	703	0	703	741	741	0	759	1,500	
5/13/07	2,016	0	759	0.00	2,775	216	100	250	0	0	250	537	593	0	593	741	741	0	759	1,500	
5/14/07	2,013	0	759	0.00	2,772	213	100	250	0	0	250	537	482	0	482	741	741	0	759	1,500	
5/15/07	1,900	0	759	0.00	2,659	210	100	250	0	0	250	537	390	0	390	741	741	0	759	1,500	
5/16/07	1,786	0	759	0.00	2,545	207	100	250	0	0	250	537	390	0	390	741	741	0	759	1,500	
5/17/07	1,691	0	759	0.00	2,450	204	100	250	0	0	250	537	390	0	390	741	741	0	759	1,500	
5/18/07	1,688	0	759	0.00	2,447	201	100	250	0	0	250	537	390	0	390	741	741	0	759	1,500	
5/19/07	1,685	0	759	0.00	2,444	198	100	250	0	0	250	537	390	0	390	741	741	0	759	1,500	
5/20/07	1,682	0	759	0.00	2,441	195	100	250			250	537	300	0	300	741	741	0	759	1,500	
5/21/07	1,679	0	759	0.00	2,438	192	100	250			250	250	250		250	741	741			741	
5/22/07	1,586	0	759	0.00	2,345	189	100	250			250	200	200		200	741	741			741	
5/23/07	1,533	0	0		1,533	186	100	250			250	200	200		200	741	741			741	
5/24/07	1,480	0	0		1,480	183	100	250			250	150	150		150	741	741			741	
5/25/07	1,477	0	0		1,477	180	100	250			250	150	150		150	741	741			741	
5/26/07	1,424	0	0		1,424	177	100	250			250	150	150		150	741	741			741	
5/27/07	1,421	0	0		1,421	174	100	250			250	150	150		150	741	741			741	
5/28/07	1,418	0	0		1,418	171	100	250			250	150	150		150	741	741			741	
5/29/07	1,415	0	0		1,415	168	100	250			250	150	150		150	741	741			741	
5/30/07	1,412	0	0		1,412	165	100	250			250	135	135		135	741	741			741	
5/31/07	1,409	0	0		1,409	162	100	250			250	120	120		120	741	741			741	
										VAMP Period											
Avg. (cfs):	1,881	0			2,631	244	100	250	0	0	250	537	537	0	537	751	751	0	749	1,500	
Supplemental Water (TAF):				0.00							0.00	0.00				0.00				0.00	

VAMP flow operation period

Appendix A-1, Table 9

2007 VAMP DAILY OPERATION PLAN — APRIL 13, 2007
(A) SINGLE-STEP; HIGH UNGAGED FLOW
Target Flow Period: April 22 - May 22 • Flow Target: 3,200 cfs
Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,420**				**2,420**	**788**	**97**	**215**			**215**	**349**	**349**		**349**	**804**	**804**			**804**	
3/16/07	**2,290**				**2,290**	**759**	**97**	**228**			**228**	**348**	**348**		**348**	**806**	**806**			**806**	
3/17/07	**2,350**				**2,350**	**739**	**194**	**213**			**213**	**338**	**338**		**338**	**802**	**802**			**802**	
3/18/07	**2,320**				**2,320**	**727**	**192**	**212**			**212**	**338**	**338**		**338**	**687**	**687**			**687**	
3/19/07	**2,310**				**2,310**	**710**	**203**	**216**			**216**	**337**	**337**		**337**	**603**	**603**			**603**	
3/20/07	**2,150**				**2,150**	**702**	**185**	**208**			**208**	**337**	**337**		**337**	**609**	**609**			**609**	
3/21/07	**2,240**				**2,240**	**659**	**378**	**215**			**215**	**334**	**334**		**334**	**607**	**607**			**607**	
3/22/07	**2,180**				**2,180**	**659**	**316**	**223**			**223**	**335**	**335**		**335**	**604**	**604**			**604**	
3/23/07	**2,200**				**2,200**	**609**	**392**	**212**			**212**	**334**	**334**		**334**	**547**	**547**			**547**	
3/24/07	**2,230**				**2,230**	**536**	**417**	**213**			**213**	**335**	**335**		**335**	**504**	**504**			**504**	
3/25/07	**2,210**				**2,210**	**476**	**497**	**214**			**214**	**336**	**336**		**336**	**502**	**502**			**502**	
3/26/07	**2,160**				**2,160**	**460**	**573**	**215**			**215**	**335**	**335**		**335**	**509**	**509**			**509**	
3/27/07	**2,050**				**2,050**	**461**	**523**	**234**			**234**	**335**	**335**		**335**	**503**	**503**			**503**	
3/28/07	**2,030**				**2,030**	**447**	**512**	**229**			**229**	**335**	**335**		**335**	**505**	**505**			**505**	
3/29/07	**2,000**				**2,000**	**437**	**486**	**229**			**229**	**337**	**337**		**337**	**503**	**503**			**503**	
3/30/07	**1,910**				**1,910**	**437**	**389**	**223**			**223**	**337**	**337**		**337**	**503**	**503**			**503**	
3/31/07	**1,880**				**1,880**	**414**	**374**	**198**			**198**	**338**	**338**		**338**	**501**	**501**			**501**	
4/1/07	**1,950**				**1,950**	**393**	**444**	**202**			**202**	**339**	**339**		**339**	**500**	**500**			**500**	
4/2/07	**1,920**				**1,920**	**380**	**444**	**221**			**221**	**338**	**338**		**338**	**502**	**502**			**502**	
4/3/07	**1,790**				**1,790**	**342**	**360**	**214**			**214**	**337**	**337**		**337**	**509**	**509**			**509**	
4/4/07	**1,720**				**1,720**	**328**	**298**	**213**			**213**	**337**	**337**		**337**	**503**	**503**			**503**	
4/5/07	**1,670**				**1,670**	**296**	**261**	**206**			**206**	**337**	**337**		**337**	**500**	**500**			**500**	
4/6/07	**1,670**				**1,670**	**271**	**288**	**195**			**195**	**337**	**337**		**337**	**502**	**502**			**502**	
4/7/07	**1,700**				**1,700**	**260**	**354**	**203**			**203**	**338**	**338**		**338**	**510**	**510**			**510**	
4/8/07	**1,770**				**1,770**	**279**	**454**	**215**			**215**	**338**	**338**		**338**	**508**	**508**			**508**	
4/9/07	**1,860**				**1,860**	**274**	**557**	**216**			**216**	**338**	**338**		**338**	**508**	**508**			**508**	
4/10/07	**1,650**				**1,650**	**276**	**322**	**192**			**192**	**339**	**339**		**339**	**504**	**504**			**504**	
4/11/07	**1,620**				**1,620**	**267**	**285**	**176**			**176**	**343**	**343**		**343**	**504**	**504**			**504**	
4/12/07	**1,710**				**1,710**	**299**	**375**	**179**			**179**	**341**	**341**		**341**	**800**	**800**			**800**	
4/13/07	1,606	0			1,606	290	300	250			250	300	300		300	768	768			768	
4/14/07	1,916	0			1,916	281	300	250			250	300	300		300	768	768			768	
4/15/07	1,837	0	0	0.00	1,837	272	300	250			250	250	250		250	768	768			768	
4/16/07	1,899	0	0	0.00	1,899	263	300	250			250	250	250		250	768	768			768	
4/17/07	1,840	0	0	0.00	1,840	254	300	250			250	250	250		250	768	768			768	
4/18/07	1,831	0	0	0.00	1,831	245	300	250			250	250	250		250	768	768			768	
4/19/07	1,822	0	0	0.00	1,822	236	300	250	50	0	300	250	250		250	768	768			768	
4/20/07	1,813	0	0	0.00	1,813	231	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/21/07	1,804	0	0	0.00	1,804	228	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/22/07	3,081	100	0	0.20	3,181	225	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/23/07	3,078	150	0	0.50	3,228	221	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/24/07	3,075	150	0	0.79	3,225	218	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/25/07	3,071	150	0	1.09	3,221	215	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/26/07	3,068	150	0	1.39	3,218	212	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/27/07	3,065	150	0	1.69	3,215	209	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/28/07	3,062	150	0	1.98	3,212	205	300	250	450	0	700	537	800	50	850	1,500	1,500	0	0	1,500	
4/29/07	3,059	150	0	2.28	3,209	202	300	250	780	0	1,030	537	500	0	500	1,500	1,500	0	0	1,500	
4/30/07	3,055	150	0	2.58	3,205	199	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/1/07	2,752	450	0	3.47	3,202	196	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/2/07	2,449	780	0	5.02	3,229	193	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/3/07	2,446	780	0	6.57	3,226	189	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/4/07	2,443	780	0	8.11	3,223	186	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/5/07	2,439	780	0	9.66	3,219	183	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/6/07	2,436	780	0	11.21	3,216	180	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/7/07	2,433	780	0	12.75	3,213	177	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/8/07	2,430	780	0	14.30	3,210	173	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/9/07	2,427	780	0	15.85	3,207	170	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/10/07	2,423	780	0	17.40	3,203	167	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/11/07	2,420	780	0	18.94	3,200	164	300	250	510	0	760	537	200	0	200	1,500	1,500	0	0	1,500	
5/12/07	2,417	780	0	20.49	3,197	161	300	250	180	0	430	537	450	30	480	1,500	1,500	0	0	1,500	
5/13/07	2,414	780	0	22.04	3,194	157	300	250	180	0	430	537	800	30	830	1,500	1,500	0	0	1,500	
5/14/07	2,661	540	0	23.11	3,201	154	300	250	180	0	430	537	800	30	830	1,500	1,500	0	0	1,500	
5/15/07	3,007	210	0	23.52	3,217	151	300	250	180	0	430	537	800	30	830	1,500	1,500	0	0	1,500	
5/16/07	3,004	210	0	23.94	3,214	148	300	250	180	0	430	537	800	30	830	1,500	1,500	0	0	1,500	
5/17/07	3,001	210	0	24.36	3,211	145	300	250	180	0	430	537	800	30	830	1,500	1,500	0	0	1,500	
5/18/07	2,998	210	0	24.77	3,208	141	300	250	180	0	430	537	800	30	830	1,500	1,500	0	0	1,500	
5/19/07	2,995	210	0	25.19	3,205	138	300	250	180	0	430	537	800	30	830	1,500	1,500	0	0	1,500	
5/20/07	2,991	210	0	25.61	3,201	135	300	250			250	537	500	30	530	1,500	1,500	0	0	1,500	
5/21/07	2,988	210	0	26.02	3,198	132	300	250			250	250	250		250	741	741			741	
5/22/07	2,685	210	0	26.44	2,895	129	300	250			250	200	200		200	741	741			741	
5/23/07	1,673	0	0		1,673	126	300	250			250	200	200		200	741	741			741	
5/24/07	1,620	0	0		1,620	123	300	250			250	150	150		150	741	741			741	
5/25/07	1,617	0	0		1,617	120	300	250			250	150	150		150	741	741			741	
5/26/07	1,564	0	0		1,564	117	300	250			250	150	150		150	741	741			741	
5/27/07	1,561	0	0		1,561	114	300	250			250	150	150		150	741	741			741	
5/28/07	1,558	0	0		1,558	111	300	250			250	150	150		150	741	741			741	
5/29/07	1,555	0	0		1,555	108	300	250			250	150	150		150	741	741			741	
5/30/07	1,552	0	0		1,552	105	300	250			250	135	135		135	741	741			741	
5/31/07	1,549	0	0		1,549	102	300	250			250	120	120		120	741	741			741	
										VAMP Period											
Avg. (cfs):	2,770	430			3,200	183	300	250	407	0	657	537	537	23	560	1,500	1,500	0	0	1,500	
Supplemental Water (TAF):				26.44							25.01	0.00				1.43				0.00	

VAMP flow operation period

Appendix A-1, Table 10

2007 VAMP DAILY OPERATION PLAN — APRIL 13, 2007

(A) SINGLE-STEP; LOW UNGAGED FLOW

Target Flow Period: April 22 - May 22 • Flow Target: 3,200 cfs

Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,420**				**2,420**	**788**	**97**	**215**			**215**	**349**	**349**		**349**	**804**	**804**			**804**	
3/16/07	**2,290**				**2,290**	**759**	**97**	**228**			**228**	**348**	**348**		**348**	**806**	**806**			**806**	
3/17/07	**2,350**				**2,350**	**739**	**194**	**213**			**213**	**338**	**338**		**338**	**802**	**802**			**802**	
3/18/07	**2,320**				**2,320**	**727**	**192**	**212**			**212**	**338**	**338**		**338**	**687**	**687**			**687**	
3/19/07	**2,310**				**2,310**	**710**	**203**	**216**			**216**	**337**	**337**		**337**	**603**	**603**			**603**	
3/20/07	**2,150**				**2,150**	**702**	**185**	**208**			**208**	**337**	**337**		**337**	**609**	**609**			**609**	
3/21/07	**2,240**				**2,240**	**659**	**378**	**215**			**215**	**334**	**334**		**334**	**607**	**607**			**607**	
3/22/07	**2,180**				**2,180**	**659**	**316**	**223**			**223**	**335**	**335**		**335**	**604**	**604**			**604**	
3/23/07	**2,200**				**2,200**	**609**	**392**	**212**			**212**	**334**	**334**		**334**	**547**	**547**			**547**	
3/24/07	**2,230**				**2,230**	**536**	**417**	**213**			**213**	**335**	**335**		**335**	**504**	**504**			**504**	
3/25/07	**2,210**				**2,210**	**476**	**497**	**214**			**214**	**336**	**336**		**336**	**502**	**502**			**502**	
3/26/07	**2,160**				**2,160**	**460**	**573**	**215**			**215**	**335**	**335**		**335**	**509**	**509**			**509**	
3/27/07	**2,050**				**2,050**	**461**	**523**	**234**			**234**	**335**	**335**		**335**	**503**	**503**			**503**	
3/28/07	**2,030**				**2,030**	**447**	**512**	**229**			**229**	**335**	**335**		**335**	**505**	**505**			**505**	
3/29/07	**2,000**				**2,000**	**437**	**486**	**229**			**229**	**337**	**337**		**337**	**503**	**503**			**503**	
3/30/07	**1,910**				**1,910**	**437**	**389**	**223**			**223**	**337**	**337**		**337**	**503**	**503**			**503**	
3/31/07	**1,880**				**1,880**	**414**	**374**	**198**			**198**	**338**	**338**		**338**	**501**	**501**			**501**	
4/1/07	**1,950**				**1,950**	**393**	**444**	**202**			**202**	**339**	**339**		**339**	**500**	**500**			**500**	
4/2/07	**1,920**				**1,920**	**380**	**444**	**221**			**221**	**338**	**338**		**338**	**502**	**502**			**502**	
4/3/07	**1,790**				**1,790**	**342**	**360**	**214**			**214**	**337**	**337**		**337**	**509**	**509**			**509**	
4/4/07	**1,720**				**1,720**	**328**	**298**	**213**			**213**	**337**	**337**		**337**	**503**	**503**			**503**	
4/5/07	**1,670**				**1,670**	**296**	**261**	**206**			**206**	**337**	**337**		**337**	**500**	**500**			**500**	
4/6/07	**1,670**				**1,670**	**271**	**288**	**195**			**195**	**337**	**337**		**337**	**502**	**502**			**502**	
4/7/07	**1,700**				**1,700**	**260**	**354**	**203**			**203**	**338**	**338**		**338**	**510**	**510**			**510**	
4/8/07	**1,770**				**1,770**	**279**	**454**	**215**			**215**	**338**	**338**		**338**	**508**	**508**			**508**	
4/9/07	**1,860**				**1,860**	**274**	**557**	**216**			**216**	**338**	**338**		**338**	**508**	**508**			**508**	
4/10/07	**1,650**				**1,650**	**276**	**322**	**192**			**192**	**339**	**339**		**339**	**504**	**504**			**504**	
4/11/07	**1,620**				**1,620**	**267**	**285**	**176**			**176**	**343**	**343**		**343**	**504**	**504**			**504**	
4/12/07	**1,710**				**1,710**	**299**	**375**	**179**			**179**	**341**	**341**		**341**	**800**	**800**			**800**	
4/13/07	1,664	0			1,664	290	358	250			250	300	300		300	768	768			768	
4/14/07	1,957	0			1,957	281	341	250			250	300	300		300	768	768			768	
4/15/07	1,861	0	0	0.00	1,861	272	324	250			250	250	250		250	768	768			768	
4/16/07	1,906	0	0	0.00	1,906	263	307	250			250	250	250		250	768	768			768	
4/17/07	1,830	0	0	0.00	1,830	254	290	250			250	250	250		250	768	768			768	
4/18/07	1,804	0	0	0.00	1,804	245	273	250			250	250	250		250	768	768			768	
4/19/07	1,778	0	0	0.00	1,778	236	256	250	50	60	360	250	250		250	768	768			768	
4/20/07	1,752	0	0	0.00	1,752	231	239	250	100	60	410	537	800	150	950	1,500	1,500	0	0	1,500	
4/21/07	1,726	0	0	0.00	1,726	228	222	250	100	60	410	537	800	170	970	1,500	1,500	0	0	1,500	
4/22/07	2,881	260	0	0.52	3,141	225	100	250	100	60	410	537	800	170	970	1,500	1,500	0	0	1,500	
4/23/07	2,878	330	0	1.17	3,208	221	100	250	100	60	410	537	800	170	970	1,500	1,500	0	0	1,500	
4/24/07	2,875	330	0	1.82	3,205	218	100	250	100	60	410	537	800	170	970	1,500	1,500	0	0	1,500	
4/25/07	2,871	330	0	2.48	3,201	215	100	250	100	60	410	537	800	170	970	1,500	1,500	0	0	1,500	
4/26/07	2,868	330	0	3.13	3,198	212	100	250	100	60	410	537	800	170	970	1,500	1,500	0	0	1,500	
4/27/07	2,865	330	0	3.79	3,195	209	100	250	100	60	410	537	800	170	970	1,500	1,500	0	0	1,500	
4/28/07	2,862	330	0	4.44	3,192	205	100	250	450	70	770	537	800	170	970	1,500	1,500	0	0	1,500	
4/29/07	2,859	330	0	5.10	3,189	202	100	250	780	60	1,090	537	500	170	670	1,500	1,500	0	0	1,500	
4/30/07	2,855	330	0	5.75	3,185	199	100	250	780	60	1,090	537	200	160	360	1,500	1,500	0	0	1,500	
5/1/07	2,552	690	0	7.12	3,242	196	100	250	780	60	1,090	537	200	160	360	1,500	1,500	0	0	1,500	
5/2/07	2,249	1,000	0	9.10	3,249	193	100	250	780	60	1,090	537	200	160	360	1,500	1,500	0	0	1,500	
5/3/07	2,246	1,000	0	11.09	3,246	189	100	250	780	60	1,090	537	200	160	360	1,500	1,500	0	0	1,500	
5/4/07	2,243	1,000	0	13.07	3,243	186	100	250	780	60	1,090	537	200	160	360	1,500	1,500	0	0	1,500	
5/5/07	2,239	1,000	0	15.05	3,239	183	100	250	780	60	1,090	537	200	160	360	1,500	1,500	0	0	1,500	
5/6/07	2,236	1,000	0	17.04	3,236	180	100	250	780	60	1,090	537	200	160	360	1,500	1,500	0	0	1,500	
5/7/07	2,233	1,000	0	19.02	3,233	177	100	250	780	60	1,090	537	200	160	360	1,500	1,500	0	0	1,500	
5/8/07	2,230	1,000	0	21.00	3,230	173	100	250	780	60	1,090	537	200	160	360	1,500	1,500	0	0	1,500	
5/9/07	2,227	1,000	0	22.99	3,227	170	100	250	780	60	1,090	537	200	160	360	1,500	1,500	0	0	1,500	
5/10/07	2,223	1,000	0	24.97	3,223	167	100	250	780	60	1,090	537	200	160	360	1,500	1,500	0	0	1,500	
5/11/07	2,220	1,000	0	26.96	3,220	164	100	250	510	70	830	537	200	160	360	1,500	1,500	0	0	1,500	
5/12/07	2,217	1,000	0	28.94	3,217	161	100	250	180	60	490	537	450	160	610	1,500	1,500	0	0	1,500	
5/13/07	2,214	1,000	0	30.92	3,214	157	100	250	180	60	490	537	800	160	960	1,500	1,500	0	0	1,500	
5/14/07	2,461	740	0	32.39	3,201	154	100	250	180	60	490	537	800	160	960	1,500	1,500	0	0	1,500	
5/15/07	2,807	400	0	33.18	3,207	151	100	250	180	60	490	537	800	160	960	1,500	1,500	0	0	1,500	
5/16/07	2,804	400	0	33.98	3,204	148	100	250	180	60	490	537	800	160	960	1,500	1,500	0	0	1,500	
5/17/07	2,801	400	0	34.77	3,201	145	100	250	180	60	490	537	800	160	960	1,500	1,500	0	0	1,500	
5/18/07	2,798	400	0	35.56	3,198	141	100	250	180	60	490	537	800	160	960	1,500	1,500	0	0	1,500	
5/19/07	2,795	400	0	36.36	3,195	138	100	250	180	60	490	537	800	160	960	1,500	1,500	0	0	1,500	
5/20/07	2,791	400	0	37.15	3,191	135	100	250			250	537	500	160	660	1,500	1,500	0	0	1,500	
5/21/07	2,788	400	0	37.94	3,188	132	100	250			250	250	250		250	741	741			741	
5/22/07	2,485	400	0	38.74	2,885	129	100	250			250	200	200		200	741	741			741	
5/23/07	1,473	0	0		1,473	126	100	250			250	200	200		200	741	741			741	
5/24/07	1,420	0	0		1,420	123	100	250			250	150	150		150	741	741			741	
5/25/07	1,417	0	0		1,417	120	100	250			250	150	150		150	741	741			741	
5/26/07	1,364	0	0		1,364	117	100	250			250	150	150		150	741	741			741	
5/27/07	1,361	0	0		1,361	114	100	250			250	150	150		150	741	741			741	
5/28/07	1,358	0	0		1,358	111	100	250			250	150	150		150	741	741			741	
5/29/07	1,355	0	0		1,355	108	100	250			250	150	150		150	741	741			741	
5/30/07	1,352	0	0		1,352	105	100	250			250	135	135		135	741	741			741	
5/31/07	1,349	0	0		1,349	102	100	250			250	120	120		120	741	741			741	
										VAMP Period											
Avg. (cfs):	2,570	630			3,200	183	100	250	407	61	717	537	537	163	700	1,500	1,500	0	0	1,500	
Supplemental Water (TAF):				38.74							25.01	3.73				10.00				0.00	

VAMP flow operation period

Appendix A-1, Table 11

2007 VAMP DAILY OPERATION PLAN — APRIL 16, 2007

Target Flow Period: April 22 - May 22 • Flow Target: 3,200 cfs

Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,420**				**2,420**	**788**	**97**	**215**			**215**	**349**	**349**		**349**	**804**	**804**			**804**	
3/16/07	**2,290**				**2,290**	**759**	**97**	**228**			**228**	**348**	**348**		**348**	**806**	**806**			**806**	
3/17/07	**2,350**				**2,350**	**739**	**194**	**213**			**213**	**338**	**338**		**338**	**802**	**802**			**802**	
3/18/07	**2,320**				**2,320**	**727**	**192**	**212**			**212**	**338**	**338**		**338**	**687**	**687**			**687**	
3/19/07	**2,310**				**2,310**	**710**	**203**	**216**			**216**	**337**	**337**		**337**	**603**	**603**			**603**	
3/20/07	**2,150**				**2,150**	**702**	**185**	**208**			**208**	**337**	**337**		**337**	**609**	**609**			**609**	
3/21/07	**2,240**				**2,240**	**659**	**378**	**215**			**215**	**334**	**334**		**334**	**607**	**607**			**607**	
3/22/07	**2,180**				**2,180**	**659**	**316**	**223**			**223**	**335**	**335**		**335**	**604**	**604**			**604**	
3/23/07	**2,200**				**2,200**	**609**	**392**	**212**			**212**	**334**	**334**		**334**	**547**	**547**			**547**	
3/24/07	**2,230**				**2,230**	**536**	**417**	**213**			**213**	**335**	**335**		**335**	**504**	**504**			**504**	
3/25/07	**2,210**				**2,210**	**476**	**497**	**214**			**214**	**336**	**336**		**336**	**502**	**502**			**502**	
3/26/07	**2,160**				**2,160**	**460**	**573**	**215**			**215**	**335**	**335**		**335**	**509**	**509**			**509**	
3/27/07	**2,050**				**2,050**	**461**	**523**	**234**			**234**	**335**	**335**		**335**	**503**	**503**			**503**	
3/28/07	**2,030**				**2,030**	**447**	**512**	**229**			**229**	**335**	**335**		**335**	**505**	**505**			**505**	
3/29/07	**2,000**				**2,000**	**437**	**486**	**229**			**229**	**337**	**337**		**337**	**503**	**503**			**503**	
3/30/07	**1,910**				**1,910**	**437**	**389**	**223**			**223**	**337**	**337**		**337**	**503**	**503**			**503**	
3/31/07	**1,880**				**1,880**	**414**	**374**	**198**			**198**	**338**	**338**		**338**	**501**	**501**			**501**	
4/1/07	**1,950**				**1,950**	**393**	**444**	**202**			**202**	**339**	**339**		**339**	**500**	**500**			**500**	
4/2/07	**1,920**				**1,920**	**380**	**444**	**221**			**221**	**338**	**338**		**338**	**502**	**502**			**502**	
4/3/07	**1,790**				**1,790**	**342**	**360**	**214**			**214**	**337**	**337**		**337**	**509**	**509**			**509**	
4/4/07	**1,720**				**1,720**	**328**	**298**	**213**			**213**	**337**	**337**		**337**	**503**	**503**			**503**	
4/5/07	**1,670**				**1,670**	**296**	**261**	**206**			**206**	**337**	**337**		**337**	**500**	**500**			**500**	
4/6/07	**1,670**				**1,670**	**271**	**288**	**195**			**195**	**337**	**337**		**337**	**502**	**502**			**502**	
4/7/07	**1,700**				**1,700**	**260**	**354**	**203**			**203**	**338**	**338**		**338**	**510**	**510**			**510**	
4/8/07	**1,770**				**1,770**	**279**	**454**	**215**			**215**	**338**	**338**		**338**	**508**	**508**			**508**	
4/9/07	**1,860**				**1,860**	**274**	**557**	**216**			**216**	**338**	**338**		**338**	**508**	**508**			**508**	
4/10/07	**1,650**				**1,650**	**276**	**322**	**192**			**192**	**339**	**339**		**339**	**504**	**504**			**504**	
4/11/07	**1,620**				**1,620**	**267**	**285**	**176**			**176**	**343**	**343**		**343**	**504**	**504**			**504**	
4/12/07	**1,720**				**1,720**	**299**	**385**	**179**			**179**	**341**	**341**		**341**	**500**	**500**			**500**	
4/13/07	**1,660**				**1,660**	**290**	**354**	**181**			**181**	**340**	**340**		**340**	**503**	**503**			**503**	
4/14/07	**1,710**				**1,710**	**291**	**394**	**204**			**204**	**343**	**343**		**343**	**503**	**503**			**503**	
4/15/07	**1,890**				**1,890**	**293**	**578**	**241**			**241**	**296**	**296**		**296**	**507**	**507**			**507**	
4/16/07	1,618				1,618	284	300	250			250	250	250		250	768	768			768	
4/17/07	1,600				1,600	275	300	250			250	250	250		250	768	768			768	
4/18/07	1,843				1,843	266	300	250			250	250	250		250	768	768			768	
4/19/07	1,843				1,843	257	300	250	50	0	300	250	250		250	768	768			768	
4/20/07	1,834				1,834	231	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/21/07	1,825				1,825	228	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/22/07	3,081	100	0	0.20	3,181	225	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/23/07	3,078	150	0	0.50	3,228	221	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/24/07	3,075	150	0	0.79	3,225	218	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/25/07	3,071	150	0	1.09	3,221	215	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/26/07	3,068	150	0	1.39	3,218	212	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/27/07	3,065	150	0	1.69	3,215	209	300	250	100	0	350	537	800	50	850	1,500	1,500	0	0	1,500	
4/28/07	3,062	150	0	1.98	3,212	205	300	250	450	0	700	537	800	50	850	1,500	1,500	0	0	1,500	
4/29/07	3,059	150	0	2.28	3,209	202	300	250	780	0	1,030	537	500	0	500	1,500	1,500	0	0	1,500	
4/30/07	3,055	150	0	2.58	3,205	199	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/1/07	2,752	450	0	3.47	3,202	196	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/2/07	2,449	780	0	5.02	3,229	193	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/3/07	2,446	780	0	6.57	3,226	189	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/4/07	2,443	780	0	8.11	3,223	186	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/5/07	2,439	780	0	9.66	3,219	183	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/6/07	2,436	780	0	11.21	3,216	180	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/7/07	2,433	780	0	12.75	3,213	177	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/8/07	2,430	780	0	14.30	3,210	173	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/9/07	2,427	780	0	15.85	3,207	170	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/10/07	2,423	780	0	17.40	3,203	167	300	250	780	0	1,030	537	200	0	200	1,500	1,500	0	0	1,500	
5/11/07	2,420	780	0	18.94	3,200	164	300	250	510	0	760	537	200	0	200	1,500	1,500	0	0	1,500	
5/12/07	2,417	780	0	20.49	3,197	161	300	250	180	0	430	537	450	30	480	1,500	1,500	0	0	1,500	
5/13/07	2,414	780	0	22.04	3,194	157	300	250	180	0	430	537	800	40	840	1,500	1,500	0	0	1,500	
5/14/07	2,661	540	0	23.11	3,201	154	300	250	180	0	430	537	800	40	840	1,500	1,500	0	0	1,500	
5/15/07	3,007	220	0	23.54	3,227	151	300	250	180	0	430	537	800	40	840	1,500	1,500	0	0	1,500	
5/16/07	3,004	220	0	23.98	3,224	148	300	250	180	0	430	537	800	40	840	1,500	1,500	0	0	1,500	
5/17/07	3,001	220	0	24.42	3,221	145	300	250	180	0	430	537	800	40	840	1,500	1,500	0	0	1,500	
5/18/07	2,998	220	0	24.85	3,218	141	300	250	180	0	430	537	800	40	840	1,500	1,500	0	0	1,500	
5/19/07	2,995	220	0	25.29	3,215	138	300	250	180	0	430	537	800	0	800	1,500	1,500	0	0	1,500	
5/20/07	2,991	220	0	25.73	3,211	135	300	250			250	537	500	0	500	1,500	1,500	0	0	1,500	
5/21/07	2,988	180	0	26.08	3,168	132	300	250			250	250	250		250	741	741			741	
5/22/07	2,685	180	0	26.44	2,865	129	300	250			250	200	200		200	741	741			741	
5/23/07	1,673	0	0		1,673	126	300	250			250	200	200		200	741	741			741	
5/24/07	1,620	0	0		1,620	123	300	250			250	150	150		150	741	741			741	
5/25/07	1,617	0	0		1,617	120	300	250			250	150	150		150	741	741			741	
5/26/07	1,564	0	0		1,564	117	300	250			250	150	150		150	741	741			741	
5/27/07	1,561	0	0		1,561	114	300	250			250	150	150		150	741	741			741	
5/28/07	1,558	0	0		1,558	111	300	250			250	150	150		150	741	741			741	
5/29/07	1,555	0	0		1,555	108	300	250			250	150	150		150	741	741			741	
5/30/07	1,552	0	0		1,552	105	300	250			250	135	135		135	741	741			741	
5/31/07	1,549	0	0		1,549	102	300	250			250	120	120		120	741	741			741	
										VAMP Period											
Avg. (cfs):	2,770	430			3,200	183	300	250	407	0	657	537	537	23	560	1,500	1,500	0	0	1,500	
Supplemental Water (TAF):				26.44							25.01	0.00				1.43				0.00	

VAMP flow operation period

Appendix A-1, Table 12

2007 VAMP DAILY OPERATION PLAN — APRIL 18, 2007

Target Flow Period: April 22 - May 22 * Flow Target: 3,200 cfs

Bold Numbers: observed real-time mean daily flows

	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,420**				**2,420**	**788**	**97**	**215**			**215**	**349**	**349**		**349**	**804**	**804**			**804**	
3/16/07	**2,290**				**2,290**	**759**	**97**	**228**			**228**	**348**	**348**		**348**	**806**	**806**			**806**	
3/17/07	**2,350**				**2,350**	**739**	**194**	**213**			**213**	**338**	**338**		**338**	**802**	**802**			**802**	
3/18/07	**2,320**				**2,320**	**727**	**192**	**212**			**212**	**338**	**338**		**338**	**687**	**687**			**687**	
3/19/07	**2,310**				**2,310**	**710**	**203**	**216**			**216**	**337**	**337**		**337**	**603**	**603**			**603**	
3/20/07	**2,150**				**2,150**	**702**	**185**	**208**			**208**	**337**	**337**		**337**	**609**	**609**			**609**	
3/21/07	**2,240**				**2,240**	**659**	**378**	**215**			**215**	**334**	**334**		**334**	**607**	**607**			**607**	
3/22/07	**2,180**				**2,180**	**659**	**316**	**223**			**223**	**335**	**335**		**335**	**604**	**604**			**604**	
3/23/07	**2,200**				**2,200**	**609**	**392**	**212**			**212**	**334**	**334**		**334**	**547**	**547**			**547**	
3/24/07	**2,230**				**2,230**	**536**	**417**	**213**			**213**	**335**	**335**		**335**	**504**	**504**			**504**	
3/25/07	**2,210**				**2,210**	**476**	**497**	**214**			**214**	**336**	**336**		**336**	**502**	**502**			**502**	
3/26/07	**2,160**				**2,160**	**460**	**573**	**215**			**215**	**335**	**335**		**335**	**509**	**509**			**509**	
3/27/07	**2,050**				**2,050**	**461**	**523**	**234**			**234**	**335**	**335**		**335**	**503**	**503**			**503**	
3/28/07	**2,030**				**2,030**	**447**	**512**	**229**			**229**	**335**	**335**		**335**	**505**	**505**			**505**	
3/29/07	**2,000**				**2,000**	**437**	**486**	**229**			**229**	**337**	**337**		**337**	**503**	**503**			**503**	
3/30/07	**1,910**				**1,910**	**437**	**389**	**223**			**223**	**337**	**337**		**337**	**503**	**503**			**503**	
3/31/07	**1,880**				**1,880**	**414**	**374**	**198**			**198**	**338**	**338**		**338**	**501**	**501**			**501**	
4/1/07	**1,950**				**1,950**	**393**	**444**	**202**			**202**	**339**	**339**		**339**	**500**	**500**			**500**	
4/2/07	**1,920**				**1,920**	**380**	**444**	**221**			**221**	**338**	**338**		**338**	**502**	**502**			**502**	
4/3/07	**1,790**				**1,790**	**342**	**360**	**214**			**214**	**337**	**337**		**337**	**509**	**509**			**509**	
4/4/07	**1,720**				**1,720**	**328**	**298**	**213**			**213**	**337**	**337**		**337**	**503**	**503**			**503**	
4/5/07	**1,670**				**1,670**	**296**	**261**	**206**			**206**	**337**	**337**		**337**	**500**	**500**			**500**	
4/6/07	**1,670**				**1,670**	**271**	**288**	**195**			**195**	**337**	**337**		**337**	**502**	**502**			**502**	
4/7/07	**1,700**				**1,700**	**260**	**354**	**203**			**203**	**338**	**338**		**338**	**510**	**510**			**510**	
4/8/07	**1,770**				**1,770**	**279**	**454**	**215**			**215**	**338**	**338**		**338**	**508**	**508**			**508**	
4/9/07	**1,860**				**1,860**	**274**	**557**	**216**			**216**	**338**	**338**		**338**	**508**	**508**			**508**	
4/10/07	**1,650**				**1,650**	**276**	**322**	**192**			**192**	**339**	**339**		**339**	**504**	**504**			**504**	
4/11/07	**1,620**				**1,620**	**267**	**285**	**176**			**176**	**343**	**343**		**343**	**504**	**504**			**504**	
4/12/07	**1,720**				**1,720**	**299**	**385**	**179**			**179**	**341**	**341**		**341**	**500**	**500**			**500**	
4/13/07	**1,660**				**1,660**	**290**	**354**	**181**			**181**	**340**	**340**		**340**	**503**	**503**			**503**	
4/14/07	**1,710**				**1,710**	**291**	**394**	**204**			**204**	**343**	**343**		**343**	**503**	**503**			**503**	
4/15/07	**1,890**				**1,890**	**293**	**578**	**241**			**241**	**296**	**296**		**296**	**507**	**507**			**507**	
4/16/07	**1,970**				**1,970**	**346**	**652**	**247**			**247**	**295**	**295**		**295**	**503**	**503**			**503**	
4/17/07	**1,850**				**1,850**	**314**	**550**	**237**			**237**	**295**	**295**		**295**	**503**	**503**			**503**	
4/18/07	1,685				1,685	284	300	250			250	250	250		250	768	768			768	
4/19/07	1,659				1,659	254	300	250	50	0	300	250	250		250	768	768			768	
4/20/07	1,839				1,839	231	300	250	100	0	350	599	600	250	850	1,500	1,500	0	0	1,500	
4/21/07	1,822				1,822	228	300	250	100	0	350	599	600	250	850	1,500	1,500	0	0	1,500	
4/22/07	2,881	300	0	0.60	3,181	225	300	250	100	0	350	599	600	250	850	1,500	1,500	0	0	1,500	
4/23/07	2,878	350	0	1.29	3,228	221	300	250	100	0	350	599	600	250	850	1,500	1,500	0	0	1,500	
4/24/07	2,875	350	0	1.98	3,225	218	300	250	100	0	350	599	600	250	850	1,500	1,500	0	0	1,500	
4/25/07	2,871	350	0	2.68	3,221	215	300	250	100	0	350	599	600	250	850	1,500	1,500	0	0	1,500	
4/26/07	2,868	350	0	3.37	3,218	212	300	250	100	0	350	599	600	250	850	1,500	1,500	0	0	1,500	
4/27/07	2,865	350	0	4.07	3,215	209	300	250	250	0	500	599	600	250	850	1,500	1,500	0	0	1,500	
4/28/07	2,862	350	0	4.76	3,212	205	300	250	375	0	625	599	600	100	700	1,500	1,500	0	0	1,500	
4/29/07	2,859	350	0	5.45	3,209	202	300	250	500	0	750	476	475	100	575	1,500	1,500	0	0	1,500	
4/30/07	2,855	350	0	6.15	3,205	199	300	250	650	0	900	374	375	75	450	1,500	1,500	0	0	1,500	
5/1/07	2,727	475	0	7.09	3,202	196	300	250	700	0	950	272	270	50	320	1,500	1,500	0	0	1,500	
5/2/07	2,624	575	0	8.23	3,199	193	300	250	700	0	950	272	270	0	270	1,500	1,500	0	0	1,500	
5/3/07	2,516	700	0	9.62	3,216	189	300	250	700	0	950	272	270	0	270	1,500	1,500	0	0	1,500	
5/4/07	2,513	700	0	11.01	3,213	186	300	250	700	0	950	272	270	0	270	1,500	1,500	0	0	1,500	
5/5/07	2,509	700	0	12.40	3,209	183	300	250	700	0	950	272	270	0	270	1,500	1,500	0	0	1,500	
5/6/07	2,506	700	0	13.79	3,206	180	300	250	700	0	950	272	270	0	270	1,500	1,500	0	0	1,500	
5/7/07	2,503	700	0	15.17	3,203	177	300	250	700	0	950	272	270	0	270	1,500	1,500	0	0	1,500	
5/8/07	2,500	700	0	16.56	3,200	173	300	250	700	0	950	272	270	0	270	1,500	1,500	0	0	1,500	
5/9/07	2,497	700	0	17.95	3,197	170	300	250	700	0	950	272	270	0	270	1,500	1,500	0	0	1,500	
5/10/07	2,493	700	0	19.34	3,193	167	300	250	575	0	825	272	270	0	270	1,500	1,500	0	0	1,500	
5/11/07	2,490	700	0	20.73	3,190	164	300	250	450	0	700	374	375	0	375	1,500	1,500	0	0	1,500	
5/12/07	2,487	700	0	22.12	3,187	161	300	250	350	0	600	476	475	50	525	1,500	1,500	0	0	1,500	
5/13/07	2,589	575	0	23.26	3,164	157	300	250	350	0	600	599	600	50	650	1,500	1,500	0	0	1,500	
5/14/07	2,686	500	0	24.25	3,186	154	300	250	350	0	600	599	600	50	650	1,500	1,500	0	0	1,500	
5/15/07	2,807	400	0	25.04	3,207	151	300	250	350	0	600	599	600	50	650	1,500	1,500	0	0	1,500	
5/16/07	2,804	400	0	25.83	3,204	148	300	250	350	0	600	599	600	50	650	1,500	1,500	0	0	1,500	
5/17/07	2,801	400	0	26.63	3,201	145	300	250	350	0	600	599	600	50	650	1,500	1,500	0	0	1,500	
5/18/07	2,798	400	0	27.42	3,198	141	300	250	350	0	600	599	600	50	650	1,500	1,500	0	0	1,500	
5/19/07	2,795	400	0	28.21	3,195	138	300	250	305	0	555	599	600	50	650	1,500	1,500	0	0	1,500	
5/20/07	2,791	400	0	29.01	3,191	135	300	250			250	599	600	50	650	1,500	1,500	0	0	1,500	
5/21/07	2,788	400	0	29.80	3,188	132	300	250			250	550	550		550	741	741			741	
5/22/07	2,785	355	0	30.51	3,140	129	300	250			250	425	425		425	741	741			741	
5/23/07	1,973	0	0		1,973	126	300	250			250	325	325		325	741	741			741	
5/24/07	1,845	0	0		1,845	123	300	250			250	225	225		225	741	741			741	
5/25/07	1,742	0	0		1,742	120	300	250			250	150	150		150	741	741			741	
5/26/07	1,639	0	0		1,639	117	300	250			250	150	150		150	741	741			741	
5/27/07	1,561	0	0		1,561	114	300	250			250	150	150		150	741	741			741	
5/28/07	1,558	0	0		1,558	111	300	250			250	150	150		150	741	741			741	
5/29/07	1,555	0	0		1,555	108	300	250			250	150	150		150	741	741			741	
5/30/07	1,552	0	0		1,552	105	300	250			250	135	135		135	741	741			741	
5/31/07	1,549	0	0		1,549	102	300	250			250	120	120		120	741	741			741	
										VAMP Period											
Avg. (cfs):	2,704	496			3,200	183	300	250	407	0	657	471	471	90	560	1,500	1,500	0	0	1,500	
Supplemental Water (TAF):				30.51							25.00	0.00				5.50				0.00	

VAMP flow operation period

Appendix A-1, Table 13

2007 VAMP DAILY OPERATION PLAN — MAY 4, 2007

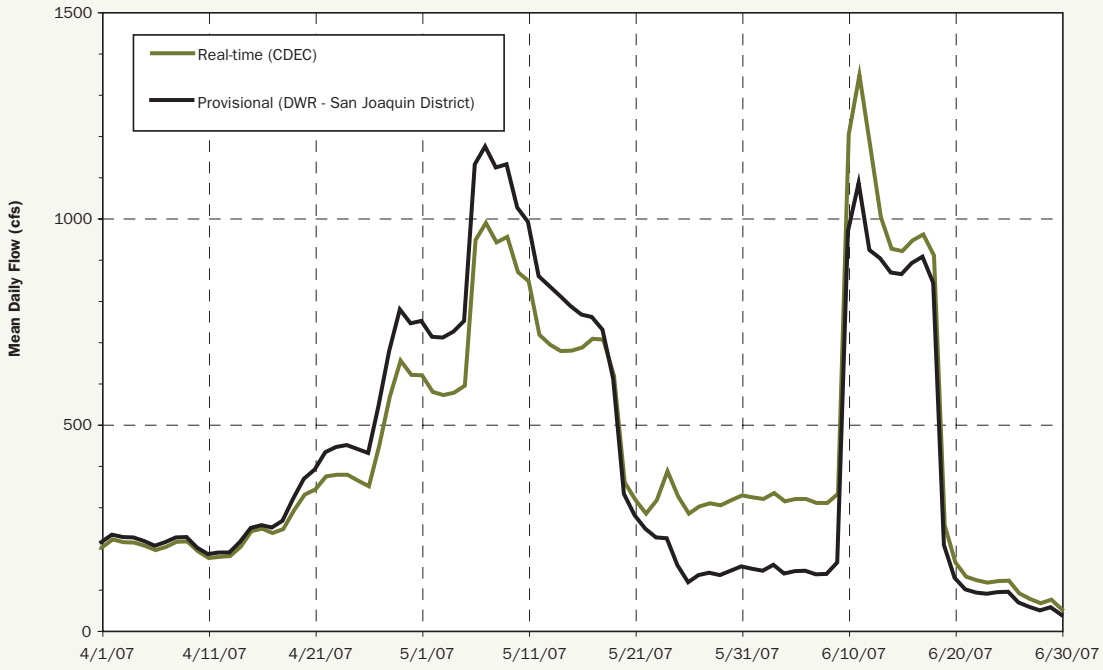
Target Flow Period: April 22 - May 22 * Flow Target: 3,200 cfs

Bold Numbers: observed real-time mean daily flows

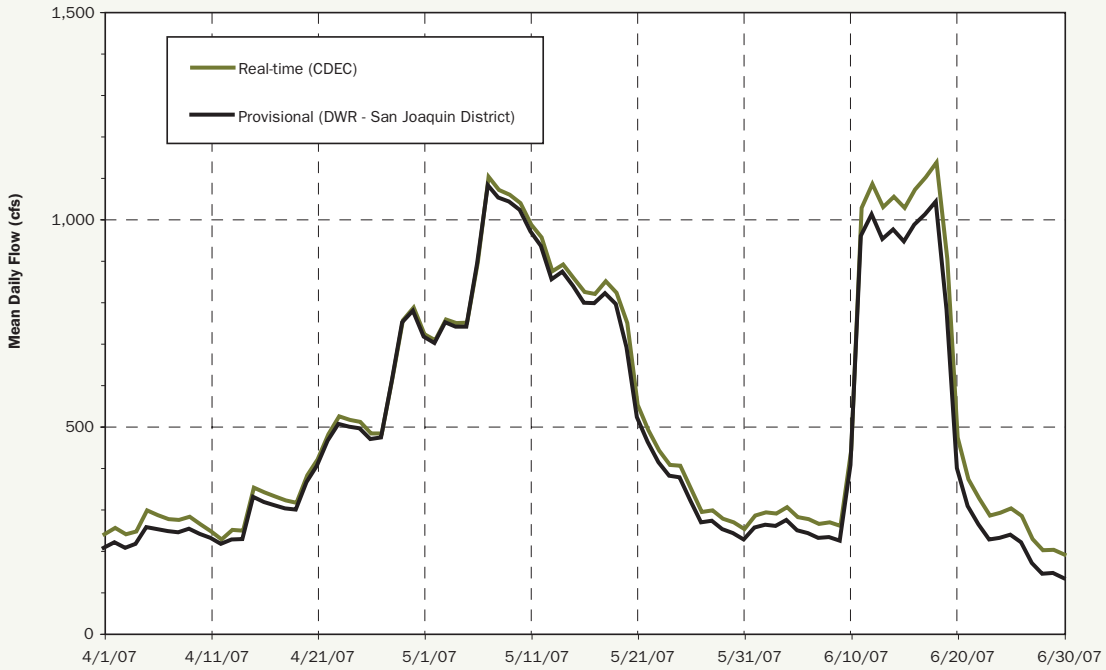
	San Joaquin River near Vernalis							Merced River at Cressey				Tuolumne River at LaGrange				Stanislaus R blw Goodwin					
Date	Existing Flow	VAMP Suppl. Flow	Other Suppl. Flow	Cum. VAMP Suppl. Flow	VAMP Flow	SJR above Merced R. (2 day lag)	Ungaged Flow above Vernalis	Existing Flow	MeID VAMP Suppl. Flow	Exch Contr VAMP Suppl. Flow	VAMP Flow (3 day lag)	Existing Flow - base FERC Volume	Existing Flow - Adjusted FERC Pulse	VAMP Suppl. Flow	VAMP Flow (2 day lag)	Existing Flow - Base	Existing Flow- reshaped	VAMP Suppl. Flow	Other Suppl. Flow	VAMP Flow (2-day lag)	Maintain Priority Flow Level M=Merced T=Tuol. S=Stan.
	(cfs)	(cfs)	(cfs)	(TAF)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)		(cfs)	(cfs)	(cfs)	
3/15/07	**2,420**				2,420	788	80	215			215	349	349		349	804	804			804	
3/16/07	**2,290**				2,290	759	79	228			228	348	348		348	806	806			806	
3/17/07	**2,350**				2,350	739	176	213			213	338	338		338	802	802			802	
3/18/07	**2,320**				2,320	727	174	212			212	338	338		338	687	687			687	
3/19/07	**2,310**				2,310	710	185	216			216	337	337		337	603	603			603	
3/20/07	**2,150**				2,150	702	167	208			208	337	337		337	609	609			609	
3/21/07	**2,240**				2,240	659	360	215			215	334	334		334	607	607			607	
3/22/07	**2,180**				2,180	659	298	223			223	335	335		335	604	604			604	
3/23/07	**2,200**				2,200	609	375	212			212	334	334		334	547	547			547	
3/24/07	**2,230**				2,230	536	399	213			213	335	335		335	504	504			504	
3/25/07	**2,210**				2,210	476	479	214			214	336	336		336	502	502			502	
3/26/07	**2,160**				2,160	460	555	215			215	335	335		335	509	509			509	
3/27/07	**2,050**				2,050	461	505	234			234	335	335		335	503	503			503	
3/28/07	**2,030**				2,030	447	494	229			229	335	335		335	505	505			505	
3/29/07	**2,000**				2,000	437	469	229			229	337	337		337	503	503			503	
3/30/07	**1,910**				1,910	437	371	223			223	337	337		337	503	503			503	
3/31/07	**1,880**				1,880	414	356	198			198	338	338		338	501	501			501	
4/1/07	**1,950**				1,950	393	426	202			202	339	339		339	500	500			500	
4/2/07	**1,920**				1,920	380	436	221			221	338	338		338	502	502			502	
4/3/07	**1,790**				1,790	342	342	214			214	337	337		337	509	509			509	
4/4/07	**1,720**				1,712	328	290	213			213	337	337		337	503	503			503	
4/5/07	**1,670**				1,662	296	253	206			206	337	337		337	500	500			500	
4/6/07	**1,670**				1,662	271	280	195			195	337	337		337	502	502			502	
4/7/07	**1,700**				1,693	260	347	203			203	338	338		338	510	510			510	
4/8/07	**1,770**				1,762	279	446	215			215	338	338		338	508	508			508	
4/9/07	**1,860**				1,862	274	559	216			216	338	338		338	508	508			508	
4/10/07	**1,650**				1,652	276	324	192			192	339	339		339	504	504			504	
4/11/07	**1,620**				1,612	267	277	176			176	343	343		343	504	504			504	
4/12/07	**1,720**				1,712	299	377	179			179	341	341		341	500	500			500	
4/13/07	**1,660**				1,662	290	356	181			181	340	340		340	503	503			503	
4/14/07	**1,710**				1,712	291	396	204			204	343	343		343	503	503			503	
4/15/07	**1,890**				1,892	293	580	241			241	296	296		296	507	507			507	
4/16/07	**1,972**				1,972	346	654	247			247	295	295		295	503	503			503	
4/17/07	**1,834**				1,834	314	534	237			237	295	295		295	503	503			503	
4/18/07	**1,744**				1,744	317	359	246			246	295	295		295	503	503			503	
4/19/07	**1,764**				1,764	311	405	**250**	**41**	**0**	291	589	589		589	1,032	1,032			1,032	
4/20/07	**1,874**				1,874	278	522	**250**	**80**	**0**	330	599	600	267	867	1,503	1,503	0	0	1,503	
4/21/07	**2,703**				2,703	271	525	**250**	**92**	**0**	342	599	600	275	875	1,503	1,503	0	0	1,503	
4/22/07	**3,202**	**308**	**0**	**0.61**	3,510	242	571	**250**	**124**	**0**	374	599	600	275	875	1,507	1,507	0	0	1,507	
4/23/07	**3,435**	**355**	**0**	**1.32**	3,790	273	811	**250**	**128**	**0**	378	599	600	271	871	1,501	1,501	0	0	1,501	
4/24/07	**3,313**	**367**	**0**	**2.04**	3,680	282	714	**250**	**128**	**0**	378	599	600	269	869	1,504	1,504	0	0	1,504	
4/25/07	**3,195**	**395**	**0**	**2.83**	3,590	291	571	**250**	**113**	**0**	363	599	600	183	783	1,501	1,501	0	0	1,501	
4/26/07	**3,123**	**397**	**0**	**3.61**	3,520	281	487	**250**	**100**	**0**	350	599	600	45	645	1,500	1,500	0	0	1,500	
4/27/07	**3,059**	**311**	**0**	**4.23**	3,370	238	417	**250**	**198**	**0**	448	599	600	0	600	1,502	1,502	0	0	1,502	
4/28/07	**3,012**	**158**	**0**	**4.54**	3,170	218	381	**250**	**318**	**0**	568	599	600	0	599	1,502	1,502	0	0	1,502	
4/29/07	**3,060**	**100**	**0**	**4.74**	3,160	204	470	**250**	**405**	**0**	655	476	475	14	489	1,502	1,502	0	0	1,502	
4/30/07	**3,003**	**198**	**0**	**5.14**	3,200	243	433	**250**	**370**	**0**	620	374	375	32	407	1,502	1,502	0	0	1,502	
5/1/07	**2,758**	**332**	**0**	**5.79**	3,090	256	327	**250**	**369**	**0**	619	272	270	46	316	1,500	1,500	0	0	1,500	
5/2/07	**2,523**	**437**	**0**	**6.66**	2,960	237	153	**250**	**329**	**0**	579	272	270	42	312	1,497	1,497	0	0	1,497	
5/3/07	**2,404**	**416**	**0**	**7.49**	2,820	180	128	**250**	**321**	**0**	571	272	270	101	371	1,504	1,504	0	0	1,504	
5/4/07	2,454	411	0	8.30	2,865	186	200	250	425	0	675	272	270	150	420	1,500	1,500	0	0	1,500	
5/5/07	2,404	430	0	9.15	2,834	183	200	250	450	0	700	272	270	100	370	1,500	1,500	0	0	1,500	
5/6/07	2,406	471	0	10.09	2,877	180	200	250	700	0	950	272	270	70	340	1,500	1,500	0	0	1,500	
5/7/07	2,403	525	0	11.13	2,928	177	200	250	800	0	1,050	272	270	0	270	1,500	1,500	0	0	1,500	
5/8/07	2,400	520	0	12.16	2,920	173	200	250	800	0	1,050	272	270	0	270	1,500	1,500	0	0	1,500	
5/9/07	2,397	700	0	13.55	3,097	170	200	250	800	0	1,050	272	270	0	270	1,500	1,500	0	0	1,500	
5/10/07	2,393	800	0	15.14	3,193	167	200	250	725	0	975	272	270	0	270	1,500	1,500	0	0	1,500	
5/11/07	2,390	800	0	16.72	3,190	164	200	250	625	0	875	374	375	0	375	1,500	1,500	0	0	1,500	
5/12/07	2,387	800	0	18.31	3,187	161	200	250	500	0	750	476	475	0	475	1,500	1,500	0	0	1,500	
5/13/07	2,489	725	0	19.75	3,214	157	200	250	500	0	750	599	600	0	600	1,500	1,500	0	0	1,500	
5/14/07	2,586	625	0	20.99	3,211	154	200	250	500	0	750	599	600	0	600	1,500	1,500	0	0	1,500	
5/15/07	2,707	500	0	21.98	3,207	151	200	250	500	0	750	599	600	0	600	1,500	1,500	0	0	1,500	
5/16/07	2,704	500	0	22.97	3,204	148	200	250	500	0	750	599	600	0	600	1,500	1,500	0	0	1,500	
5/17/07	2,701	500	0	23.96	3,201	145	200	250	500	0	750	599	600	0	600	1,500	1,500	0	0	1,500	
5/18/07	2,698	500	0	24.95	3,198	141	200	250	500	0	750	599	600	0	600	1,500	1,500	0	0	1,500	
5/19/07	2,695	500	0	25.95	3,195	138	200	250	425	0	675	599	600	0	600	1,500	1,500	0	0	1,500	
5/20/07	2,691	500	0	26.94	3,191	135	200	250			250	599	600	0	600	1,500	1,500	0	0	1,500	
5/21/07	2,688	500	0	27.93	3,188	132	200	250			250	550	350		350	741	741			741	
5/22/07	2,685	425	0	28.77	3,110	129	200	250			250	425	325		325	741	741			741	
5/23/07	1,673	0	0		1,673	126	200	250			250	325	225		225	741	741			741	
5/24/07	1,645	0	0		1,645	123	200	250			250	225	150		150	741	741			741	
5/25/07	1,542	0	0		1,542	120	200	250			250	150	150		150	741	741			741	
5/26/07	1,464	0	0		1,464	117	200	250			250	150	150		150	741	741			741	
5/27/07	1,461	0	0		1,461	114	200	250			250	150	150		150	741	741			741	
5/28/07	1,458	0	0		1,458	111	200	250			250	150	150		150	741	741			741	
5/29/07	1,455	0	0		1,455	108	200	250			250	150	150		150	741	741			741	
5/30/07	1,452	0	0		1,452	105	200	250			250	135	135		135	741	741			741	
5/31/07	1,449	0	0		1,449	102	200	250			250	120	120		120	741	741			741	
										VAMP Period											
Avg. (cfs):	2,721	468			3,189	201	299	250	399	0	649	471	471	69	540	1,501	1,501	0	0	1,501	
Supplemental Water (TAF):				28.77							24.53	0.00				4.24				0.00	

VAMP flow operation period

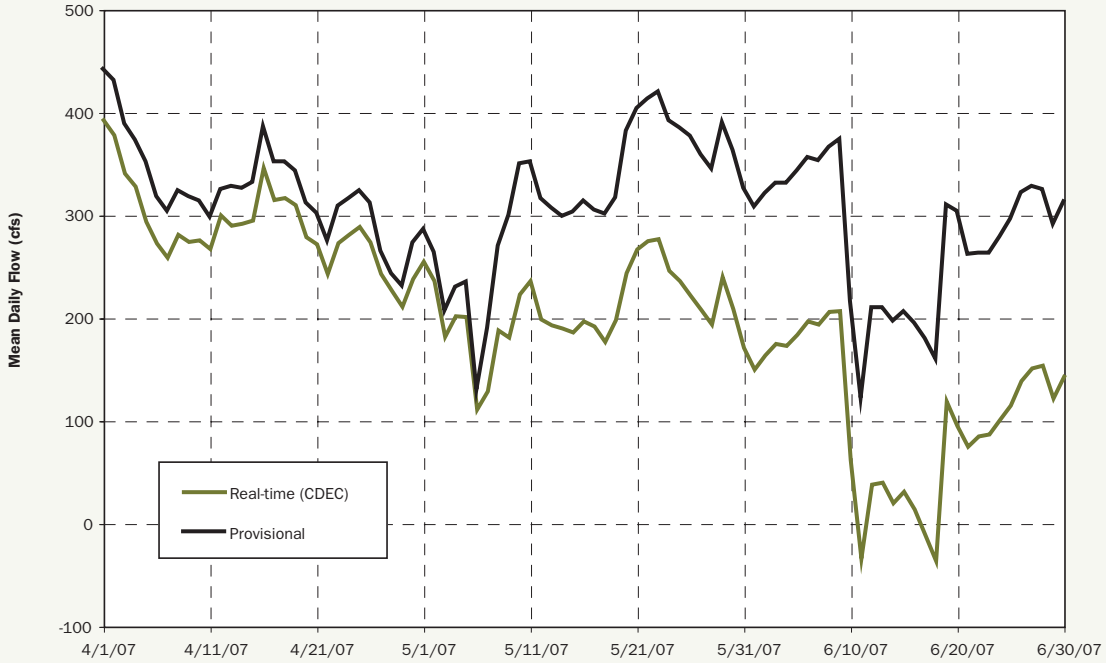
Appendix A-2, Figure 1
Merced River at Cressey



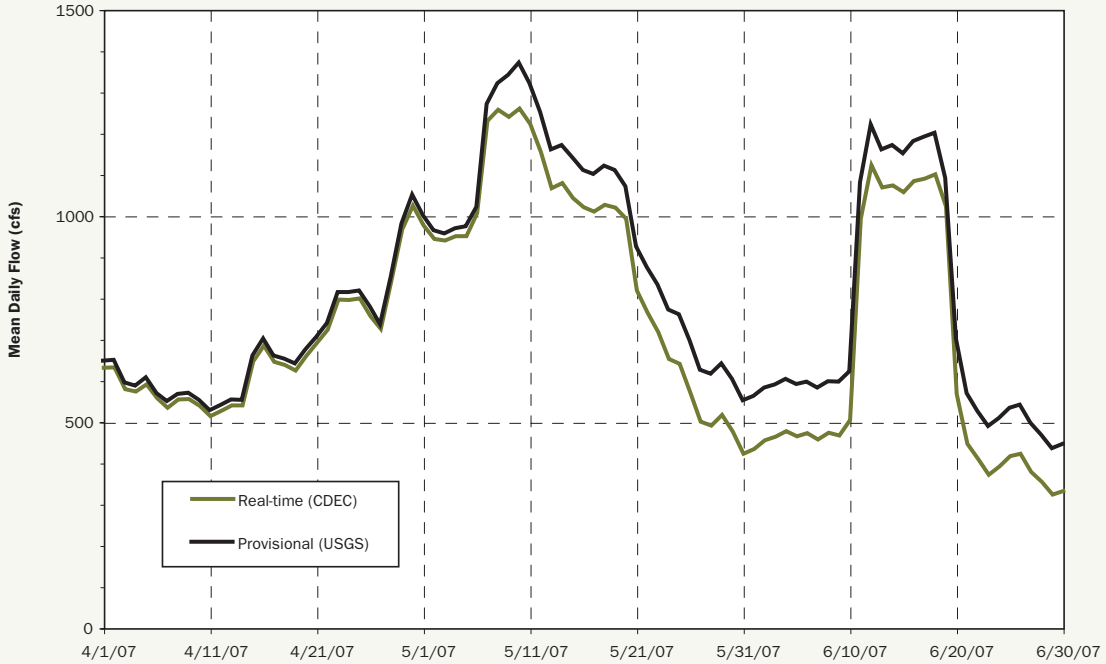
Appendix A-2, Figure 2
Merced River near Stevinson



Appendix A-2, Figure 3
San Joaquin River above Merced River



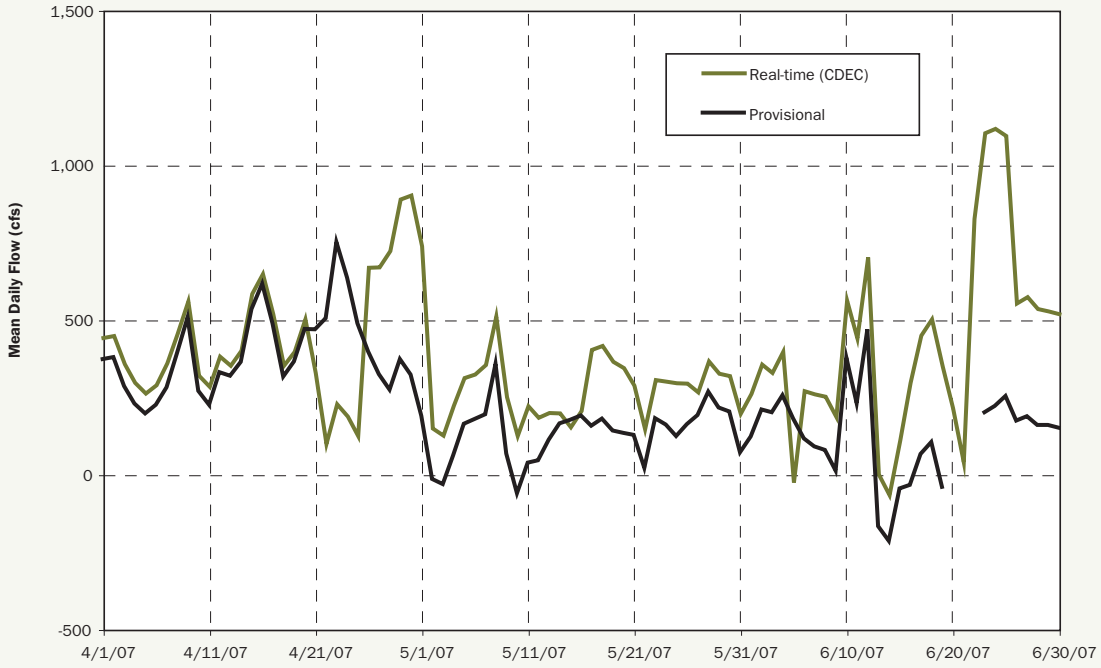
Appendix A-2, Figure 4
San Joaquin River near Newman



Appendix A-2, Figure 5
Tuolumne River below LaGrange Dam

Appendix A-2, Figure 6
San Joaquin River near Vernalis

Appendix A-2, Figure 7
Ungaged Flow in San Joaquin River near Vernalis



San Joaquin River Group Authority

P.O. Box 4060 • Modesto, CA 95352 • (209) 526-7405 • fax (209) 526-7315

Modesto Irrigation District

Turlock Irrigation District

Oakdale Irrigation District

Merced Irrigation District

Frian Water Users Authority

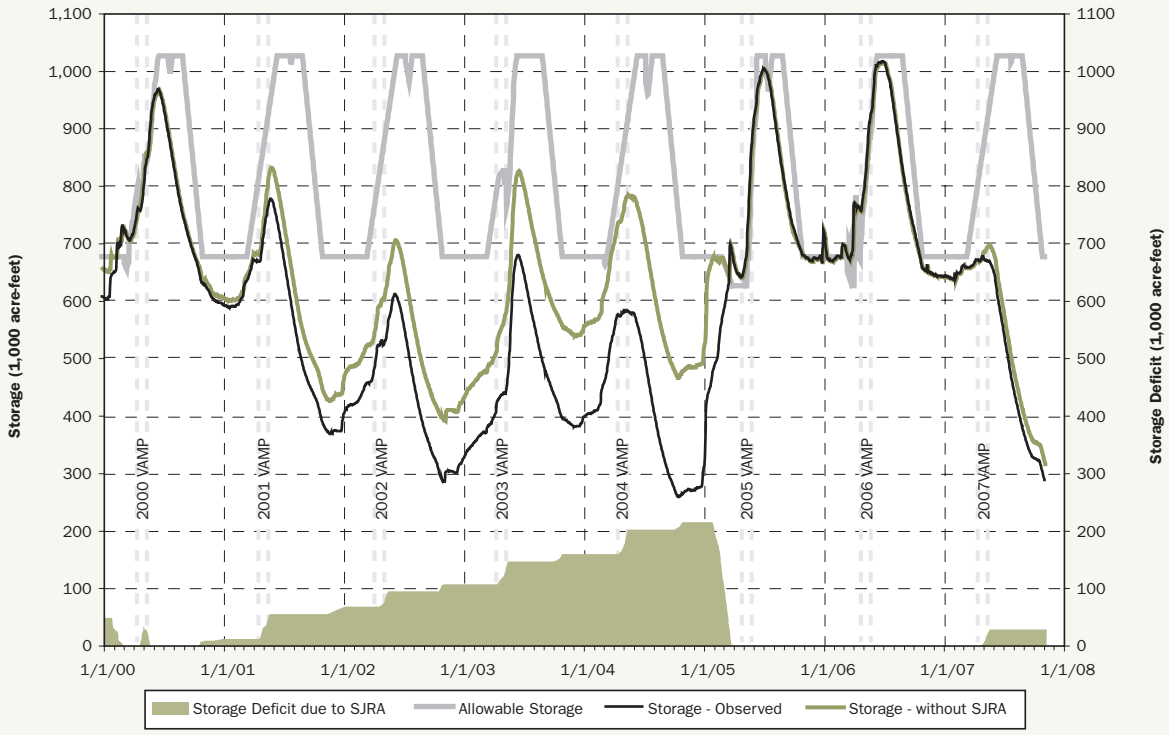
City and County of San Francisco

South San Joaquin Irrigation District

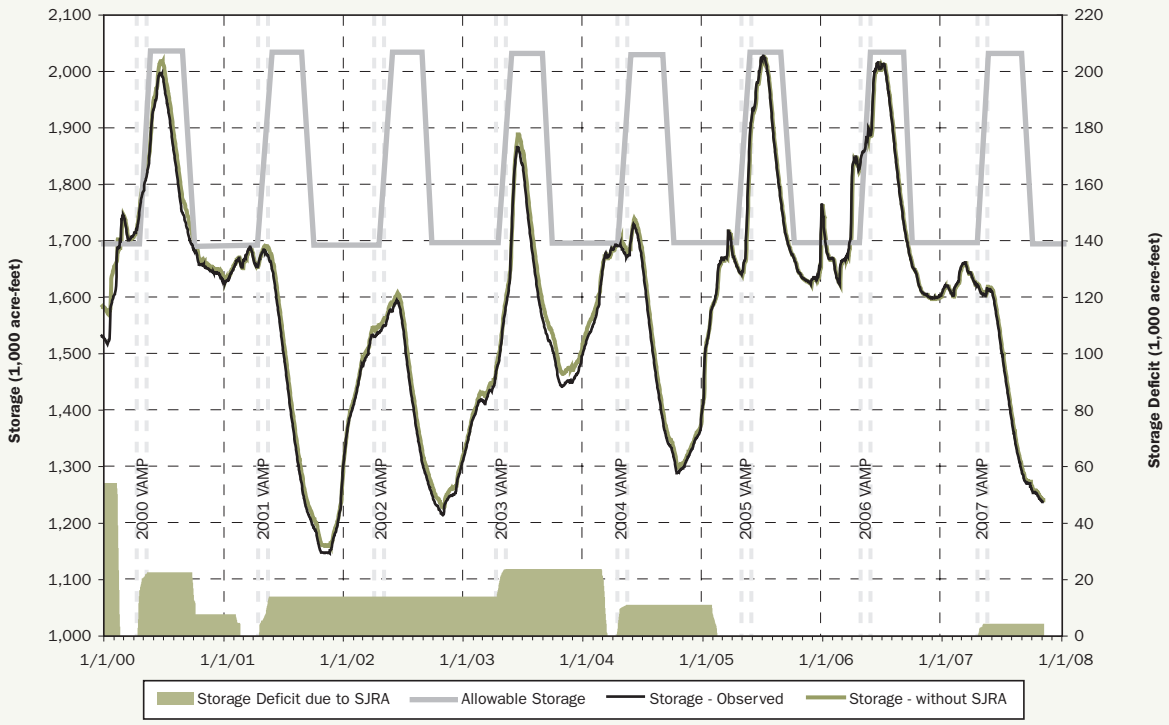
San Joaquin River Exchange Contractors

APPENDIX B

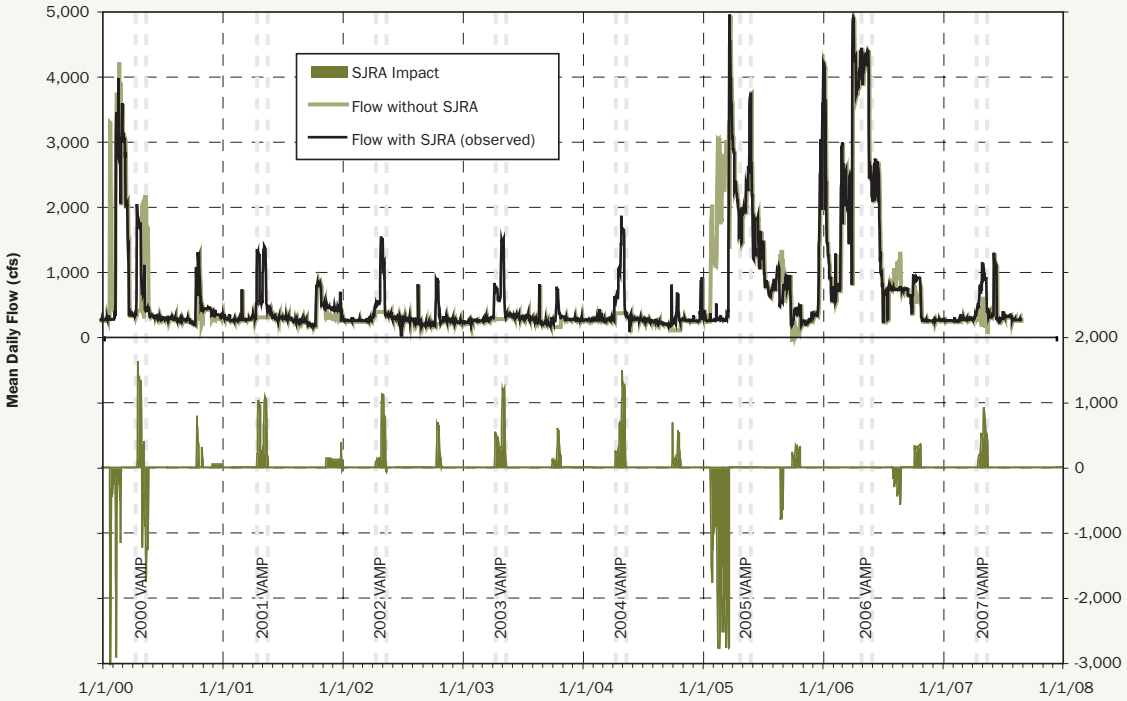
Appendix B-1, Figure 1
SJRA Storage Impacts, 2000-2007 Lake McClure (Merced River)



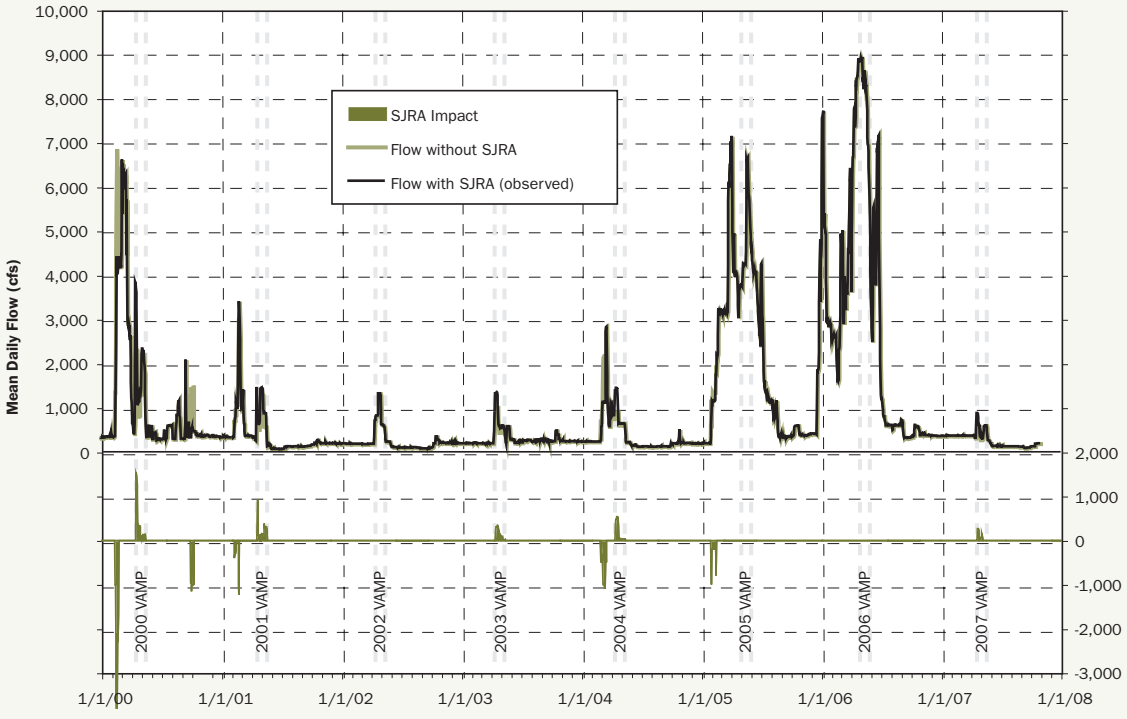
Appendix B-1, Figure 2
SJRA Storage Impacts, 2000-2007 Don Pedro Reservoir (Tuolumne River)



Appendix B-1, Figure 3
Merced River below Crocker-Huffman Dam 2000-2007



Appendix B-1, Figure 4
Tuolumne River below LaGrange Dam 2000-2007



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South San Joaquin Irrigation District

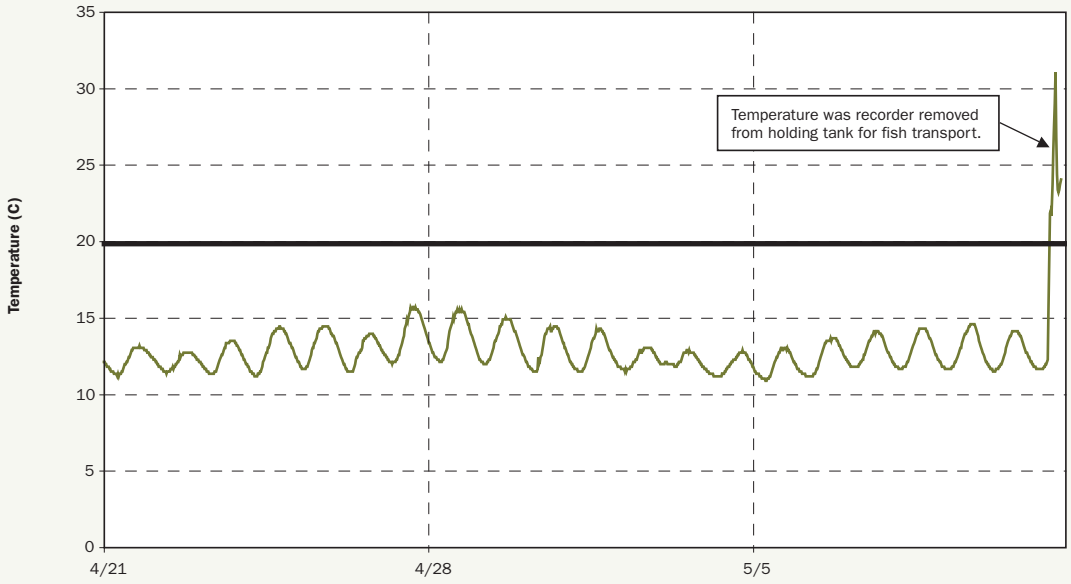
San Joaquin River Exchange Contractors

APPENDIX C

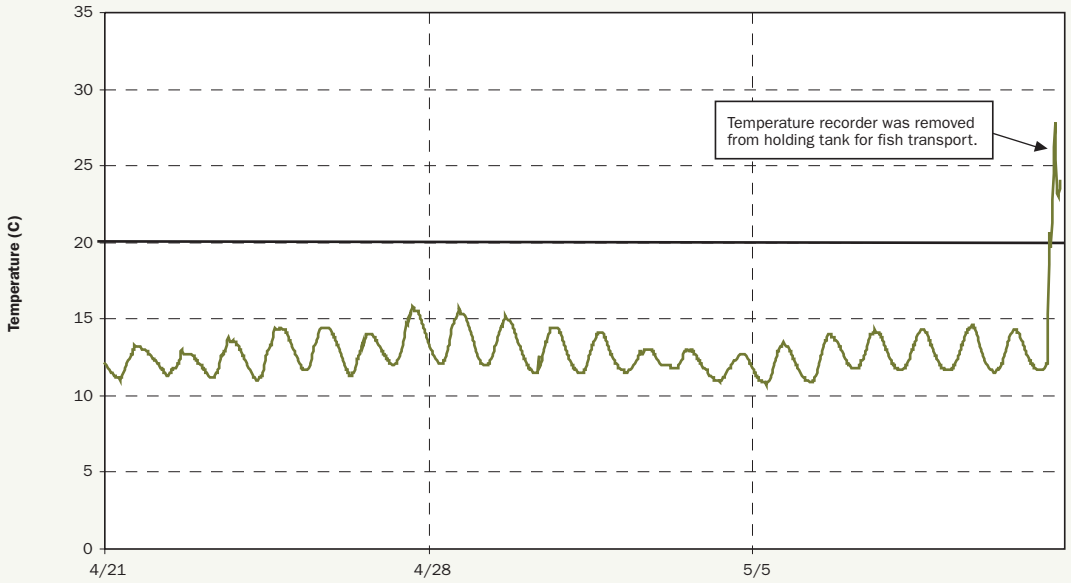
Appendix C-1
Water Temperature Monitoring Locations

Appendix C-1 VAMP 2007 Water Temperature Monitoring								
Site #	**Logger Number**	**Temperature Monitoring Location**	**Lat**	**Long**	**Distance from Durham Ferry**	**Date Deployed**	**Date Retrieved**	**Notes**
n/a	900618	Hatchery 1	n/a	n/a	n/a	4/6/07		
n/a	877664	Hatchery 2	n/a	n/a	n/a	4/6/07		
n/a	900619	Hatchery 3	n/a	n/a	n/a	4/6/07		
n/a	900620	Hatchery 4	n/a	n/a	n/a	4/6/07		
1	900616	Durham Ferry	N 37 41.381	W 121 15.657	0	4/3/07	7/19/07	Near intake pump on tree at water line
2	877665	Mossdale	N 37 47.180	W 121 18.425	11	4/3/07	Missing	Under bridge on cable
3	900625	Old River at HORB	N 37 48.457	W 121 19.872	14	4/3/07	7/19/07	On tree near flagging across from intake pump
4	900617	Dos Reis	N 37 49.808	W 121 18.665	16	4/3/07	7/19/07	On tree normally used across from launch ramp
5	877669	DWR Monitoring Station	N 37 51.869	W 121 19.376	19	4/3/07	Missing	As normal
6a	900615	Confluence – Top	N 37 56.818	W 121 20.285	27	4/3/07	Missing	As normal
6b	626431	Confluence- Bottom	N 37 56.818	W 121 20.285	27	4/3/07	Missing	As normal
7	626437	Downstream of Channel Marker 30	N 37 59.776	W 121 25.569	33	4/3/07	Missing	As normal
8	877666	Turner Cut	N 37 59.468	W121 27.267	35	4/3/07	Missing	On USGS gaging station
9	900622	"Q" Piling 1/2 mile upstream of channel marker 13	N 38 01.940	W 121 28.769	37	4/3/07	Missing	As normal
10	900624	All Pro abandoned boat	N 38 04.522	W 121 34.413	45	4/3/07	Missing	As normal
11	551654	Jersey Point USGS Gauging Station	N 38 03.172	W121 41.637	56	4/3/07	Missing	As normal
12	562570	Antioch Marina	N 38 01.147	W121 48.829	64	4/3/07	Missing	On pilings across channel from marina upstream
13	551657	Chipps Island	N 38 03.084	W 121 55.463	72	4/3/07	Missing	As normal
14	562563	Holland Riverside Marina	N 37 58.323	W 121 34.887	South Delta	4/2/07	Missing	On "No Wake" sign
15	900623	Old River / Indian Slough Confluence	N 37 54.954	W 121 33.949	South Delta	4/2/07	7/13/07	On "Indian Slough" sign
16	877663	CCF Radial Gates	N 37 49.773	W 121 33.096	South Delta	4/2/07	Missing	on DWR gaging station near intake gates
17	900626	Grant Line Canal at Travy Blvd Bridge	N 37 49.143	W 121 27.026	South Delta	4/2/07	Missing	under bridge near repairs
18	540810	Middle River at Victoria Canal Confluence	N37 53.323	W121 29.334	South Delta	4/2/07	Missing	On Staff gage
19	877668	Werner Cut: Channel above Woodward Isle	N 37 56.319	W 121 30.584	South Delta	4/2/07	7/13/07	On old pilings
Total Loggers: 24 - Set to record every 24 mins (132 days)								

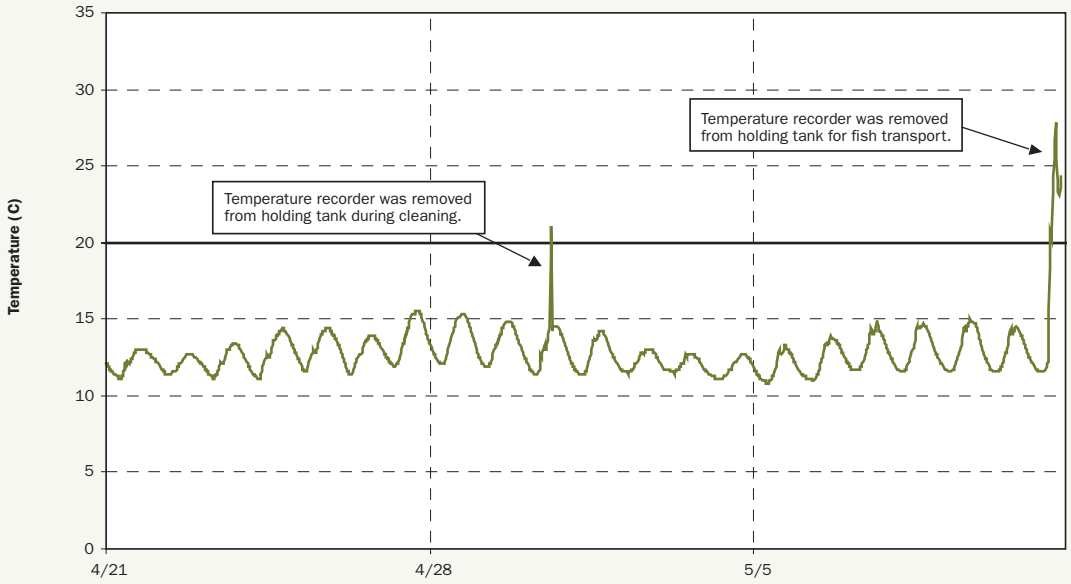
Appendix C-2
Hatchery 1
Water Temperature in Holding Tank



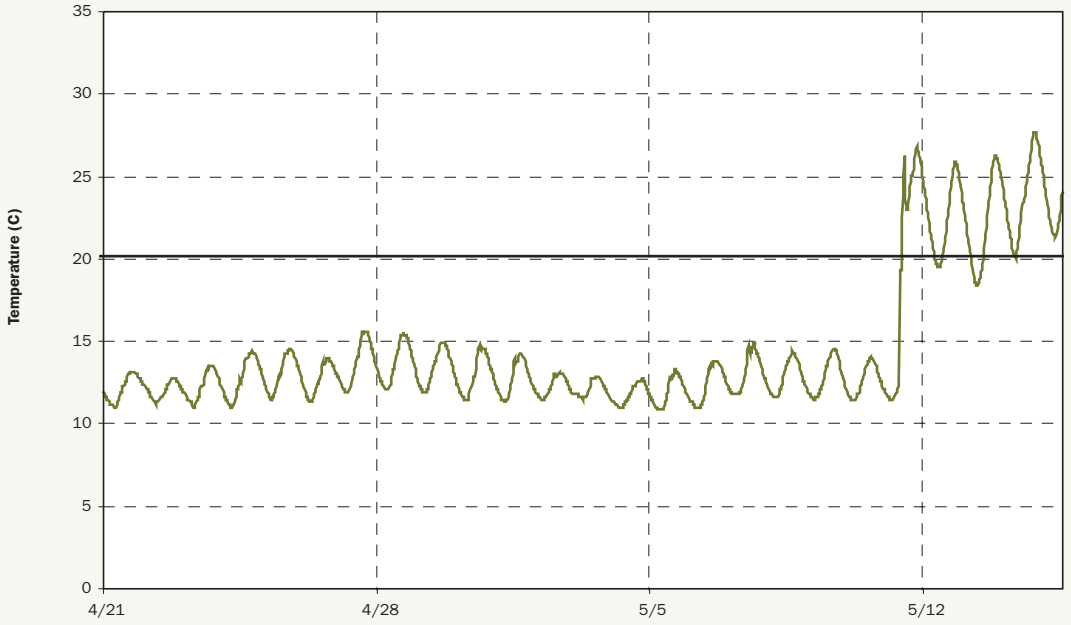
Appendix C-2
Hatchery 2
Water Temperature in Holding Tank



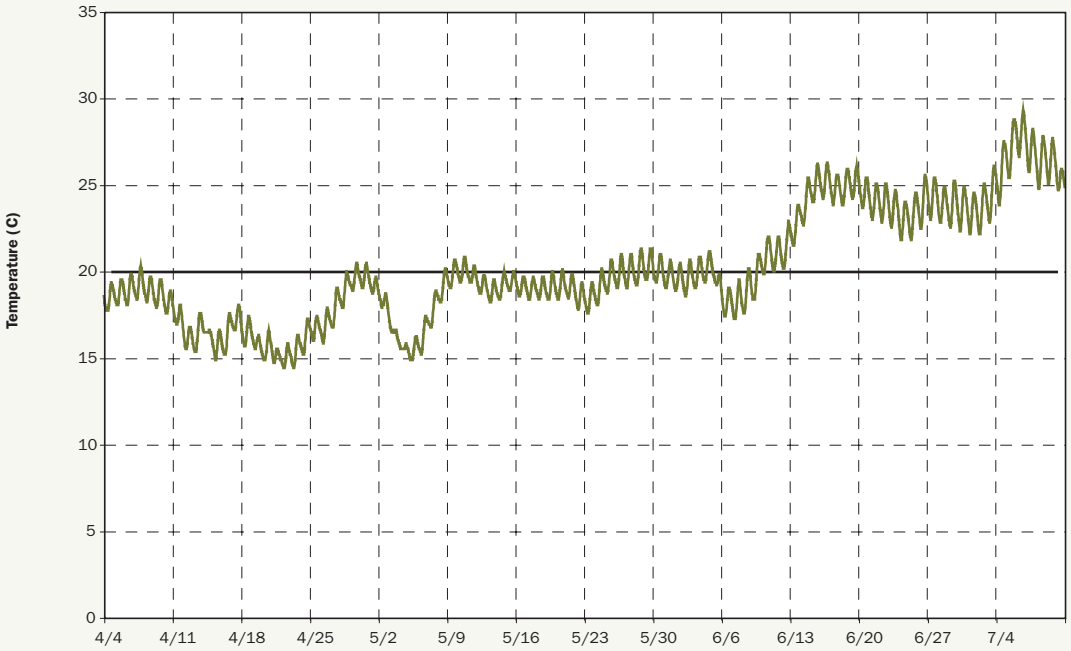
Appendix C-2
Hatchery 3
Water Temperature in Holding Tank



Appendix C-2
Hatchery 4
Water Temperature in Holding Tank

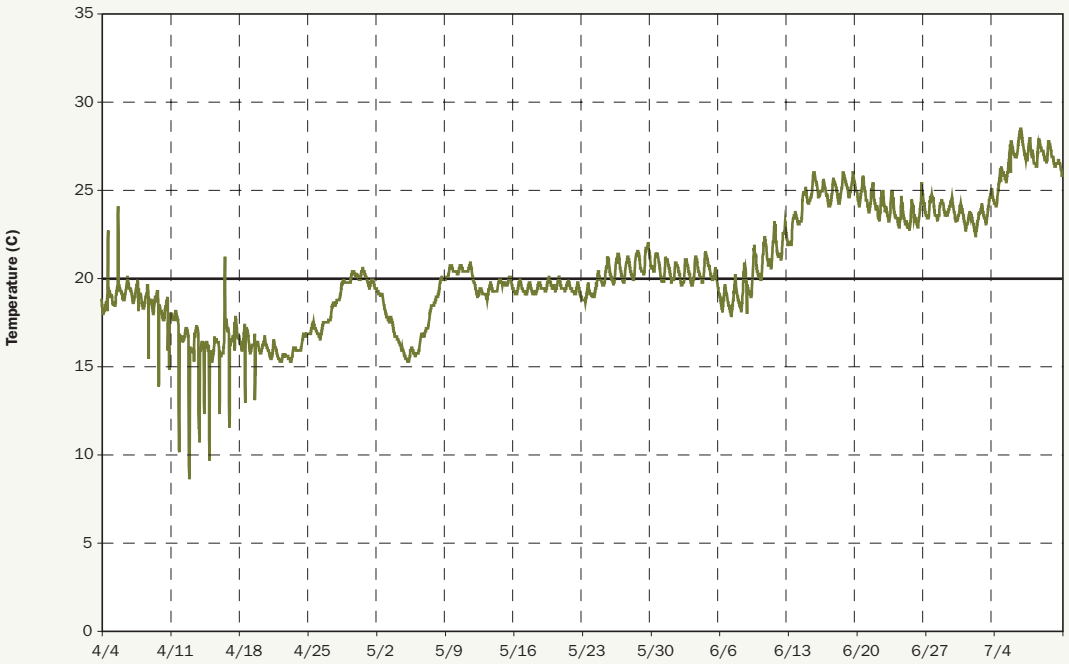


Appendix C-2
Durham Ferry

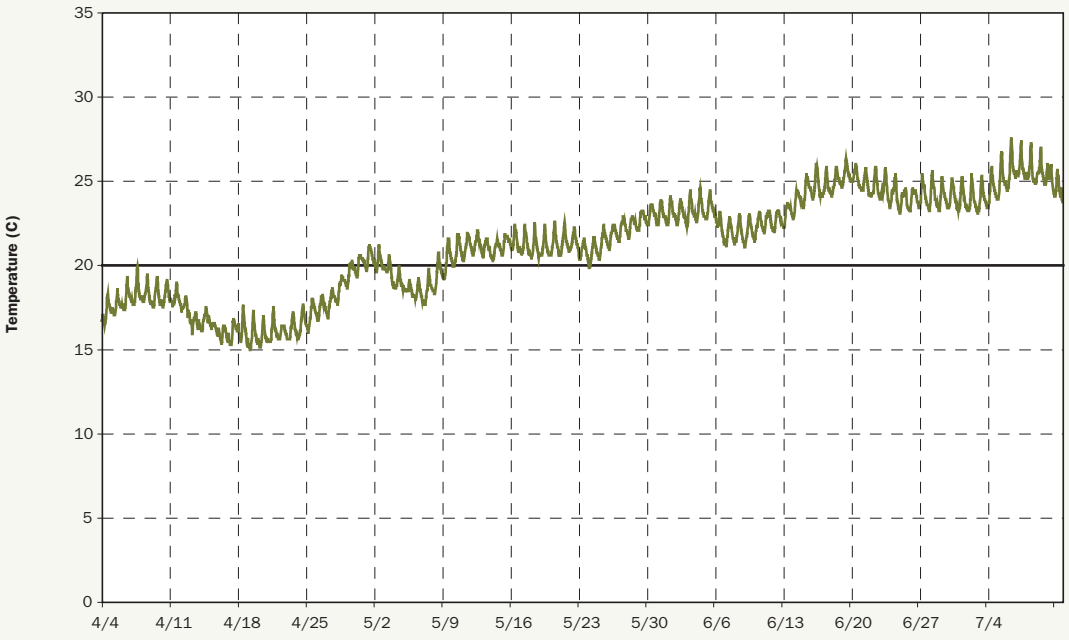


Appendix C-2
Old River at HORB

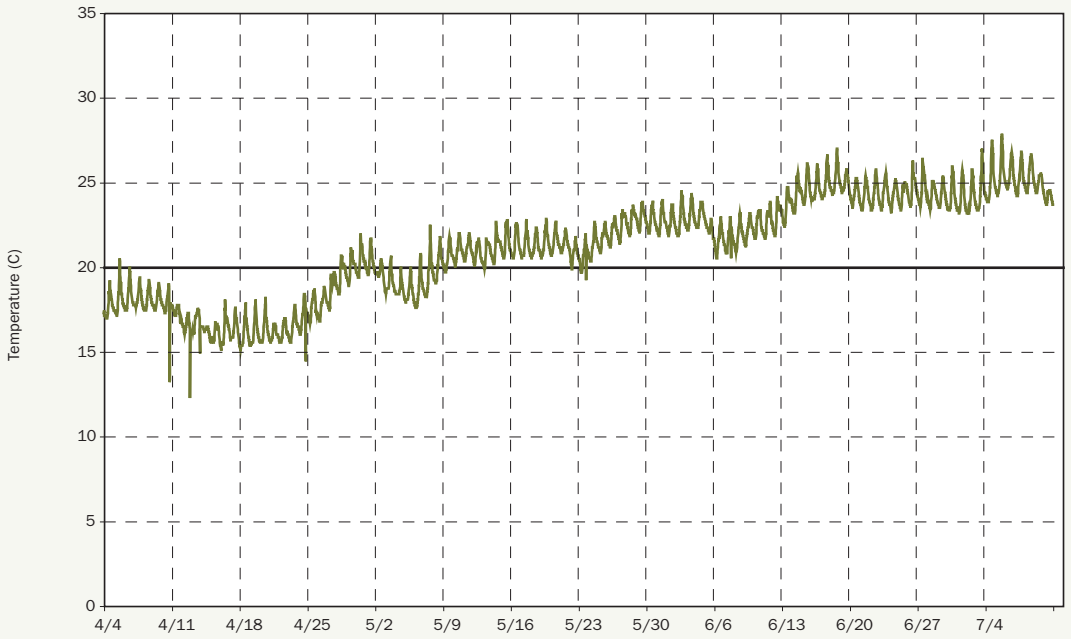
Appendix C-2
Dos Reis



Appendix C-2
Old River/Indian Slough Confluence



Appendix C-2
Werner Cut - Channel above Woodward Isle



Appendix C-3. Chinook salmon smolt conditon 48-hours post-release.

Release Location	CWT codes	Exam. Date	n	min FL	max FL	mean FL	river temp C	truck temp C	Delivery Time	Fish released	min scale loss	max scale loss	mean scale loss	color (% norm.)	Fin hemor-rhaging (% none)	Eyes (% norm.)	Gill color (% norm.)	Partial adclips (number)	Missing ad clips (number)	mortalities	comments or other abnormal-ities
Durham Ferry I	acoustic tagged	5/5/07	10	104	113	109	11.0	17.0	10:30	11:30	1.0	3.0	2.2	100	100	100	100	0	0	0	
Mossdale I	acoustic tagged	5/5/07	10	105	111	109.0	13.0	17.0	12:00	13:00	1.0	4.0	2.0	100	100	100	100	0	0	0	
MRH I	acoustic tagged	5/14/07	10	103	113	110.0			11:15		1.0	6.0	2.7	100	100	100	96	0	0	0	mortality; scale loss
Durham Ferry II	acoustic tagged	5/12/07	20	103	126	113.0	11.0	19.0	10:45	11:40	1.0	6.0	3.3	100	100.0	100.0	100.0	0.0	0.0	0	
Mossdale II	acoustic tagged	5/12/07	20	107	122	112.8	11.5	21.0	11:30	12:30	1.0	7.0	2.1	100	100.0	100.0	100.0	0.0	0.0	0	
MRH II	acoustic tagged	5/14/07	10	109	119	113.8			12:15		1.0	5.0	2.6	100	100.0	100.0	100.0	0.0	0.0	0	

Appendix C-4
Detections of acoustic-tagged salmon from May 3 & 4 releases upstream of the Head of Old River Barrier.

Release Dates: May 3 and May 4, 2007 Relase Locations: Durham Ferry, Mossdale, Bowman Road, Stockton

									Mobile Monitoring	
Release Date	Release Time	Release Site	Tag Code	Upstream of HORB Date/Time	Bowman Road Date/Time	Stockton Date/Time	Turner cut Date/Time	R16 Date/Time	Near Stockton Date/Comment	Other Locations Date/Comment
5/3/07	11:30	Durham Ferry	3000	5/4/07 9:51	5/4/07 16:54			5/16/07 2:14		
5/3/07	11:30	Durham Ferry	3007	5/4/07 10:13	5/5/07 20:03					
5/3/07	11:30	Durham Ferry	3014	5/4/07 10:18	5/4/07 15:01	5/4/07 19:41				
5/3/07	11:30	Durham Ferry	3021	5/4/07 7:50	5/4/07 14:49			5/8/07 14:56	5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3035	5/4/07 4:03	5/4/07 10:53	5/5/07 21:14				
5/3/07	11:30	Durham Ferry	3042						5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3049	5/4/07 10:14	5/4/07 15:41	5/4/07 22:29			5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3056	5/6/07 12:00	5/7/07 0:43	5/7/07 11:13		5/10/07 19:40	5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3077	5/4/07 8:30	5/4/07 13:04	5/4/07 16:48				
5/3/07	11:30	Durham Ferry	3084	5/4/07 4:04	5/4/07 17:01					
5/3/07	11:30	Durham Ferry	3091	5/4/07 8:58	5/4/07 14:37		5/7/07 7:49			
5/3/07	11:30	Durham Ferry	3098	5/4/07 12:01	5/4/07 17:29				5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3105	5/4/07 4:42	5/4/07 13:22					
5/3/07	11:30	Durham Ferry	3112	5/4/07 13:15	5/4/07 17:10					
5/3/07	11:30	Durham Ferry	3119	5/4/07 0:34	5/4/07 5:19					
5/3/07	11:30	Durham Ferry	3126	5/4/07 4:08					5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3133	5/4/07 13:25	5/4/07 18:12	5/5/07 22:23			5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3140						5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3147	5/4/07 4:34	5/4/07 13:16					
5/3/07	11:30	Durham Ferry	3154	5/4/07 12:49	5/4/07 17:25	5/5/07 9:06		5/8/07 18:59	5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3182	5/4/07 2:16	5/4/07 10:20	5/4/07 14:47				
5/3/07	11:30	Durham Ferry	3189	5/4/07 4:51	5/4/07 11:54					
5/3/07	11:30	Durham Ferry	3196	5/4/07 14:14	5/5/07 8:02	5/5/07 13:22	5/8/07 6:28		5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3203	5/6/07 17:37	5/7/07 11:16	5/7/07 16:36			5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3210	5/4/07 6:25	5/4/07 12:24	5/4/07 15:28				
5/3/07	11:30	Durham Ferry	3217	5/4/07 13:00	5/4/07 17:27					
5/3/07	11:30	Durham Ferry	3231	5/4/07 10:55	5/4/07 16:00					
5/3/07	11:30	Durham Ferry	3238	5/4/07 15:46	5/4/07 23:13					
5/3/07	11:30	Durham Ferry	3245	5/4/07 11:36	5/4/07 18:00					
5/3/07	11:30	Durham Ferry	3252	5/4/07 21:20	5/5/07 10:27					
5/3/07	11:30	Durham Ferry	3259	5/4/07 13:51	5/4/07 18:18					
5/3/07	11:30	Durham Ferry	3266	5/4/07 6:00	5/4/07 13:37	5/4/07 17:38				
5/3/07	11:30	Durham Ferry	3280	5/4/07 12:30	5/4/07 16:25					
5/3/07	11:30	Durham Ferry	3287	5/4/07 14:23						
5/3/07	11:30	Durham Ferry	3294	5/4/07 13:54	5/4/07 18:20					5/8/07, CCFB
5/3/07	11:30	Durham Ferry	3301	5/5/07 10:29	5/5/07 15:51			5/8/07 16:49		
5/3/07	11:30	Durham Ferry	3308	5/4/07 14:39	5/4/07 19:57	5/5/07 18:38				
5/3/07	11:30	Durham Ferry	3315	5/4/07 8:08	5/4/07 14:00	5/4/07 18:17		5/9/07 7:02		
5/3/07	11:30	Durham Ferry	3322	5/4/07 12:39	5/4/07 16:21		5/6/07 6:11			
5/3/07	11:30	Durham Ferry	3350	5/4/07 13:46	5/6/07 10:38					
5/3/07	11:30	Durham Ferry	3357	5/4/07 11:43	5/4/07 16:13					
5/3/07	11:30	Durham Ferry	3378	5/4/07 3:11	5/4/07 11:09					
5/3/07	11:30	Durham Ferry	3392	5/4/07 1:01	5/4/07 8:39					
5/3/07	11:30	Durham Ferry	3399	5/4/07 13:16	5/4/07 18:16	5/5/07 11:26		5/9/07 9:01		
5/3/07	11:30	Durham Ferry	3413	5/4/07 8:15	5/4/07 13:44					
5/3/07	11:30	Durham Ferry	3427	5/4/07 1:51	5/4/07 10:01	5/4/07 13:40	5/6/07 8:41			
5/3/07	11:30	Durham Ferry	3434	5/4/07 3:47	5/4/07 12:40	5/4/07 19:11				
5/3/07	11:30	Durham Ferry	3441						5/17-18,Tag Not Moving	
5/3/07	11:30	Durham Ferry	3448	5/4/07 11:57	5/4/07 16:37			5/10/07 12:39		
5/3/07	11:30	Durham Ferry	3469	5/4/07 12:50	5/4/07 17:30	5/5/07 11:39				
5/3/07	11:30	Durham Ferry	3490	5/3/07 23:43	5/4/07 8:44					
5/3/07	11:30	Durham Ferry	3497	5/4/07 2:02	5/4/07 9:09					
5/3/07	11:30	Durham Ferry	3504	5/4/07 5:52	5/4/07 12:24					
5/3/07	11:30	Durham Ferry	3511	5/4/07 5:51	5/4/07 12:33					
5/3/07	11:30	Durham Ferry	3518	5/5/07 0:20	5/5/07 17:24	5/6/07 0:56				
5/3/07	11:30	Durham Ferry	3539	5/10/07 8:01						
5/3/07	11:30	Durham Ferry	3546	5/6/07 0:14	5/6/07 5:54					
5/3/07	11:30	Durham Ferry	3553	5/4/07 16:25	5/4/07 21:50	5/5/07 14:37		5/9/07 15:24		
5/3/07	11:30	Durham Ferry	3560	5/6/07 7:12	5/6/07 13:45					
5/3/07	11:30	Durham Ferry	3567	5/4/07 10:20	5/4/07 14:36	5/4/07 19:37				
5/3/07	11:30	Durham Ferry	3574	5/4/07 1:12	5/4/07 9:04		5/6/07 4:01			
5/3/07	11:30	Durham Ferry	3602	5/5/07 1:08	5/5/07 8:55	5/5/07 12:37				
5/3/07	11:30	Durham Ferry	3616	5/4/07 10:16	5/4/07 14:36					
5/3/07	11:30	Durham Ferry	3623	5/4/07 19:47	5/5/07 4:51					
5/3/07	11:30	Durham Ferry	3637	5/4/07 4:26	5/4/07 12:34		5/6/07 7:34			
5/3/07	11:30	Durham Ferry	3651	5/4/07 11:29	5/4/07 16:07					
5/3/07	11:30	Durham Ferry	3658	5/7/07 7:54	5/7/07 14:23	5/7/07 17:26				
5/3/07	11:30	Durham Ferry	3665	5/6/07 12:25	5/6/07 16:40	5/7/07 9:31				
5/3/07	11:30	Durham Ferry	3672	5/4/07 10:12	5/4/07 16:06					
5/3/07	11:30	Durham Ferry	3679	5/4/07 4:38	5/4/07 17:17					
5/3/07	11:30	Durham Ferry	3686	5/4/07 5:32	5/4/07 20:37					
5/3/07	11:30	Durham Ferry	3693	5/5/07 1:41	5/5/07 10:37	5/5/07 14:12				
5/3/07	13:00	Mossdale	3700	5/3/07 15:17	5/3/07 22:08					
5/3/07	13:00	Mossdale	3707	5/3/07 18:26	5/4/07 1:20					
5/3/07	13:00	Mossdale	3714	5/3/07 18:30	5/4/07 1:16					
5/3/07	13:00	Mossdale	3721	5/3/07 15:58	5/4/07 0:39					

continued on following page

Appendix C-4
Detections of acoustic-tagged salmon from May 3 & 4 releases upstream of the Head of Old River Barrier.

Release Dates: May 3 and May 4, 2007 Relase Locations: Durham Ferry, Mossdale, Bowman Road, Stockton

									Mobile Monitoring	
Release Date	Release Time	Release Site	Tag Code	Upstream of HORB Date/Time	Bowman Road Date/Time	Stockton Date/Time	Turner cut Date/Time	R16 Date/Time	Near Stockton Date/Comment	Other Locations Date/Comment
5/3/07	13:00	Mossdale	3728	5/3/07 15:41	5/4/07 0:20					
5/3/07	13:00	Mossdale	3735	5/3/07 15:27	5/3/07 23:06			5/8/07 15:36		
5/3/07	13:00	Mossdale	3742	5/3/07 18:05	5/5/07 9:24	5/5/07 13:20				
5/3/07	13:00	Mossdale	3749	5/3/07 15:00	5/3/07 20:30					
5/3/07	13:00	Mossdale	3756	5/3/07 16:14	5/4/07 10:06	5/4/07 13:53				
5/3/07	13:00	Mossdale	3763	5/3/07 15:49	5/3/07 22:21	5/4/07 9:10				
5/3/07	13:00	Mossdale	3770	5/3/07 15:23	5/4/07 7:09					
5/3/07	13:00	Mossdale	3777	5/3/07 15:27	5/3/07 23:38	5/4/07 9:52		5/8/07 20:36		
5/3/07	13:00	Mossdale	3784	5/3/07 15:59	5/3/07 23:40	5/4/07 8:30				
5/3/07	13:00	Mossdale	3791	5/3/07 16:56	5/4/07 9:31	5/4/07 19:23				
5/3/07	13:00	Mossdale	3798	5/3/07 14:49	5/4/07 0:29			5/9/07 11:14		
5/3/07	13:00	Mossdale	3805	5/3/07 15:53	5/3/07 22:49					
5/3/07	13:00	Mossdale	3812	5/3/07 16:22	5/4/07 0:45	5/4/07 11:52				
5/3/07	13:00	Mossdale	3819	5/3/07 15:51	5/4/07 7:36					
5/3/07	13:00	Mossdale	3826	5/3/07 17:32						
5/3/07	13:00	Mossdale	3833	5/3/07 16:12	5/4/07 9:42					
5/3/07	13:00	Mossdale	3840	5/3/07 23:09	5/4/07 13:25	5/5/07 13:06				
5/3/07	13:00	Mossdale	3847	5/3/07 16:00	5/3/07 23:18					
5/3/07	13:00	Mossdale	3854	5/3/07 16:10	5/3/07 23:36	5/4/07 8:55				
5/3/07	13:00	Mossdale	3861	5/3/07 15:50	5/3/07 22:27					
5/3/07	13:00	Mossdale	3868	5/3/07 15:44	5/3/07 21:04	5/4/07 9:24				
5/3/07	13:00	Mossdale	3875	5/3/07 16:11	5/4/07 6:20	5/4/07 13:34				
5/3/07	13:00	Mossdale	3882	5/3/07 15:27						
5/3/07	13:00	Mossdale	3889	5/3/07 17:00	5/3/07 23:27					
5/3/07	13:00	Mossdale	3896	5/3/07 15:57	5/3/07 22:25	5/4/07 8:53				
5/3/07	13:00	Mossdale	3903	5/3/07 15:03	5/3/07 22:41	5/4/07 10:58				
5/3/07	13:00	Mossdale	3910	5/3/07 15:17	5/3/07 21:44	5/4/07 8:24	5/5/07 12:09			5/9/07 06:58, Hwy 4
5/3/07	13:00	Mossdale	3910	5/3/07 15:17	5/3/07 21:44	5/4/07 8:24	5/5/07 12:09			5/9/07 13:27, Tracy
5/3/07	13:00	Mossdale	3917	5/3/07 15:10	5/4/07 0:16					
5/3/07	13:00	Mossdale	3924	5/3/07 22:08	5/4/07 9:16					
5/3/07	13:00	Mossdale	3931	5/3/07 15:14	5/4/07 10:09					
5/3/07	13:00	Mossdale	3938	5/3/07 15:50	5/4/07 10:27			5/12/07 9:25		
5/3/07	13:00	Mossdale	3945	5/3/07 15:52	5/4/07 3:17	5/4/07 11:56				
5/3/07	13:00	Mossdale	3952	5/3/07 15:58	5/3/07 23:02	5/4/07 9:03		5/10/07 11:53		
5/3/07	13:00	Mossdale	3959	5/3/07 17:16	5/4/07 1:51					
5/3/07	13:00	Mossdale	3966	5/3/07 15:29	5/3/07 22:52					
5/3/07	13:00	Mossdale	3973	5/3/07 15:58						
5/3/07	13:00	Mossdale	3980	5/3/07 15:58	5/3/07 23:13					
5/3/07	13:00	Mossdale	3987	5/3/07 17:53						
5/3/07	13:00	Mossdale	3994	5/3/07 15:13						
5/3/07	13:00	Mossdale	4001	5/3/07 15:57	5/3/07 22:05	5/4/07 10:53				
5/3/07	13:00	Mossdale	4008	5/3/07 15:28	5/4/07 13:16	5/4/07 16:48				
5/3/07	13:00	Mossdale	4015	5/3/07 22:05	5/4/07 5:29	5/4/07 14:38	5/7/07 22:47			
5/3/07	13:00	Mossdale	4022	5/3/07 16:14	5/3/07 23:32					
5/3/07	13:00	Mossdale	4029	5/3/07 16:31	5/4/07 1:13					
5/3/07	13:00	Mossdale	4036	5/3/07 14:48						
5/3/07	13:00	Mossdale	4043	5/3/07 17:01	5/3/07 23:42					
5/3/07	13:00	Mossdale	4050	5/3/07 18:22	5/4/07 2:02					
5/3/07	13:00	Mossdale	4057	5/3/07 14:49	5/3/07 19:42	5/4/07 10:05				
5/3/07	13:00	Mossdale	4064	5/3/07 15:29	5/4/07 10:00	5/4/07 17:35				
5/3/07	13:00	Mossdale	4071	5/3/07 15:41	5/3/07 21:51	5/4/07 10:06				
5/3/07	13:00	Mossdale	4078	5/3/07 16:43	5/4/07 0:42	5/4/07 10:35				
5/3/07	13:00	Mossdale	4092	5/3/07 15:59						
5/3/07	13:00	Mossdale	4099	5/3/07 19:43	5/4/07 14:00					
5/3/07	13:00	Mossdale	4106	5/3/07 15:57	5/4/07 0:25	5/4/07 10:15				
5/3/07	13:00	Mossdale	4120	5/3/07 21:30	5/4/07 3:40			5/9/07 6:21		
5/3/07	13:00	Mossdale	4127	5/3/07 15:17	5/4/07 0:04	5/4/07 10:13				
5/3/07	13:00	Mossdale	4134	5/3/07 16:45						
5/3/07	13:00	Mossdale	4141	5/3/07 15:59	5/5/07 6:03					
5/3/07	13:00	Mossdale	4148	5/3/07 17:05	5/4/07 12:37			5/11/07 18:58		
5/3/07	13:00	Mossdale	4155	5/3/07 15:50						
5/3/07	13:00	Mossdale	4162	5/3/07 15:58	5/5/07 4:12					
5/3/07	13:00	Mossdale	4169	5/3/07 15:47	5/3/07 22:23					
5/3/07	13:00	Mossdale	4176	5/3/07 15:31	5/3/07 21:26	5/4/07 9:03			5/17-18,Tag Not Moving	
5/3/07	13:00	Mossdale	4183	5/3/07 17:41	5/4/07 0:37		5/5/07 7:20			
5/3/07	13:00	Mossdale	4190	5/3/07 23:38						
5/3/07	13:00	Mossdale	4197	5/3/07 15:19	5/4/07 9:33					
5/3/07	13:00	Mossdale	4204	5/3/07 15:10	5/3/07 20:12	5/4/07 9:06				
5/3/07	13:00	Mossdale	4211	5/3/07 15:46	5/3/07 21:19					
5/3/07	13:00	Mossdale	4218	5/3/07 16:04	5/4/07 0:58	5/5/07 17:38				
5/3/07	13:00	Mossdale	4225	5/3/07 15:52	5/4/07 0:42					
5/3/07	13:00	Mossdale	4232	5/3/07 19:28	5/4/07 1:47	5/4/07 10:35				
5/3/07	13:00	Mossdale	4239	5/3/07 17:14	5/5/07 9:53					
5/3/07	13:00	Mossdale	4246	5/3/07 21:12	5/4/07 7:10					
5/3/07	13:00	Mossdale	4253	5/3/07 15:58	5/3/07 21:57					

continued on following page

Appendix C-4
Detections of acoustic-tagged salmon from May 3 & 4 releases upstream of the Head of Old River Barrier.

Release Dates: May 3 and May 4, 2007 Relase Locations: Durham Ferry, Mossdale, Bowman Road, Stockton

									Mobile Monitoring	
Release Date	Release Time	Release Site	Tag Code	Upstream of HORB Date/Time	Bowman Road Date/Time	Stockton Date/Time	Turner cut Date/Time	R16 Date/Time	Near Stockton Date/Comment	Other Locations Date/Comment
5/3/07	13:00	Mossdale	4260	5/3/07 15:27	5/3/07 22:08					
5/3/07	13:00	Mossdale	4267	5/3/07 15:40						
5/3/07	13:00	Mossdale	4274	5/3/07 18:16	5/4/07 9:37			5/9/07 4:38		
5/3/07	13:00	Mossdale	4281	5/3/07 15:27	5/3/07 22:09	5/4/07 10:36				
5/3/07	13:00	Mossdale	4288	5/3/07 15:33	5/3/07 22:19	5/4/07 8:22				
5/3/07	13:00	Mossdale	4302	5/3/07 18:38						
5/3/07	13:00	Mossdale	4309	5/3/07 18:56	5/4/07 13:03					
5/3/07	13:00	Mossdale	4316	5/3/07 16:09						
5/3/07	13:00	Mossdale	4323	5/3/07 16:27	5/3/07 23:25					
5/3/07	13:00	Mossdale	4330	5/3/07 15:04	5/4/07 0:28					
5/3/07	13:00	Mossdale	4337	5/3/07 15:54	5/3/07 23:22	5/4/07 9:11				
5/3/07	13:00	Mossdale	4344	5/3/07 15:10	5/3/07 23:49					
5/3/07	13:00	Mossdale	4351	5/3/07 14:57	5/3/07 22:05					
5/3/07	13:00	Mossdale	4358	5/3/07 16:20	5/3/07 23:25					
5/3/07	13:00	Mossdale	4365	5/3/07 17:01						
5/3/07	13:00	Mossdale	4372	5/3/07 15:59	5/3/07 23:20					
5/3/07	13:00	Mossdale	4379	5/3/07 15:51	5/3/07 23:15		5/7/07 11:30			
5/3/07	13:00	Mossdale	4386	5/3/07 15:57	5/4/07 1:36	5/4/07 11:47		5/9/07 17:40		
5/3/07	13:00	Mossdale	4393	5/3/07 16:23	5/4/07 9:42					
5/3/07	12:15	Bowman Rd.	5107			5/4/07 18:26				
5/3/07	12:15	Bowman Rd.	5142			5/4/07 18:59				
5/3/07	12:15	Bowman Rd.	5156			5/4/07 16:26				
5/3/07	12:15	Bowman Rd.	5163						5/17-18,Tag Not Moving	
5/3/07	12:15	Bowman Rd.	5177			5/5/07 9:56				
5/3/07	12:15	Bowman Rd.	5184			5/4/07 15:42				
5/3/07	12:15	Bowman Rd.	5196						5/17-18,Tag Not Moving	
5/3/07	12:15	Bowman Rd.	5198			5/6/07 21:20				
5/3/07	12:15	Bowman Rd.	5205			5/4/07 19:59				
5/3/07	12:15	Bowman Rd.	5219						5/17-18,Tag Not Moving	
5/3/07	12:15	Bowman Rd.	5233			5/4/07 16:19				
5/3/07	12:15	Bowman Rd.	5240			5/4/07 15:30				
5/3/07	12:15	Bowman Rd.	5247			5/4/07 18:25				
5/3/07	12:15	Bowman Rd.	5254			5/4/07 16:13				
5/3/07	12:15	Bowman Rd.	5261					5/6/07 7:21		
5/3/07	12:15	Bowman Rd.	5268			5/4/07 16:55				
5/3/07	12:15	Bowman Rd.	5282			5/4/07 15:41				
5/3/07	12:15	Bowman Rd.	5303			5/4/07 17:22				
5/3/07	12:15	Bowman Rd.	5317			5/4/07 17:00				
5/3/07	12:15	Bowman Rd.	5331			5/4/07 16:00				
5/3/07	12:15	Bowman Rd.	5352			5/4/07 19:58				
5/3/07	12:15	Bowman Rd.	5359					5/8/07 15:37		
5/3/07	12:15	Bowman Rd.	5373			5/4/07 19:33				
5/3/07	12:15	Bowman Rd.	5387			5/6/07 5:42				
5/3/07	12:15	Bowman Rd.	5401			5/4/07 18:41	5/7/07 17:09			
5/3/07	12:15	Bowman Rd.	5408			5/6/07 21:20			5/17-18,Tag Not Moving	
5/3/07	12:15	Bowman Rd.	5429					5/9/07 19:15		
5/3/07	12:15	Bowman Rd.	5527			5/4/07 18:12				
5/3/07	12:15	Bowman Rd.	5548			5/4/07 18:45				
5/3/07	12:15	Bowman Rd.	5583			5/4/07 16:04		5/8/07 20:28		
5/3/07	12:15	Bowman Rd.	5618			5/4/07 19:19				
5/3/07	12:15	Bowman Rd.	5632			5/4/07 16:38			5/17-18,Tag Not Moving	
5/3/07	12:15	Bowman Rd.	5688			5/4/07 16:36				
5/3/07	12:15	Bowman Rd.	5716			5/4/07 16:36				
5/3/07	12:15	Bowman Rd.	5751			5/4/07 17:17		5/9/07 13:00		
5/3/07	12:15	Bowman Rd.	5765			5/4/07 19:18				
5/3/07	12:15	Bowman Rd.	5786			5/4/07 18:48				
5/4/07	12:51	Stockton	5800				5/7/07 3:22			
5/4/07	12:51	Stockton	5898				5/6/07 8:22			
5/4/07	12:51	Stockton	6381				5/6/07 10:57			
5/4/07	12:51	Stockton	5912					5/9/07 6:31		
5/4/07	12:51	Stockton	5919					5/8/07 22:20		
5/4/07	12:51	Stockton	6003					5/9/07 17:07		
5/4/07	12:51	Stockton	6031					5/8/07 17:42		
5/4/07	12:51	Stockton	6038						5/17-18,Tag Not Moving	
5/4/07	12:51	Stockton	6059					5/8/07 21:25		
5/4/07	12:51	Stockton	6122					5/8/07 15:34		
5/4/07	12:51	Stockton	6171					5/9/07 7:28		
5/4/07	12:51	Stockton	6022						5/17-18,Tag Not Moving	
5/4/07	12:51	Stockton	6262						5/17-18,Tag Not Moving	
5/4/07	12:51	Stockton	6269						5/17-18,Tag Not Moving	
5/4/07	12:51	Stockton	6276						5/17-18,Tag Not Moving	
5/4/07	12:51	Stockton	6311					5/10/07 18:38		
5/4/07	12:51	Stockton	6367						5/17-18,Tag Not Moving	
5/4/07	12:51	Stockton	6458					5/8/07 21:25		

Appendix C-5
Detections of acoustic-tagged salmon released May 4 downstream of the Head of Old River Barrier.

Release Date: May 4, 2007				Release Location: Old River downtstream of HORB			
Release Date	Release Time	Release Site	Tag Code	Tracy Fish Facilities Date/Time	Clifton Court Inlet Date/Time	Skinner Fish Facilities Date/Time	Old River at Hwy 4 Date/Time
5/4/07	10:17	D/S of HORB	4400	5/6/07 6:04	5/9/07 5:47		
5/4/07	10:17	D/S of HORB	4407				5/6/07 18:40
5/4/07	10:17	D/S of HORB	4449	5/10/07 11:14	5/7/07 3:54		
5/4/07	10:17	D/S of HORB	4456				5/14/07 12:29
5/4/07	10:17	D/S of HORB	4477		5/6/07 13:10		
5/4/07	10:17	D/S of HORB	4505	5/10/07 0:26			
5/4/07	10:17	D/S of HORB	4512	5/5/07 23:07			
5/4/07	10:17	D/S of HORB	4519				5/11/07 5:14
5/4/07	10:17	D/S of HORB	4526				5/9/07 20:09
5/4/07	10:17	D/S of HORB	4547				5/7/07 15:03
5/4/07	10:17	D/S of HORB	4561	5/9/07 6:16			
5/4/07	10:17	D/S of HORB	4568		5/6/07 12:18		
5/4/07	10:17	D/S of HORB	4610	5/11/07 1:42			5/8/07 19:46
5/4/07	10:17	D/S of HORB	4617	5/7/07 14:02			
5/4/07	10:17	D/S of HORB	4631	5/9/07 6:51			5/7/07 18:14
5/4/07	10:17	D/S of HORB	4645				5/6/07 12:20
5/4/07	10:17	D/S of HORB	4659	5/8/07 1:26			
5/4/07	10:17	D/S of HORB	4673	5/9/07 12:38	5/7/07 4:29		5/6/07 16:20
5/4/07	10:17	D/S of HORB	4694				5/6/07 14:16
5/4/07	10:17	D/S of HORB	4701	5/8/07 0:40			5/7/07 15:18
5/4/07	10:17	D/S of HORB	4708	5/9/07 7:24			
5/4/07	10:17	D/S of HORB	4715	5/6/07 6:56			5/8/07 16:50
5/4/07	10:17	D/S of HORB	4722	5/5/07 23:13			5/6/07 16:44
5/4/07	10:17	D/S of HORB	4743		5/6/07 2:26	5/7/07 9:00	
5/4/07	10:17	D/S of HORB	4771	5/16/07 16:46			
5/4/07	10:17	D/S of HORB	4757		5/6/07 13:08		
5/4/07	10:17	D/S of HORB	4785		5/8/07 4:48	5/9/07 20:09	5/7/07 17:23
5/4/07	10:17	D/S of HORB	4799		5/9/07 5:48		
5/4/07	10:17	D/S of HORB	4834				5/7/07 10:31
5/4/07	10:17	D/S of HORB	4841		5/7/07 4:45		
5/4/07	10:17	D/S of HORB	4848		5/6/07 13:37		
5/4/07	10:17	D/S of HORB	4855	5/9/07 14:24			
5/4/07	10:17	D/S of HORB	4862				5/7/07 17:41
5/4/07	10:17	D/S of HORB	4869		5/6/07 11:49		
5/4/07	10:17	D/S of HORB	4883		5/6/07 2:52	5/9/07 7:50	
5/4/07	10:17	D/S of HORB	4897		5/8/07 4:18		
5/4/07	10:17	D/S of HORB	4904	5/7/07 11:37			
5/4/07	10:17	D/S of HORB	4932	5/6/07 5:40	5/9/07 5:54		5/8/07 18:08
5/4/07	10:17	D/S of HORB	4939	5/7/07 12:01			
5/4/07	10:17	D/S of HORB	4946				5/7/07 5:09
5/4/07	10:17	D/S of HORB	4988		5/6/07 13:11	5/7/07 6:18	
5/4/07	10:17	D/S of HORB	4995	5/5/07 19:58			5/6/07 15:03
5/4/07	10:17	D/S of HORB	5002		5/6/07 12:14		
5/4/07	10:17	D/S of HORB	5009				5/6/07 19:47
5/4/07	10:17	D/S of HORB	5016				5/7/07 14:00
5/4/07	10:17	D/S of HORB	5044	5/7/07 12:18			
5/4/07	10:17	D/S of HORB	5051	5/12/07 18:13			5/7/07 18:13
5/4/07	10:17	D/S of HORB	5065		5/7/07 13:20		
5/4/07	10:17	D/S of HORB	5072		5/7/07 14:15		5/6/07 15:43

Appendix C-6
Detections of acoustic-tagged salmon from May 10 & 11 releases upstream of the Head of Old River Barrier.

Release Dates: May 10 and May 11, 2007 Relase Locations: Durham Ferry, Mossdale, Bowman Road, Stockton

									Mobile Monitoring	
Release Date	Release Time	Release Site	Tag Code	Upstream of HORB Date/Time	Bowmand Road Date/Time	Stockton Date/Time	Turner Cut Date/Time	R16 Date/Time	Near Stockton Date/Comment	Other Locations Date/Comment
5/10/07	11:40	Durham Ferry	3003	5/10/07 23:05						
5/10/07	11:40	Durham Ferry	3010					5/13/07 13:51		
5/10/07	11:40	Durham Ferry	3017						5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3031						5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3038	5/11/07 1:55	5/11/07 8:05	5/11/07 23:09			5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3045	5/11/07 13:15	5/11/07 20:31				5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3052	5/11/07 3:51	5/11/07 14:16	5/11/07 19:10			5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3059	5/11/07 9:29	5/11/07 18:26				5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3066	5/11/07 8:14						
5/10/07	11:40	Durham Ferry	3073	5/11/07 4:22	5/11/07 10:32	5/11/07 14:38				
5/10/07	11:40	Durham Ferry	3080	5/11/07 1:58	5/11/07 8:15	5/13/07 0:04			5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3087	5/11/07 1:23	5/11/07 11:29				5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3094						5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3101	5/11/07 11:24					5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3108	5/11/07 4:34	5/11/07 11:34				5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3115						5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3122	5/11/07 8:38						
5/10/07	11:40	Durham Ferry	3129	5/11/07 9:04	5/11/07 16:12				5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3136	5/11/07 1:27						
5/10/07	11:40	Durham Ferry	3143	5/11/07 7:07	5/11/07 12:25					
5/10/07	11:40	Durham Ferry	3150						5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3157						5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3171	5/11/07 1:29					5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3185						5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3192	5/11/07 0:20	5/11/07 8:35				5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3199	5/11/07 5:10						
5/10/07	11:40	Durham Ferry	3206					5/13/07 19:41		
5/10/07	11:40	Durham Ferry	3213	5/11/07 11:02	5/11/07 22:32			5/13/07 9:11		
5/10/07	11:40	Durham Ferry	3220	5/11/07 15:02						
5/10/07	11:40	Durham Ferry	3227	5/11/07 14:43	5/11/07 20:34			5/14/07 11:01		
5/10/07	11:40	Durham Ferry	3262	5/11/07 6:11	5/11/07 12:14					
5/10/07	11:40	Durham Ferry	3269	5/11/07 6:04						
5/10/07	11:40	Durham Ferry	3276	5/11/07 0:36	5/11/07 9:18					
5/10/07	11:40	Durham Ferry	3290	5/10/07 21:40						
5/10/07	11:40	Durham Ferry	3297	5/11/07 3:35	5/11/07 12:34				5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3311	5/11/07 0:01						
5/10/07	11:40	Durham Ferry	3332	5/11/07 1:06	5/11/07 7:39					
5/10/07	11:40	Durham Ferry	3339	5/11/07 4:57	5/11/07 13:00			5/13/07 9:29		
5/10/07	11:40	Durham Ferry	3360	5/11/07 3:27	5/11/07 16:12					
5/10/07	11:40	Durham Ferry	3367	5/11/07 2:11	5/11/07 9:16					
5/10/07	11:40	Durham Ferry	3374	5/11/07 0:49						
5/10/07	11:40	Durham Ferry	3381	5/11/07 1:54						
5/10/07	11:40	Durham Ferry	3409	5/11/07 2:19	5/11/07 8:43					
5/10/07	11:40	Durham Ferry	3437	5/11/07 5:00	5/11/07 10:54					
5/10/07	11:40	Durham Ferry	3444	5/11/07 1:17						
5/10/07	11:40	Durham Ferry	3465	5/11/07 9:00	5/11/07 14:38					
5/10/07	11:40	Durham Ferry	3472	5/11/07 8:52	5/11/07 18:00	5/11/07 21:47				
5/10/07	11:40	Durham Ferry	3493	5/11/07 5:31	5/11/07 11:22	5/12/07 17:13				
5/10/07	11:40	Durham Ferry	3500	5/11/07 11:29	5/11/07 18:23	5/12/07 8:58		5/13/07 19:03		
5/10/07	11:40	Durham Ferry	3507	5/11/07 3:39	5/11/07 10:28					
5/10/07	11:40	Durham Ferry	3521	5/11/07 8:29	5/11/07 13:34			5/13/07 18:03		
5/10/07	11:40	Durham Ferry	3535	5/11/07 10:17	5/11/07 17:32	5/12/07 8:25				
5/10/07	11:40	Durham Ferry	3549	5/11/07 14:41						
5/10/07	11:40	Durham Ferry	3556	5/10/07 23:05						
5/10/07	11:40	Durham Ferry	3577	5/11/07 8:03						
5/10/07	11:40	Durham Ferry	3584	5/11/07 11:44	5/11/07 19:12					
5/10/07	11:40	Durham Ferry	3591	5/11/07 4:47	5/11/07 19:08	5/12/07 2:41				
5/10/07	11:40	Durham Ferry	3598	5/11/07 8:54						
5/10/07	11:40	Durham Ferry	3612	5/11/07 4:32						
5/10/07	11:40	Durham Ferry	3619	5/10/07 21:29	5/11/07 3:04					
5/10/07	11:40	Durham Ferry	3633	5/11/07 7:33	5/11/07 13:49		5/13/07 8:06	5/12/07 19:05		
5/10/07	11:40	Durham Ferry	3640	5/11/07 0:41	5/11/07 8:21				5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3668	5/11/07 4:46						
5/10/07	11:40	Durham Ferry	3689	5/11/07 2:00	5/11/07 8:01				5/17-18, Tag Not Moving	
5/10/07	11:40	Durham Ferry	3696	5/11/07 10:16	5/11/07 21:46					
5/10/07	12:30	Mossdale	3703	5/10/07 16:24	5/10/07 21:30	5/11/07 5:12				
5/10/07	12:30	Mossdale	3710	5/10/07 16:54	5/10/07 21:32	5/11/07 5:25				
5/10/07	12:30	Mossdale	3717	5/10/07 15:06						
5/10/07	12:30	Mossdale	3724	5/10/07 18:57	5/11/07 0:12				5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	3731	5/10/07 16:27						
5/10/07	12:30	Mossdale	3738	5/10/07 15:17	5/10/07 19:18			5/13/07 20:21		
5/10/07	12:30	Mossdale	3745	5/10/07 15:45	5/11/07 7:08		5/12/07 15:19			
5/10/07	12:30	Mossdale	3752	5/10/07 17:40						
5/10/07	12:30	Mossdale	3759	5/10/07 18:52	5/11/07 12:12					
5/10/07	12:30	Mossdale	3766	5/10/07 15:41	5/10/07 19:22					
5/10/07	12:30	Mossdale	3773	5/10/07 15:16	5/10/07 22:47					
5/10/07	12:30	Mossdale	3780	5/10/07 18:01	5/11/07 0:06		5/15/07 17:23	5/13/07 8:26		
5/10/07	12:30	Mossdale	3787	5/10/07 16:53	5/10/07 21:06					
5/10/07	12:30	Mossdale	3794	5/10/07 16:26						
5/10/07	12:30	Mossdale	3801	5/10/07 17:56	5/11/07 6:01	5/11/07 10:50	5/12/07 1:42			5/14/07, Hwy 4
5/10/07	12:30	Mossdale	3808	5/10/07 16:13	5/10/07 20:25					
5/10/07	12:30	Mossdale	3815	5/10/07 15:29						
5/10/07	12:30	Mossdale	3822	5/10/07 15:07	5/10/07 19:00	5/11/07 5:22			5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	3829	5/10/07 16:26	5/10/07 20:08					
5/10/07	12:30	Mossdale	3836	5/10/07 16:00	5/10/07 23:29				5/17-18, Tag Not Moving	

continued on following page

Appendix C-6
Detections of acoustic-tagged salmon from May 10 & 11 releases upstream of the Head of Old River Barrier.

Release Dates: May 10 and May 11, 2007 Relase Locations: Durham Ferry, Mossdale, Bowman Road, Stockton

									Mobile Monitoring	
Release Date	Release Time	Release Site	Tag Code	Upstream of HORB Date/Time	Bowmand Road Date/Time	Stockton Date/Time	Turner Cut Date/Time	R16 Date/Time	Near Stockton Date/Comment	Other Locations Date/Comment
5/10/07	12:30	Mossdale	3843	5/10/07 16:19						
5/10/07	12:30	Mossdale	3850	5/10/07 17:28	5/12/07 4:53					
5/10/07	12:30	Mossdale	3857	5/10/07 15:57	5/10/07 19:31					
5/10/07	12:30	Mossdale	3871	5/10/07 16:16	5/11/07 3:12					
5/10/07	12:30	Mossdale	3878	5/10/07 17:06	5/11/07 6:24					
5/10/07	12:30	Mossdale	3885	5/10/07 16:54	5/10/07 22:06	5/11/07 8:04				
5/10/07	12:30	Mossdale	3892	5/10/07 16:00	5/10/07 20:01	5/11/07 5:46			5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	3899	5/10/07 15:42	5/10/07 19:22	5/11/07 5:09		5/13/07 20:34		
5/10/07	12:30	Mossdale	3906	5/10/07 16:43	5/10/07 21:01	5/11/07 4:55				
5/10/07	12:30	Mossdale	3913	5/10/07 15:16	5/10/07 20:15	5/11/07 2:57	5/13/07 15:12	5/12/07 19:28		
5/10/07	12:30	Mossdale	3920	5/10/07 17:01						
5/10/07	12:30	Mossdale	3927	5/10/07 17:40	5/11/07 5:40			5/13/07 12:01		
5/10/07	12:30	Mossdale	3934	5/10/07 16:50	5/10/07 22:35	5/11/07 6:20			5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	3948	5/10/07 16:47						
5/10/07	12:30	Mossdale	3955	5/10/07 16:54	5/10/07 21:30					
5/10/07	12:30	Mossdale	3962	5/10/07 15:57	5/10/07 19:28					
5/10/07	12:30	Mossdale	3969	5/10/07 16:46	5/10/07 21:42					
5/10/07	12:30	Mossdale	3976	5/10/07 15:43	5/10/07 19:53					
5/10/07	12:30	Mossdale	3983	5/10/07 15:39	5/10/07 19:55	5/11/07 7:06				
5/10/07	12:30	Mossdale	3990	5/10/07 18:41	5/11/07 0:50	5/11/07 11:02				
5/10/07	12:30	Mossdale	3997	5/10/07 17:34	5/11/07 0:42					
5/10/07	12:30	Mossdale	4004	5/10/07 16:54						
5/10/07	12:30	Mossdale	4011	5/10/07 17:54	5/11/07 3:39				5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	4018	5/10/07 17:21	5/10/07 21:41	5/11/07 5:40				
5/10/07	12:30	Mossdale	4025	5/10/07 17:21						
5/10/07	12:30	Mossdale	4032	5/10/07 17:07	5/10/07 22:41				5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	4039	5/10/07 16:39	5/10/07 22:08					
5/10/07	12:30	Mossdale	4046	5/10/07 15:07	5/10/07 19:17	5/12/07 13:50				
5/10/07	12:30	Mossdale	4053	5/10/07 18:56	5/11/07 1:01	5/11/07 15:10		5/13/07 12:04		
5/10/07	12:30	Mossdale	4060	5/10/07 15:28	5/10/07 19:47					
5/10/07	12:30	Mossdale	4074	5/10/07 15:06	5/10/07 20:08					
5/10/07	12:30	Mossdale	4081	5/10/07 17:16	5/10/07 21:36	5/11/07 7:37			5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	4088	5/10/07 15:28						
5/10/07	12:30	Mossdale	4095	5/10/07 15:51	5/11/07 4:40				5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	4102	5/10/07 16:25	5/10/07 20:32				5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	4109	5/10/07 16:08			5/13/07 6:09	5/12/07 21:04		
5/10/07	12:30	Mossdale	4116	5/10/07 15:00						
5/10/07	12:30	Mossdale	4123	5/10/07 15:21	5/10/07 19:45		5/13/07 1:06			
5/10/07	12:30	Mossdale	4130	5/10/07 18:51	5/13/07 0:35					
5/10/07	12:30	Mossdale	4137	5/10/07 15:15	5/10/07 19:56	5/11/07 8:03			5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	4144	5/10/07 17:22	5/10/07 21:56	5/11/07 20:11				
5/10/07	12:30	Mossdale	4151	5/10/07 16:33	5/10/07 20:43	5/11/07 23:35				
5/10/07	12:30	Mossdale	4158	5/10/07 15:58	5/10/07 19:29					
5/10/07	12:30	Mossdale	4165	5/10/07 15:01						
5/10/07	12:30	Mossdale	4179	5/10/07 16:54	5/10/07 21:50	5/11/07 5:57				
5/10/07	12:30	Mossdale	4186	5/10/07 16:00	5/10/07 21:35	5/11/07 6:09			5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	4193	5/10/07 15:39	5/14/07 19:48					
5/10/07	12:30	Mossdale	4200	5/10/07 15:57	5/10/07 19:29					
5/10/07	12:30	Mossdale	4207	5/10/07 18:01						
5/10/07	12:30	Mossdale	4214	5/10/07 17:00	5/10/07 23:24			5/14/07 22:43		
5/10/07	12:30	Mossdale	4221	5/10/07 15:41	5/10/07 19:45				5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	4228	5/10/07 15:40	5/10/07 20:05	5/11/07 4:52				
5/10/07	12:30	Mossdale	4235	5/10/07 15:39	5/10/07 20:29			5/13/07 20:55		
5/10/07	12:30	Mossdale	4242	5/10/07 15:06	5/10/07 19:43	5/11/07 4:48				
5/10/07	12:30	Mossdale	4249	5/10/07 16:54	5/10/07 21:47	5/11/07 5:47				
5/10/07	12:30	Mossdale	4256	5/10/07 17:01	5/10/07 21:21	5/11/07 4:31				
5/10/07	12:30	Mossdale	4263	5/10/07 18:29	5/11/07 0:02	5/13/07 1:18				
5/10/07	12:30	Mossdale	4270	5/10/07 16:42	5/10/07 21:57	5/11/07 10:30				
5/10/07	12:30	Mossdale	4277	5/10/07 20:34						
5/10/07	12:30	Mossdale	4284	5/10/07 15:06	5/10/07 20:20	5/12/07 21:11				
5/10/07	12:30	Mossdale	4291	5/10/07 15:07	5/10/07 19:00					
5/10/07	12:30	Mossdale	4298	5/10/07 15:57	5/10/07 19:34					
5/10/07	12:30	Mossdale	4305	5/10/07 15:05	5/10/07 21:32	5/11/07 7:00			5/17-18, Tag Not Moving	
5/10/07	12:30	Mossdale	4312	5/10/07 15:21	5/11/07 3:35					
5/10/07	12:30	Mossdale	4319	5/10/07 15:36	5/11/07 0:19		5/14/07 2:25			
5/10/07	12:30	Mossdale	4326	5/10/07 15:28	5/10/07 19:55					
5/10/07	12:30	Mossdale	4333	5/10/07 16:54	5/11/07 2:47					
5/10/07	12:30	Mossdale	4340	5/10/07 15:33	5/11/07 5:24			5/13/07 12:27		
5/10/07	12:30	Mossdale	4347	5/10/07 16:54	5/10/07 22:09	5/11/07 10:29		5/13/07 9:18		
5/10/07	12:30	Mossdale	4354	5/10/07 16:43	5/10/07 20:30			5/16/07 11:48		
5/10/07	12:30	Mossdale	4361	5/10/07 16:34						
5/10/07	12:30	Mossdale	4368	5/10/07 16:54	5/10/07 21:45	5/11/07 5:52		5/11/07 18:16		
5/10/07	12:30	Mossdale	4375	5/10/07 15:28	5/10/07 19:47	5/11/07 5:01				
5/10/07	12:30	Mossdale	4382	5/10/07 17:51						
5/10/07	12:30	Mossdale	4396	5/10/07 16:33						
5/11/07	12:05	Bowman Rd.	5110			5/11/07 18:41			5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5117			5/19/07 21:47			5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5131					5/13/07 20:01		
5/11/07	12:05	Bowman Rd.	5145						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5166			5/11/07 19:02				
5/11/07	12:05	Bowman Rd.	5229			5/11/07 20:08		5/13/07 9:00		
5/11/07	12:05	Bowman Rd.	5243						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5264			5/11/07 23:30				
5/11/07	12:05	Bowman Rd.	5285			5/15/07 20:50			5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5313						5/17-18, Tag Not Moving	

continued on following page

Appendix C-6
Detections of acoustic-tagged salmon from May 10 & 11 releases upstream of the Head of Old River Barrier.

Release Dates: May 10 and May 11, 2007 Relase Locations: Durham Ferry, Mossdale, Bowman Road, Stockton

									Mobile Monitoring	
Release Date	Release Time	Release Site	Tag Code	Upstream of HORB Date/Time	Bowmand Road Date/Time	Stockton Date/Time	Turner Cut Date/Time	R16 Date/Time	Near Stockton Date/Comment	Other Locations Date/Comment
5/11/07	12:05	Bowman Rd.	5327						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5334						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5341				5/14/07 16:03	5/13/07 18:12		
5/11/07	12:05	Bowman Rd.	5348						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5362					5/13/07 21:21		
5/11/07	12:05	Bowman Rd.	5390			5/11/07 18:25			5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5404			5/12/07 23:31				
5/11/07	12:05	Bowman Rd.	5411						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5418					5/14/07 20:24		
5/11/07	12:05	Bowman Rd.	5425					5/12/07 17:04		
5/11/07	12:05	Bowman Rd.	5432			5/11/07 19:43				
5/11/07	12:05	Bowman Rd.	5446			5/11/07 16:16				
5/11/07	12:05	Bowman Rd.	5453						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5460						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5474			5/11/07 15:47	5/13/07 15:59	5/13/07 12:39		
5/11/07	12:05	Bowman Rd.	5481			5/11/07 16:48				
5/11/07	12:05	Bowman Rd.	5502			5/11/07 15:47			5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5516					5/13/07 19:32		
5/11/07	12:05	Bowman Rd.	5523			5/11/07 22:04				
5/11/07	12:05	Bowman Rd.	5530						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5537					5/12/07 20:55		
5/11/07	12:05	Bowman Rd.	5544						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5565			5/15/07 3:45				
5/11/07	12:05	Bowman Rd.	5579						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5593			5/12/07 15:30				
5/11/07	12:05	Bowman Rd.	5600			5/11/07 18:14			5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5614					5/13/07 9:36		
5/11/07	12:05	Bowman Rd.	5628			5/11/07 18:20				
5/11/07	12:05	Bowman Rd.	5642			5/13/07 3:45			5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5663			5/11/07 19:43			5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5698					5/12/07 20:02		
5/11/07	12:05	Bowman Rd.	5677						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5684						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5691						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5705						5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5719			5/13/07 17:24			5/17-18, Tag Not Moving	
5/11/07	12:05	Bowman Rd.	5754			5/13/07 10:06				
5/11/07	12:05	Bowman Rd.	5761			5/11/07 19:51				
5/11/07	12:05	Bowman Rd.	5782			5/12/07 6:02				
5/11/07	12:05	Bowman Rd.	5796			5/17/07 2:36			5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	5803						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	5824						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	5838					5/13/07 19:13		
5/11/07	12:43	Stockton	5845					5/12/07 17:57		
5/11/07	12:43	Stockton	5873						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	5901						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	5915						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	5936					5/13/07 8:50		
5/11/07	12:43	Stockton	5943						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	5950						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	5971						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	5978					5/12/07 8:16		5/13/07 21:12, Tracy
5/11/07	12:43	Stockton	5985						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	5999						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6020					5/13/07 13:51		
5/11/07	12:43	Stockton	6062						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6083						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6090						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6097						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6111						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6118						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6174						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6181					5/13/07 9:54		
5/11/07	12:43	Stockton	6188						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6195						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6202						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6230						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6251						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6258						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6265						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6293					5/14/07 10:26		
5/11/07	12:43	Stockton	6300						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6307						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6314						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6321				5/13/07 6:25			
5/11/07	12:43	Stockton	6328					5/12/07 19:00		
5/11/07	12:43	Stockton	6342						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6384						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6391						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6405						5/17-18, Tag Not Moving	
5/11/07	12:43	Stockton	6412					5/13/07 19:40		
5/11/07	12:43	Stockton	6419				5/12/07 11:07			

Appendix C-7
Detections of acoustic-tagged salmon released May 11 downstream of the Head of Old River Barrier.

Release Date: May 11, 2007				Release Location: Old River downtstream of HORB			
Release Date	Release Time	Release Site	Tag Code	Tracy Fish Facilities Date/Time	Clifton Court Inlet Date/Time	Skinner Fish Facilities Date/Time	Old River at Hwy 4 Date/Time
5/11/07	11:22	D/S of HORB	4403			5/13/07 15:58	
5/11/07	11:22	D/S of HORB	4424	5/14/07 14:32		5/18/07 16:06	5/13/07 20:41
5/11/07	11:22	D/S of HORB	4431	5/13/07 17:00			
5/11/07	11:22	D/S of HORB	4438	5/13/07 17:19			
5/11/07	11:22	D/S of HORB	4452	5/15/07 17:11			
5/11/07	11:22	D/S of HORB	4466	5/13/07 20:30			
5/11/07	11:22	D/S of HORB	4487			5/14/07 4:48	
5/11/07	11:22	D/S of HORB	4494	5/15/07 14:32			
5/11/07	11:22	D/S of HORB	4501	5/13/07 14:56			
5/11/07	11:22	D/S of HORB	4515	5/14/07 2:15			5/14/07 12:14
5/11/07	11:22	D/S of HORB	4522	5/13/07 14:40			
5/11/07	11:22	D/S of HORB	4529	5/15/07 11:01			
5/11/07	11:22	D/S of HORB	4536				5/13/07 21:50
5/11/07	11:22	D/S of HORB	4543				5/14/07 21:42
5/11/07	11:22	D/S of HORB	4564	5/15/07 1:08			
5/11/07	11:22	D/S of HORB	4585				5/13/07 17:36
5/11/07	11:22	D/S of HORB	4592	5/14/07 0:45			
5/11/07	11:22	D/S of HORB	4599	5/12/07 19:58			
5/11/07	11:22	D/S of HORB	4606	5/13/07 9:25			
5/11/07	11:22	D/S of HORB	4620				5/13/07 18:14
5/11/07	11:22	D/S of HORB	4669	5/13/07 14:51			
5/11/07	11:22	D/S of HORB	4683	5/13/07 0:00			
5/11/07	11:22	D/S of HORB	4704				5/14/07 1:40
5/11/07	11:22	D/S of HORB	4725	5/16/07 2:11			
5/11/07	11:22	D/S of HORB	4746	5/13/07 2:12			
5/11/07	11:22	D/S of HORB	4760	5/14/07 14:28			5/13/07 21:00
5/11/07	11:22	D/S of HORB	4781	5/12/07 19:11			
5/11/07	11:22	D/S of HORB	4802	5/15/07 14:09			
5/11/07	11:22	D/S of HORB	4809	5/18/07 17:34			
5/11/07	11:22	D/S of HORB	4830	5/13/07 11:58			
5/11/07	11:22	D/S of HORB	4837				5/14/07 18:39
5/11/07	11:22	D/S of HORB	4844	5/14/07 1:37			
5/11/07	11:22	D/S of HORB	4879	5/13/07 23:07			
5/11/07	11:22	D/S of HORB	4900	5/15/07 1:00			
5/11/07	11:22	D/S of HORB	4942	5/13/07 18:04			
5/11/07	11:22	D/S of HORB	5033	5/13/07 8:33			
5/11/07	11:22	D/S of HORB	5054	5/13/07 8:09			
5/11/07	11:22	D/S of HORB	5068				5/14/07 6:11
5/11/07	11:22	D/S of HORB	5082	5/14/07 15:08			
5/11/07	11:22	D/S of HORB	5096	5/16/07 18:38			

APPENDIX D

Field Standard Operating Procedure

Surgical Tag Implantation Procedures Used in VAMP Studies

Purpose

To provide guidelines and standard protocols for surgical tagging of juvenile salmonids for VAMP studies.

Area of Applicability

All staff involved in surgical tagging of juvenile salmonids for VAMP studies.

References

Adams, N.S., Rondorf, D.W., Evans, S.D., Kelly, J.E. 1998. Effects of Surgically and Gastrically Implanted Radio Transmitters on Growth and Feeding Behavior of Juvenile Chinook Salmon. Transactions of the American Fisheries Society 127:128-136.

Kelsch, S. W., and B. Shields. 1996. Care and Handling of Sampled Organisms. Fisheries

Techniques, 2nd edition. American Fisheries Society 121-155.

Martinelli, T.L., H.C. Hansel, and R. S. Shively. 1998. Growth and physiological responses to surgical and gastric radio transmitter implantation techniques in subyearling Chinook salmon. Hydrobiologia 371/372: 79-87.

Summerfelt, R. C. and L. S. Smith. 1990. Anesthesia, surgery, and related techniques. Pages 213-272 in C. B. Schreck and P. B. Moyle, editors. Methods for fish biology. American Fisheries Society, Bethesda, Maryland.

Materials Needed

- Thermometer
- YSI 55 dissolved oxygen (DO) meter
- Acoustic tags and acoustic tag equipment
- Chlorhexidine solution (30mL/L D-H2O)
- Saline solution (7g/L D-H2O)
- Tricaine methanesulfonate (MS-222; 100g/L),
- Sodium bicarbonate solution (buffer; 100g/L)
- Stress coat - stock concentration and 25% solution (250mL/L D-H2O)
- 70% ethanol or isopropyl alcohol solution
- 19 L bucket(s) marked at 10 L and clearly labeled 'Anesthesia'
- 19 L perforated recovery buckets (7 L holding capacity)
- 19 L bucket clearly labeled 'Reject' for fish that are not tagged
- Pair of gravity feed containers marked at 10 L, and connected by rubber tubing with in-line shut-off valves – one labeled 'anesthesia' and one labeled 'freshwater'
- Syringes for measuring anesthetic, buffer, and stress coat
- Oxygen delivery system or bubblers
- Dip nets
- Nitrile gloves
- Scale measuring to the nearest 0.1 g
- Large plastic weigh boats
- Measuring board with ruler to the nearest millimeter
- Surgery table (tray with foam pad and groove cut)
- Trays for holding solutions used to disinfect surgical tools
- Needle drivers

- Forceps
- Scalpel handle and blades
- Oxytetracycline (100 mg/mL concentration)
- Pipette (2-20 microliter (_L) volume) and tips
- Sutures (size: 5-0 and 4-0) with an RB-1 needle
- Spray bottles for alcohol
- Timer(s)
- Sharps container
- Datasheets and writing tools

Procedures

1) Collection and Pre-Tag Holding

A. The pre-tag holding period begins once the fish are placed in holding tanks. Prior to tag implantation, the pre-tag holding period should be at least 12-36 h. Fish should not have access to food during the pre-tagging holding period.

B. Each species collected is held in a separate holding tank to reduce stress. Record the species and collection date on each pre-tag holding container.

2) Fish Size Criteria

A. Size of fish tagged is dependent on the type of tag being used. A maximum tag weight to body weight ratio of 5% is used to calculate minimum fish size.

3) Pre-Tag Preparations

A. Environmental conditions

i. Dissolved oxygen (DO): will be measured as percent saturation in a pre- and post-tag holding tank or raceway during each tag session.

1. Measurements will be taken using a YSI model 55 DO meter

2. DO concentrations in pre- and post-tag holding tanks should be between 80% and 130% saturation.

ii. Temperature: will be measured in °C in a pre- and post-tag holding tank during each tag session.

1. Changes in water temperature exceeding 2°C require tempering (Kelsch and Shields 1996). "Tempering" means "to bring to a suitable state by mixing in or adding a usually liquid ingredient". Therefore, prior to exposing fish to a new water source the fish holding temperature and the temperature of the new water source need to be measured to ensure that the difference between the two water sources is ≤ 2°C. If the temperature difference is > 2°C then water in the container holding fish should be tempered at a rate of 0.5°C/15 min until the temperature difference between the two water sources is ≤ 2°C. New source water should be added in small amounts multiple times over 15 min to gradually change the temperature by 0.5°C. Once the temperature difference between the two water sources is ≤ 2°C fish can be transferred to the new water source.

B. Setup of equipment

i. Tags should be programmed and prepared for implantation.

ii. Disinfect all tags in chlorhexidine solution and thoroughly rinse in saline. Line tags up near the surgery table.

iii. Prepare surgical table and equipment for use.

iv. Setup measuring board and scale

1. Ensure the scale is functioning properly. Scales should be calibrated at the start of the season, checked each week for accuracy, and recalibrated as necessary.

2. Put approximately 1-2 mL of diluted stress coat on the weigh boat and the measuring board.

C. Recovery buckets must be filled with untreated river water and supplied with oxygen or a bubbler just prior to tagging. The concentration of DO in recovery buckets should be between 120 and 150% saturation.

D. Administration of anesthetic: The effectiveness of MS-222 as an anesthetic varies with factors such as temperature and fish density. Adjustments of the anesthesia concentration should be based on the amount of time it takes for a fish to lose equilibrium (induction time).

i. Fill the anesthesia bucket with 10 L of untreated river water. As a starting concentration, add 7 mL (1 mL= 1 cc) of MS-222 stock solution. This will yield an anesthetic concentration of 70 mg/L.

ii. Fill both gravity feed containers with 10 L of untreated river water. Add 2 mL of MS-222 stock solution to the container marked anesthesia. This will yield an anesthetic concentration of 20 mg/L.

iii. For each mL of MS-222 added to a container, add the same amount of bicarbonate solution (buffer).

iv. Water in all containers (anesthesia and gravity feed) should be changed periodically to minimize dilution of anesthesia water and temperature changes and to ensure you do not run out of water during a surgery.

v. Add a small amount of diluted stress coat for each liter of water in the anesthesia, gravity feed, and recovery containers to protect fish from loss/damage to the slime layer.

vi. Containers should be filled and prepared just prior to tagging to avoid temperature changes.

4) Implantation of Tags

A. Anesthetizing fish

i. Net one fish from the pre-tag holding source and place directly into an anesthesia bucket. Secure the lid as soon as the fish is in the bucket. Start a timer to keep track of how long a fish has been in the anesthesia bucket.

1. Time of sedation for a fish should normally be 2 - 4 minutes, with an average time of about 3 minutes. If loss of equilibrium takes less than 1 min or greater than 5 min, reject that fish. If after sedating a few fish, they are consistently losing equilibrium in more or less time than typical, adjust the concentration of the anesthetic (up or down) in 0.5 ml increments of stock MS-222 solution.

2. Remove the lid after one minute to observe the fish for loss of equilibrium. Once the fish loses equilibrium, visually screen the fish for tags, fin clips, fungus, disease, descaling, bloated belly, or any obvious abnormalities. Make sure to keep the fish submerged during this examination. Relay any information to the data recorder.

3. Keep the fish in the water for an additional 30 - 60 sec after it has lost equilibrium.

4. Rejects - If the fish is unacceptable for tagging, place the fish in the bucket labeled Rejects, and relay the information to the data recorder.

B. Recording fish length and weight

i. Transfer the fish to the scale and weigh the fish to the nearest 0.1 g.

ii. Transfer the fish to the measuring board and measure the fork length to the nearest millimeter (mm).

iii. Data must be vocally relayed to the data recorder to avoid data errors. The data recorder should then record this information and repeat numbers back to avoid any miscommunication.

iv. Any fish that is dropped on the floor during this process must be rejected. A fish dropped on the table during surgery may still be tagged. If a fish is dropped on the floor after it is tagged, remove the tag and reject the fish.

C. Surgery

i. Place the fish on the surgery table ventral side up. Anesthesia should be administered through the gravity feed tubing as soon as the fish is on the surgery table. The tubing must be placed just inside the mouth so the water flows across the gills. If the flow is too low, the fish will flare its opercula and become agitated. Adjust the flow so that the gilling rate of the fish is steady. Use the in-line valve to control the flow of anesthesia, fresh water, or a mixture of both. Start with a constant flow of anesthesia and monitor the condition of the fish.

ii. Using a scalpel, make an incision, approximately 5 mm in length (dependent on tag size), about 3 mm away from and parallel to the mid-ventral line. Start your incision a few millimeters in front of the pelvic girdle, approximately 20% of the distance from the base of the pelvic fins to the base of the pectoral fins, and draw the blade toward the head of the fish. (For example, in Figure 1, the distance between the base of the pelvic and pectoral fins is ~45 mm, so the incision should start ~9 mm in front of the base of the pelvic fins.) The incision should be just deep enough to penetrate the peritoneum (the thin membrane separating the gut cavity from the musculature), avoiding the internal organs. The spleen is generally near the incision point, so pay close attention to the depth of the incision. Refer to Figure 1 for location of internal organs and Figure 2 for placement of incision. Avoid getting anesthesia water in the incision.

Figure 1
Lateral view of a juvenile salmonid, showing the location of internal organs.

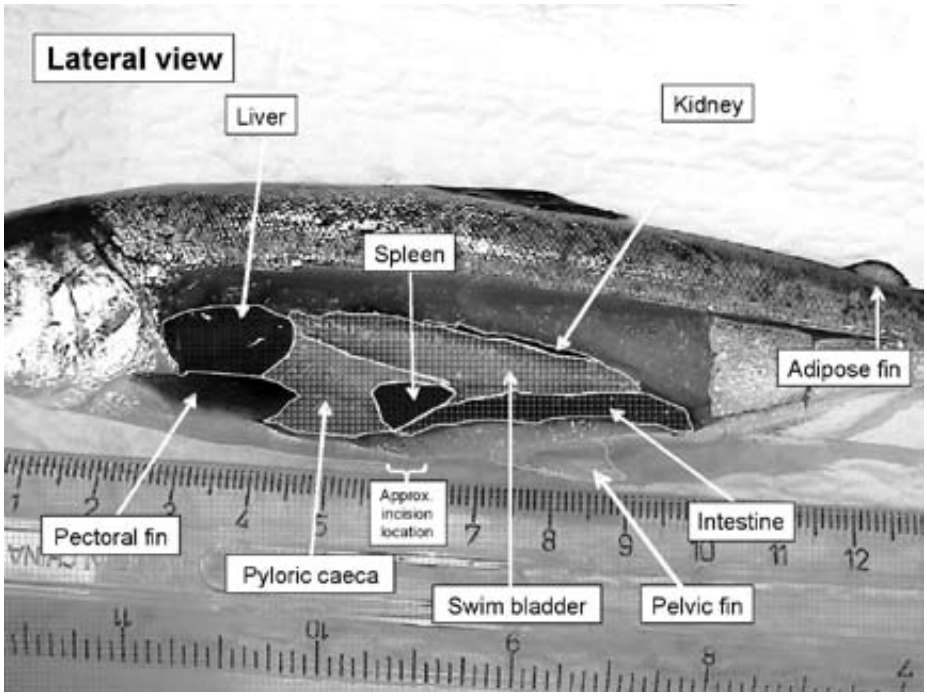
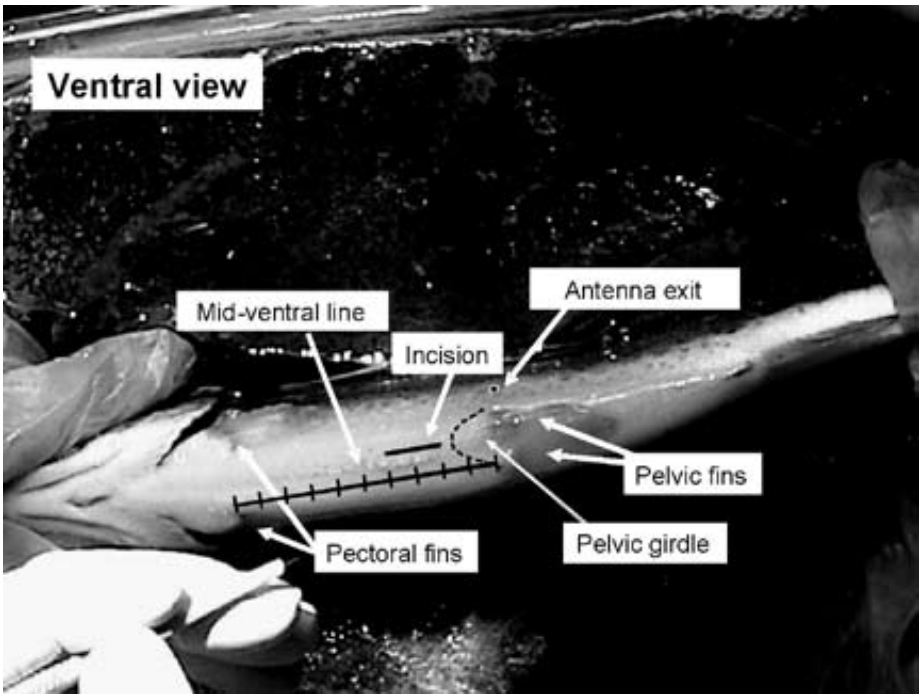


Figure 2
Ventral view of a juvenile salmonid, showing the location external organs and proper placement of incision and antenna exit (if applicable). This view corresponds to a left-handed surgeon's view and placement of the incision. For right-handed surgeons, the fish would be facing the right and the incision and antenna exit would be on the opposite side of the midline.



1. There is no exact specification for what size scalpel blade to use for each fish. We use a 5 mm blade for hatchery steelhead, which typically weigh more than 50.0 g. We use a 3 mm blade for smaller fish, such as yearling and subyearling Chinook salmon that typically weigh less than 50.0 g.

2. One scalpel blade can be used on about seven fish before it becomes dull. If the blade is pulling roughly or making jagged incisions, it needs to be changed prior to tagging the next fish.

3. Use forceps to open the incision to ensure you did not damage any internal organs or cause excessive bleeding. If you observe damage or think you damaged an organ, do not implant the tag, and reject that fish. Excessive bleeding should be noted on the datasheet.

iii. Gently push the tag into the body cavity, and position it so that it lies directly under the incision. This positioning will provide a barrier between the suture needle and internal organs. Through time the tag location will naturally move posterior in the fish.

iv. Use a pipette to administer oxytetracycline in the incision at a dosage of 50 mg/kg of body weight. Calculate the amount to administer for each fish using 1 _L of oxytetracycline for every 2 g of body weight (weight in g/2 = # of _L of oxytetracycline). For example, a 24.0 g fish would get 12 _L of oxytetracycline (Summerfelt and Smith 1990). Change the pipette tip after each fish.

v. Begin suturing the incision. Two or three interrupted stitches are used to close the incision, depending on the size of the tag and incision.

1. To make a stitch, lock the needle (at the end of the suture) in the needle drivers so the needle point faces you. Enter the outside edge of the incision on the side farthest from you and exit through the other edge of the incision, pulling the suture perpendicular through the two edges. The needle should enter and exit the skin as close to the edge of the incision as possible without tearing the skin (~ 2 mm from edge of incision). Pull the needle and suture through the skin to leave a tag end of about 2 - 3 cm of suture material protruding from the needle entrance location, then release the needle from the needle drivers. With your non-dominant hand, grasp the long end of the suture material (usually

with thumb and forefinger) at or below the needle, and make two forward wraps (i.e., away from your body) around the tip of the needle driver, which should be held in your dominant hand. With the two wraps still around the needle driver, grasp the short tag end of suture material with the needle driver and tighten the stitch by pulling the wraps off the needle driver and pulling both ends of suture material perpendicular to the incision. On the first knot, the dominant hand holding the needle driver should pull toward your body and the non-dominant hand should pull away from your body. Tighten the suture lightly, just so the edges of the incision meet, but do not overlap, pucker, or bulge the edges of the incision. The second knot is the same as the first, but in reverse order. On the second knot, grasp the long end of suture material with your non-dominant hand, make two reverse wraps (i.e., toward you body) around the end of the needle driver, grasp the short end of suture with the needle driver, and tighten the stitch. This time, the knot should be tightened by pulling your dominant hand (holding the needle drivers) away from you and your non-dominant hand toward you. The second knot can be slightly tighter than the first, again taking care not to overlap, pucker, or bulge the edges of the incision. The third knot is a repeat of the first and should be tightened snug to prevent the stitch from coming loose. This completes one stitch. Cut the suture with the needle drivers, leaving ends approximately 5 mm in length.

a. An alternative stitch consists of two knots, each with three wraps around the needle driver. The first knot consists of three forward wraps around the needle driver, and then is tightened by pulling the needle driver toward your body. The second is the same as the first, but in reverse order as described above.

b. When pulling a knot tight, be sure the knot lays flat and does not twist onto itself into a "balled-up" knot

2. There is no exact specification for what size suture to use. Generally, 4-0 suture is used for hatchery steelhead, which typically weigh greater than 50.0 g. For fish weighing less than 50.0 g, such as yearling and subyearling Chinook salmon, 5-0 suture is used.

3. Generally, a good time to switch the in-line valve on the gravity feed buckets to untreated river water is just prior to the last stitch. This initiates recovery from anesthesia as early as possible. However, if the fish appears to be inadequately gilling, provide a mixture or all fresh water as soon as possible. If the fish is too active to finish the surgery safely do not switch to fresh water, but maintain sedation.

4. If the incision is too long to close with two stitches, it is acceptable to add a 3rd stitch. Relay this information to the data recorder so they can note the extra stitch on the datasheet.

5. Because sutures are long, each individual suture (one packet) can be used on 2-4 fish. Rinse the suture material and the needle in the sanitizing solution used for instruments.

vi. Transfer the fish from the surgery table directly to a labeled recovery bucket. If a direct transfer is not possible, use a container filled with untreated river water to make the transfer.

vii. Between surgeries, the surgeon should prepare their tools for the next surgery. Disinfect the tools in chlorhexidine solution and rinse thoroughly with saline, load a new pipette tip, and ensure that the scalpel blade and suture are acceptable to use on the next fish.

viii. When all fish in a recovery bucket have spent 10 minutes in the bucket and gained equilibrium, transfer the bucket to the post-tag holding container (tank or raceway that has a constant flow of untreated river water).

5) Cleanup at the end of the tagging day

A. Wipe down all counter tops, scales and measuring boards with ethanol or isopropyl alcohol to disinfect.

B. Soak scalpels, catheters, forceps, and scissors in chlorhexidine solution for 15 minutes, rinse in saline solution, and thoroughly dry to prevent rusting.

C. Spray tagging platform (foam) with ethanol to disinfect.

D. Scrub needle drivers with a small brush and spray with ethanol or isopropyl alcohol.

E. Buckets should be rinsed thoroughly with untreated river water and placed upside down to dry. In addition, all buckets need to be cleaned weekly in accordance with Sterilization of 5 Gallon Buckets; FIE732.0.

APPROVED BY: _____ DATE _____
QUALITY ASSURANCE OFFICER

REVIEWED BY _____ DATE _____
LABORATORY SUPERVISOR