DRAFT STRAWMAN ALLOCATION OF RESPONSIBILITY REPORT

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

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EXECUTIVE SUMMARY

The San Joaquin River at its confluence with the Stockton Deep Water Ship Channel (DWSC) annually experiences episodes of low dissolved oxygen. The episodes are most prolonged and acute in the summer with oxygen concentrations often falling to between 2.0 and 2.5 mg/l. The geographic extent of the problem is from Channel Point to Turner Cut and Disappointment Slough, a distance of 8-10 miles. The State of California placed the San Joaquin River on the 303(d) list in 1994 because of low dissolved oxygen levels and committed to deliver a technical Total Maximum Daily Load (TMDL) to the U.S. EPA by June of 2003.

The conceptual model of the dissolved oxygen impairment is that there are at least three primary factors or processes influencing oxygen levels. The first is flow. Increased flows can, depending on the source of the water, increase the load of upstream oxidizable organic material but decrease water residence time. The second factor is the channel itself. Deepening the river decreased the efficiency of atmospheric reaeration and of algal photosynthesis and increased water residence time allowing a larger fraction of the imported organic material to be oxidized. The third is the size and timing of the arrival of loads of oxidizable organic material from the City of Stockton Wastewater Treatment Plant and from the upper Basin. Upstream loads appear most important in summer and decline in significance in the fall and winter as the City of Stockton commences to discharge high concentrations of ammonia. Prior to this study there was little information on what the upstream load(s) of oxygen requiring substances were, where they originated, and what mechanisms controlled them. Similarly, little empirical information existed to demonstrate either the importance of increased flow or of channel deepening.

The purpose of this report is threefold. First, summarize data demonstrating the importance of upstream flow on channel oxygen levels and present a revised hypothesis about why flow is important. Second, present data demonstrating the importance of channel deepening on channel oxygen levels. Third, summarize data on the source, nature and mechanisms controlling upstream loads. The overall goal of the report is to help guide future research and to provide information to the Steering Committee on the sources and causes of the oxygen problem.

Hydrology of the San Joaquin River basin is one of the most manipulated in the world. All the major tributaries in the upper watershed are dammed and their water either exported from the basin or used internally for municipal and agricultural production. As a result, present flows in the lower San Joaquin River at Vernalis have been reduced from historic values by 44-56 percent between April and September. Daily minimum dissolved oxygen concentrations at the Rough and Ready Island oxygen meter were plotted against net daily flow at the Stockton UVM station for all June through December time periods between 1994-2001. The results demonstrate a strong positive relationship between summer flow and minimum oxygen concentrations in the DWSC. The correlation predicts that each 1000-CFS increase in flow will increase minimum oxygen concentrations by 1.7 mg/l. The results are consistent with predictions of the Systech

Water Quality Model suggesting a decreasing oxygen deficit in 1999 and 2000 with increasing flow.

The Stockton Deep-Water Ship Channel was constructed in phases between 1875 and the present for inland navigation by ocean going ships to enhance commercial enterprise in the San Joaquin River basin. During the summer of 1999, 2000, and 2001 the City of Stockton made weekly dissolved oxygen measurements at a series of locations upstream of and through the DWSC. The 63 separate sets of measurements demonstrate a consistent pattern of the highest oxygen concentration 8 miles upstream of the DWSC, intermediate levels at the entrance to the channel and the lowest values within the channel ($P<0.001$ for differences between each site, ANOVA with Tukey mean separation test). The decline in oxygen at the entrance to the channel is hypothesized to mainly result from tidal mixing of river and oxygen depleted DWSC water. Only 1 of 126 measurements (0.8 percent) taken outside the DWSC was below the Basin Plan Objective for dissolved oxygen while 40 percent (25/63) of the values in the channel were. These data are consistent with the hypothesis that the channel is one of the main causes of the impairment. The results also substantiate the predictions of the Systech Water Quality Model that violations of the Basin Plan would not have occurred in 1999 and 2000 if the DWSC had not been constructed.

The San Joaquin River upstream of Stockton drains a seven-million-acre watershed. Important land uses include silviculture, rangeland, irrigated agriculture, wildlife refuges, dairies and municipal and industrial discharge. A stepwise forward multiple linear regression was performed on the 2000 and 2001 data from Maze Blvd, Mossdale and Vernalis using a ten day value for biochemical oxygen demand (BOD_{10}) as the dependent variable and dissolved organic nitrogen and carbon, ammonia, particulate organic matter, chlorophyll and phaeophytin as independent ones. Purpose of the analysis was to determine which organic fraction(s) were responsible for the oxygen demand. Chlorophyll and phaeophytin were found to be the most important variables and accounted for 76 percent of the variation in BOD_{10} measurements. The predicted oxygen demand from the regression equation is termed “apparent BOD_{10}” hereafter in the report.

Next, it is shown mathematically that channel oxygen demand from the upper basin in summer can be approximated by the apparent BOD_{10} concentrations at Mossdale as long as flows are reasonably constant. Apparent Mossdale BOD_{10} concentrations and minimum daily dissolved oxygen concentrations at Rough and Ready Island were compared for 2000 and 2001. The summer pattern for apparent BOD_{10} and dissolved oxygen are almost the inverse of each other. High BOD_{10} (or algal concentration) at Mossdale in June of 2000 and May of 2001 correspond with the commencement of the seasonal depression in oxygen concentration in the DWSC. Furthermore, the lowest annual dissolved oxygen values are coincident with the highest apparent BOD_{10} concentrations at Mossdale. Finally, the decrease in apparent BOD_{10} in September 2000 corresponds with the beginning of an improvement in channel oxygen concentrations. No DWSC dissolved oxygen data is yet available for the fall and winter of 2001. The conclusions are consistent with prior observations that the upper San Joaquin River basin is a major source of oxidizable organic material to the DWSC in summer.

Understanding the origin and mechanism(s) controlling the summer phytoplankton bloom at Mossdale is important if the DWSC oxygen problem is to be solved by upstream load control. Seasonal algal concentration patterns were analyzed in all the major sources of water from the upper basin in 2000 and 2001 to ascertain the origin of the Mossdale algal bloom. Two strategies were employed. First, seasonal pigment concentrations were examined at different locations in the San Joaquin River before, during and after the summer bloom. It was hypothesized that the chlorophyll peak observed at Mossdale would not be present in river samples collected above the major source(s) of algae. The San Joaquin River at both Maze Blvd and at Patterson demonstrated the same pattern each year as at Mossdale suggesting that the key tributaries contributing the majority of the algae were located above Patterson. The second strategy was to examine chlorophyll concentrations in each of the major tributary sources of water. It was assumed that the responsible sub basin(s) would have high standing algal concentrations (quantitatively similar to or greater than Mossdale) and would also demonstrate the same seasonal pattern. Only three sub basins fit this pattern: San Joaquin River above Hwy 165, Mud and Salt Sloughs. All three showed a significant increase and subsequent decline in chlorophyll at precisely the same time as Mossdale in both years ($P<0.05$, ANOVA and Tukey mean separation test). Also, algal concentrations, though variable at the three locations each year, were higher than at any other site measured in the watershed. Finally, all three basins are above Patterson.

The three Eastside Rivers (Merced, Tuolumne and Stanislaus) contribute 65-80 percent of the metered flow at Vernalis. However, their discharge is not distributed evenly throughout the year. Reservoir releases are increased between 15 April and 15-May to push juvenile fall run Chinook salmon downstream (Vernalis Adaptive Management Program or VAMP) and again in October to attract spawning adults. Eastside chlorophyll concentrations were consistently low and the beginning of the Mossdale algal bloom appeared in both years to coincide with the cessation of VAMP flow. Similarly, the commencement of the October fish attracting flows coincided with further decreases in Mossdale chlorophyll concentrations each year. The underlying mechanism may be that increased flow from the Eastside Rivers acts to dilute the more algal concentrated water from the upper basin. This may also be the mechanism explaining why increased channel flow appears to consistently ameliorate the DWSC oxygen deficit. The Eastside Rivers are the only significant source of summer flow in the river. If flow increases at Vernalis it is almost always because additional water is being released from Eastside reservoirs. This water always contains low phytoplankton concentrations and results in a low apparent BOD at Mossdale and a low oxygen demand in the DWSC. If correct, the observations suggest that possible control mechanisms are either an increase in summer flow from the Eastside Rivers or a decrease in algal concentrations from the upper San Joaquin River basin.

An algal growth model was developed for the San Joaquin River basin to quantify the contribution of each sub basin to the phytoplankton bloom at Mossdale. The results suggest that the San Joaquin River at Hwy 165, Salt and Mud Sloughs account for more than 90 percent of the total chlorophyll load at Maze Blvd (and by extrapolation at

Mossdale). The importance of these tributaries results both from their high standing algal concentrations and from their long relative travel time to the DWSC.

Nitrogen or phosphorus usually is found to control phytoplankton production in surface water. Three surveys were undertaken during the summer of 2001 to determine the nutrient concentration in each of the major tributaries of the San Joaquin River. The purpose of the sampling was to ascertain the origin of the nutrients and determine whether concentrations in any sub basin might be low enough to warrant attempting to control algal growth by limiting nutrient levels. The strategy consisted of sampling each tributary near its origin, about half way to the San Joaquin, and again just above the confluence. Nutrient concentrations in Mud and Salt Sloughs and in the San Joaquin River at Hwy 165 were of particular interest as these three water bodies contribute more than 90 percent of the summer Maze Blvd algal load. Data from Mud Slough suggested that algal growth might be phosphorus limited. No nutrient limitation was apparent in Salt Slough or in the San Joaquin River at Hwy 165. In contrast, phosphorus appeared potentially limiting to algal growth in the headwaters of the three Eastside Rivers. Evaluating the efficacy and cost-effectiveness of nutrient control in Mud Slough may be worthwhile. Other algal control methods should be investigated for Salt Slough and for the San Joaquin River at Hwy 165.

Finally, a list of additional studies is recommended.

INTRODUCTION

The San Joaquin River at its confluence with the Stockton Deep Water Ship Channel (DWSC) annually experiences episodes of low dissolved oxygen. The episodes are most prolonged and acute in the summer/fall, June-October, but have also been observed in other months (Gowdy, 2002). Dissolved oxygen levels as low as 0.4 mg/l[1] have been measured, though summer low values are more typically in the range of 2.0-2.5 mg/l. The geographic extent of the impairment is from Channel Point, where the San Joaquin meets the DWSC, to Turner Cut and Disappointment Slough, a distance of 8-10 miles (Figure 1).

The oxygen deficit stresses and kills resident aquatic life and prevents the upstream migration of fall run Chinook salmon. The impairment may also be biologically detrimental as it may block the movement of aquatic resources between the San Joaquin River basin and the Sacramento-San Joaquin Bay Delta for extended periods of time in the summer.

The Basin Plan[2] for the Sacramento-San Joaquin Bay-Delta Estuary contains a water quality objective requiring oxygen levels to be maintained above 6 mg/l between 1 September-30 November and above 5 mg/l at all other times. The 6-mg/l objective was adopted to protect the upstream migration of fall run Chinook salmon.

The State of California placed the San Joaquin River on the 303(d) list in 1994 because of low dissolved oxygen levels. In 1998 the problem was classified as a high priority for correction and the State committed to deliver a technical Total Maximum Daily Load (TMDL) document to the US EPA by June of 2003. Furthermore, a commitment was made to develop and present a phased implementation plan to the Regional Board for consideration as a Basin Plan Amendment by the fall of 2004.

The Bay Protection and Toxic Cleanup Plan was adopted by the State of California in 1999. A part of the Cleanup plan laid out a strategy for developing the technical elements of the TMDL and the associated implementation plan. A key element of the Plan was the formation of a Steering Committee composed of local interests to oversee the development of the TMDL, including the allocation of loads (and responsibility) and the development and financing of the implementation plan. The Steering Committee formed a Technical Advisory Committee (TAC) to advise them on the sources and causes of the oxygen impairment and to help develop a cost effective control plan.

The conceptual model of the dissolved oxygen impairment in the DWSC is that there are at least three primary factors or processes influencing oxygen levels (McCarty, 1969; U.S. EPA, 1971; Jones and Stokes Associates, 1998; Lee and Jones-Lee, 2000). The first factor is San Joaquin River flow through the DWSC. Increased flows can, depending on the source of the water, increase the load of upstream oxidizable material but decrease water residence time. The second is the channel itself. Deepening the river decreased the

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[1] October 1991

[2] Legal document regulating water quality in the Basin.

efficiency of atmospheric reaeration and of algal photosynthesis and increased water residence time allowing a larger fraction of the imported organic material to be oxidized. The third factor is the size and timing of the arrival of loads of oxidizable material from the City of Stockton Wastewater Treatment Plant and from the upper San Joaquin River basin. Biologically oxidizable organic material from the upper basin is hypothesized to originate from city and industrial wastewater and from non-point source discharge. Upstream loads appear most important in summer and decline in significance in the fall and winter as the City of Stockton commences to discharge high concentrations of ammonia. Prior to this study there was little information on what the upstream loads of oxygen requiring substances were, where they originated, and what mechanisms controlled them. Similarly, little empirical information existed to demonstrate either the importance of increased flow or of channel deepening.

The purpose of this report was threefold. First, summarize data demonstrating the importance of upstream flow on channel oxygen levels and present a revised hypothesis about why flow is important. Second, present data demonstrating the importance of channel deepening on channel oxygen levels. Third, summarize data collected by the Regional Board and other members of the TAC on the source, nature and mechanisms controlling upstream loads. The overall objective of the report is to help guide future research and to provide information to the Steering Committee on the sources and causes of the oxygen problem.

Method and Materials

Water Quality Analysis Both the U.S. Geological Survey and UC Davis collected water samples during 2000 and 2001 as part of their San Joaquin River monitoring programs. The Survey took water on 19 occasions in the summer of 2000 and 2001 from 4 locations along the main stem-river. In addition, in 2001 water was collected monthly from 5 agriculturally dominated creeks and constructed drains. The purpose of the river sampling was to characterize changes in water quality along the river's course. The purpose of the tributary sampling was to characterize the quality of agricultural return flow as it is a significant component of the summer water volume of the river. All samples were taken by the U.S. Geological Survey's depth integrated cross sectional averaged sampling method. Data for year 2000 and a part of the information for 2001 is available on the IEP web site[3]. Only the year 2000 chlorophyll data for the main river and all available information as of 30 September 2001 for the agriculturally dominated tributaries was used in this report. Locations for both the river and tributary sampling sites are indicated in Figure 2 and these, along with analytical methods, are described in Dileanis (in prep).

UC Davis collected water samples every two weeks between 13 October 1999 and 14 October 2001 at 11 locations in the San Joaquin River basin (figure 3) for a variety of water quality constituents (personal communication R Dahlgren). The Regional Board supplemented this information during the summer of 2000 and 2001 with the collection of biochemical oxygen demand (BOD) information. UC Davis chlorophyll, phaeophytin, dissolved organic nitrogen and carbon, ammonia, particulate organic matter and BOD data were used in this report. The 1999 and 2000 UC Davis data, along with a description of methods and associated detection limits, will be posted to the IEP web site. In addition, the University collected water samples on 3 occasions in 2001 from major sub basins for BOD, chlorophyll, nitrate, ammonia, total phosphorus and soluble organophosphorus analysis (Figure 4). The purpose of this sampling was to better ascertain the geographic origin of each constituent and whether phytoplankton growth might be nutrient limited at any location.

The measurement of BOD was the responsibility of the Regional Board. All BOD samples were placed on ice after collection by either UC Davis or the U.S. Geological Survey and transferred to a commercial laboratory[4] where analysis was commenced within 48 hours using a modification of APHA Standard Method 405.1 (1992). The modification consisted of employing 5 instead of 6 replicates and measuring oxygen consumption at both 5 and 10 days. In addition, oxygen consumption was measured in 5-day increments for up to 30 days in 3 samples collected from each site in year 2000. The purpose of this analysis was to determine the relationship between 10-day and longer duration BOD measurements.

[3] http://sarabande.water.ca.gov:8000/~bdtdb/sde8/calfedsjrdo_new.html
[4] Sierra Foothill Laboratory, 823 S Hwy 49, PO Box 1268, Jackson, CA 95642

Flow Daily flow was obtained for all sites, except the San Joaquin River above the Merced, from either the U.S. Geological Survey[5] or the California Water Resources Data Exchange Center[6]. No gauge exists for the San Joaquin River above the confluence of the Merced River. Therefore, the U.S. Geological Survey measured flow on each occasion after sampling.

Loads Daily chlorophyll loads (kg/day) were estimated by multiplying flow (CFS) by chlorophyll concentrations (μg/L) using the following equation:

$$(\text{Chlorophyll concentration})(2.445 \text{ X } 10^{-3})(\text{Flow})$$

BOD loads (metric tons/day) were calculated in a similar fashion:

$$(\text{BOD}_{10} \text{ concentrations})(2.445 \text{ X } 10\text{-}6) (\text{Flow}).$$

Chlorophyll, BOD, flow and their corresponding instantaneous loads are summaried by site and date in Appendix A.

Statistics Correlation and Analysis of Variance (ANOVA) computations were done with Microsoft Excel 6. Tukey mean separation test calculations were carried out according to methods in Zar (1984). Finally, a multiple stepwise forward correlation of BOD_{10} against chlorophyll, phaeophytin, dissolved organic nitrogen and carbon, ammonia and particulate organic matter was performed with Statgraphics (Statgraphics Plus, 1998).

[5] HTTP://water.usgs.gov/ca/nwis/sw
[6] HTTP://cdec.water.ca.gov.

RESULTS AND DISCUSSION

Flow

Hydrology of the San Joaquin River basin is one of the most manipulated in the world (California Water Atlas, 1978). All the major tributaries in the upper watershed are dammed and their water either exported from the basin or used internally for municipal and agricultural production. As a result, present flow in the lower San Joaquin River at Vernalis is reduced by 44-56 percent between April and September[7] from historic values (Water and Power Resources Service and South Delta Water Agency, 1980). Sixty-seventy percent of the present metered summer flow at Vernalis is from Eastside reservoirs[8], 18-20 percent is from agricultural surface irrigation return flow, about 10 percent is from Salt and Mud Sloughs and the remainder is from groundwater recharge and subsurface tile drains (Table 1 and 2). To complicate matters further, State and Federal pumping facilities at Tracy export additional water out of the South Delta, including from the lower San Joaquin River, for transport to the central and southern part of the State (Figure 1). This is accomplished by drawing San Joaquin River water down Old River and away from the DWSC. At typical summer flows the pumps may divert about half of the San Joaquin River at Vernalis while at low River discharges rates the pumps can cause reverse flows in the channel at Stockton (Jones and Stokes Associates, 1998).

In the late 1960s the flow of the San Joaquin River was recognized as an important factor influencing dissolved oxygen concentrations in the DWSC (U.S. EPA, 1971). On one hand, flow was hypothesized to exacerbate the DWSC oxygen problem by importing large amounts of organic material from the upper basin for subsequent oxidation in the channel. Higher flows resulted in the delivery of greater amounts of oxidizable material. On the other hand, enhanced flow was hypothesized to ameliorate the dissolved oxygen problem by reducing DWSC water residence time and the actual amount of organic material decomposed. The more important process was assumed to be water residence time, though no report has been found explicitly documenting this. In 1969 the Departments of Fish and Game and Water Resources (DWR), U.S Fish and Wildlife Service, and U.S. Bureau of Reclamation entered into an Interagency Agreement to construct a series of temporary rock barriers at the head of Old River in years when either river flow was predicted to fall below 1800 CFS or channel oxygen concentrations might fall below 6.0 mg/l. Purpose of the barrier was to increase water flow past Stockton by minimizing exports down Old River. Rock barriers were installed in at least ten of the 14 years between 1971-1984. The increased flow usually increased oxygen concentrations in the DWSC although on a few occasions no change in dissolved oxygen was observed (as reported in U.S. Army Corp of Engineers, 1988). Lack of response during these years was ascribed to unusually high concentrations of algal material being imported into the DWSC from the upper Basin. These increased loads were hypothesized to overwhelm the ameliorating effect of reduced water residence time.

[7]Mean summer reduction over the four water year types. Estimated summer reduction by water year class: dry 49-67%; below normal 60-68%; above normal 47-57%; wet 19-32%.
[8] Merced, Tuolumne and Stanislaus Rivers.

Chlorophyll concentrations are reported to have decreased by a factor of about four in the lower San Joaquin River since 1970 (Lehman, 2001). This decrease may now increase the reliability and effectiveness of using flow from the San Joaquin River to reduce water residence time and increase channel assimilative capacity.

The City of Stockton commissioned Systech Engineering to develop a link-node water quality model to predict dissolved oxygen concentrations in the DWSC. The model is described in (Schanz and Chen, 1993; Chen and Tsai, 1997). In 1999 the model was recalibrated under the direction of the TAC to account for sediment oxygen demand, sedimentation and resuspension of organic detritus, and growth and export of phytoplankton from the Turning Basin. The model was also modified to provide hourly instead of daily output (Chen and Tsai, 2001). The recalibrated model was used to predict oxygen concentrations during the summer of 2000. The average absolute difference between predicted and measured concentrations in 2000 was 0.6 mg/l. However, the model performed poorly in predicting episodes of low oxygen concentration[9]. No verification of the model has yet been performed for the 2001 data.

The Sytech model was used in a predictive mode to evaluate the theoretical effect of altering river flow rate through the DWSC in 1999 and 2000. The simulations were done by calculating an index of oxygen impairment called a Maximum Daily Dissolved Oxygen Deficit (Chen and Tsai, 2001). Briefly, an average seasonal load was estimated for each year and this used in the model to calculate an average maximum daily dissolved oxygen deficit in the channel as a function of increasing River flow (Figure 5 a, b). Model output predicted that oxygen deficits would decrease with increasing DWSC flow in each year. In 1999 a small deficit was predicted at 2,000 CFS while in 2000 no impairment was predicted at flows equal to or greater than 1,000 CFS. The higher deficits in the 1999 simulation resulted from the transport of greater upstream loads into the DWSC.

Daily minimum dissolved oxygen concentrations at the Rough and Ready Island dissolved oxygen meter are plotted against the daily net flow at the Stockton UVM station for June through December of 1994-2001 (Figure 6). The results are consistent with prediction of the Systech model and demonstrate a strong positive relationship between summer flow and oxygen concentration in the DWSC. The correlation predicts that each 1000-CFS increase in flow (up to 3000 CFS) will increase the minimum daily oxygen concentration at Rough and Ready Island by 1.7 mg/l. The predicted lower 90 percent band for achieving a 5 and 6 mg/l minimum daily dissolved oxygen level at Rough and Ready Island is 2200 and 2800 CFS. These results suggest that flow enhancement, either by itself or in combination with other control measures, may be an effective way to decrease the oxygen deficit.

CALFED commissioned HydroQual[10] Inc. to develop a three-dimensional dissolved oxygen model for the DWSC. It would be valuable, once the HydroQual model is

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[9] Differences between predicted and measured concentrations were often 1-2 mg/l.
[10] HydroQual, Inc, One Lethbridge Plaza, Mahwah, NJ 07430

calibrated, to repeat the flow simulations and ascertain whether the new model also predicts decreasing dissolved oxygen deficits as a function of increasing flow.

In conclusion, summer flow in the San Joaquin River at Vernalis is now entirely controlled by man and is 19-68 percent less than occurred historically. Moreover, additional water is diverted from the River below Vernalis by both the State and Federal Pumps with the result that even less water is now moving through the DWSC. Modeling and data analysis demonstrate that oxygen levels in the channel are positively correlated with flow. Therefore, the parties that regulate flow in the San Joaquin River are, at least partially, responsible for the dissolved oxygen impairment in the DWSC[11].

Stockton Deep Water Ship Channel

The Stockton Deep-Water Ship Channel was constructed in phases between 1875 and the present for inland navigation by ocean going ships. Above Stockton the San Joaquin is a large, shallow (5-10 feet), lowland type river characterized by high inorganic sediment loads and no reported violations of the Basin Plan Water Quality Objective for dissolved oxygen. This has led to the hypothesis that the channel itself may be one of the main causes of the oxygen depression (U.S. EPA, 1971; McCarty, 1969; Lee and Jones-Lee, 2000). There are three main hypotheses for how the channel contributes to the impairment. The first is that a deeper channel increases water residence time and the fraction of the imported organic material that can be oxidized. Second, the deeper channel decreases the relative proportion of the water column in contact with the atmosphere and the efficiency of natural atmospheric reaeration. Finally, the deeper channel decreases the relative proportion of the water column in the photic zone and the efficiency of algal photosynthesis and the associated oxygen production. These hypotheses led the U.S. EPA in 1971 to recommend that the channel not be deepened further (U.S. EPA, 1971).

The U.S. Army Corps of Engineers deepened the channel from 30 to 35 feet between 1984-1987. The Corps commissioned Resource Management Associates of Lafayette, California, to develop a one dimensional link node computer model of the channel to ascertain how much mitigation might be needed to compensate for the deepening[12] (U.S. Army Corps, 1988). Model results suggested that the mass of oxygen needed to mitigate for the dredging was directly proportional to river discharge and ranged from approximately 625 lbs/day under no net flow to 2,500 lbs/day at 2,000 CFS. As mitigation the Corps installed an aeration device in the DWSC opposite Channel Point capable of delivering 2,500 lbs/day and agreed to run it during September and October if oxygen levels fell below 5.2 mg/l (US Army Corps letter of 25 May 1990). However, no study was ever conducted to ascertain whether the aeration device was delivering the agreed upon mitigation. Also, no action was ever undertaken to mitigate for exacerbating

[11] This is in spite of the fact that they do not contribute a “load” of oxidizable material to the DWSC.
[12] The U.S. Army Corps of Engineers and Port continue to conduct annual maintenance dredging to maintain the charted depth of the channel. Recently, the Port approached staff of the Central Valley Regional Board to discuss the possibility of removing an additional 400,000 cubic yards of material from beneath berths off Rough and Ready Island to facilitate docking larger vessels. The dredging is proposed to commence in the fall of 2002.

low dissolved oxygen levels during other months of the year. Finally, and most important, no study or action was ever undertaken to attempt to quantify and mitigate for the cumulative impact of all channel improvements on dissolved oxygen conditions.

The Systech link node model was recently used to attempt to predict the cumulative impact of the deepening of the DWSC on dissolved oxygen levels. The depth of the San Joaquin River at Stockton prior to any channel improvements was ascertained from a review of the U.S. Army Corps of Engineer's reports to Congress. The 1896 report described summer water levels prior to 1875 in the river off Stockton as 6 feet (U.S. Army Corps, 1896). The simulation modeling described in the previous flow section was extended to also determine the effect of channel deepening on oxygen concentrations. Briefly, the maximum daily dissolved oxygen deficit was recalculated as a function of flow with present and 1875 channel bathymetry (Chen and Tsai, 2001). The results suggest that with an 1875 river cross section there would have been a very small oxygen deficit at channel flows below 500 CFS in both 1999 and 2000 (Figure 7). No violations of the Basin Plan Objective would have occurred at higher discharge rates.

During the summer of 1999, 2000, and 2001 the City of Stockton made weekly dissolved oxygen measurements at a series of locations upstream and through the DWSC. The measurements were performed independent of tidal cycle. Dissolved oxygen concentrations at mid depth for the 63 trips are presented in Table 3 for three locations in the San Joaquin River (Figure 1). The first site was 8 miles upstream of the DWSC at Bowman Road[13], the second was half a mile above the entrance to the channel[14], and the third was 3 miles down the channel off Rough and Ready Island. The data demonstrate a consistent pattern[15] of the highest oxygen concentration 8 miles above the DWSC, intermediate levels at the entrance to the channel and the lowest values within the channel ($P<0.001$ for differences between each site, ANOVA with Tukey mean separation test). The decline in oxygen at the entrance to the channel is hypothesized to mainly result from tidal mixing of river and oxygen depleted DWSC water. It is interesting to note that only 0.8 percent (1/126) oxygen measurements taken outside the DWSC was below the Basin Plan Objective for dissolved oxygen while 40 percent (25/63) of the values in the channel were. These data are consistent with the hypothesis that the channel is one of the main causes of the impairment. The results also substantiate the predictions of the Systech model that violations of the Basin Plan were unlikely in 1999 and 2000 if the flow rate of the San Joaquin River was maintained above 500 CFS and no DWSC were present.

Two additional studies would be helpful. First, the efficiency of the U.S. Army Corps aeration device should be ascertained to establish whether it is providing the agreed upon mitigation. Second, the HydroQual model should be run with the present and 1875 cross

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[13] The data for the upper River was collected between 8-9 AM and probably represents close to the minimum oxygen value for the previous 24 hours.

[14] This site also contains effluent from the City of Stockton Wastewater Treatment Plant.

[15] The mean annual decrease in oxygen concentration between Bowman Road and the entrance to the DWSC varied over the 3 years from 0.5-1.6 mg/l while the change between the entrance to the channel and Rough and Ready Island was a 1.7-2.3 mg/l decline.

section to verify the Systech results and determine the cumulative impact of the initial and all subsequent deepenings on present channel oxygen levels.

In conclusion, the DWSC was constructed and maintained over the past one hundred and twenty-five years for the benefit of commercial enterprise. Modeling and dissolved oxygen measurements taken upstream and in the channel indicate that it is unlikely there would be an oxygen impairment if the channel had not been constructed. Therefore, the parties that constructed and continue to maintain the DWSC are, at least partially, responsible for the dissolved oxygen impairment[16].

Upstream Sources

The San Joaquin River upstream of Stockton drains a seven million-acre watershed. Important land uses include silviculture, rangeland, irrigated agriculture, wildlife refuges, dairies and municipal and industrial discharge. It has been hypothesized that the synthesis and export of organic material from the upper basin is one of the major causes of oxygen depletion in the channel (McCarty, 1969; Jones & Stokes Associates, 1998; King, 2000; Lee and Jones-Lee, 2000). For example, studies conducted by the TAC in 1999 suggest that the upper basin was responsible for about 80% of the total load of oxygen requiring substances imported into the channel in August and September (Lee and Jones-Lee, 2000).

The following sections present results to determine the identity of the major oxygen requiring substances imported to the DWSC from the upper basin, their time dependent oxidation rate, seasonal pattern of abundance, change in concentration between Vernalis and the DWSC, origin, and growth down the San Joaquin River. A final section summarizes what is known about nutrients in the sub basins in an attempt to begin to evaluate the possibility of controlling phytoplankton by limiting available nitrogen and phosphorus levels.

Oxygen Requiring Substances From Upper Basin

Dr Dahlgren from UC Davis measured the concentration of all major types of oxygen requiring substances present in flowing water[17] at 10 locations in the San Joaquin basin twice a month between October 1999-November 2001 (personal communication R. Dahlgren, Figure 3). The sites included Maze Blvd and Mossdale. The San Joaquin River at Vernalis was added in the summer of 2001. The Regional Board supplemented the Dahlgren sampling at all locations between July-November of both 2000 and 2001 with BOD_{10} measurements. The Dahlgren and Regional Board data are summarized in Appendix A. Individual stepwise forward multiple linear regressions were performed on the data from Maze Blvd and Mossdale and on pooled data from Maze Blvd, Mossdale and Vernalis. BOD_{10} as used as the dependent variable and each of the above listed

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[16] This is in spite of the fact that they, like those that regulate flow, do not contribute a "load" of oxidizable material to the channel.

[17] Dissolved organic nitrogen and carbon, ammonia, particulate organic matter, chlorophyll a and phaeophytin.

constituents as independent ones. There was insufficient data to analyze the Vernalis data alone (N=8). Purpose of the analyses was to determine which organic fraction(s) were responsible for the oxygen demand at each site.

The results from the three multiple regressions emphasize the importance of algal biomass (Table 4). Chlorophyll was the single most important variable and accounted for 70-76 percent of the variation in BOD_{10} measurements from Maze Blvd and from the pooled data set from Maze Blvd, Vernalis and Mossdale. Particulate organic matter (POM)[18] was most important at Mossdale. However, POM and chlorophyll were positively correlated at all sites (Pierson correlation coefficients of 0.57-0.76) demonstrating that the two were autocorrelated and likely tracking the same variable (algal biomass). The regression of the pooled data from Maze Blvd, Vernalis and Mossdale was selected for subsequent use as the correlation had the largest sample size (N=37) and the highest overall R^2 value (0.76). The regression is:

$$BOD_{10}\,(\text{mg/l}) = 0.083\ \text{Chlorophyll}\,(\mu\text{g/l}) + 0.140\ \text{Phaeophytin}\,(\mu\text{g/l}) + 1.94$$

The regression predicts that 1 µg/l of chlorophyll *a* and a similar amount of phaeophytin will consume 2.2-mg/l oxygen in 10 days. The oxygen demand predicted from this equation is hereafter called “apparent BOD_{10}”.

The results of the regression analysis are consistent with earlier conclusions of McCarty (1969), Jones & Stokes Associates (1998), and King (2000) that algae and algal derived organic matter is responsible for most the oxygen demand from the upper basin. The data also suggest that one or more unidentified variables account for about a quarter of the variation in oxygen consumption.

A recommendation for further work is that Dr Dahlgren be funded to continue collecting field data in the San Joaquin basin. The monitoring should include the measurement of BOD_{10} throughout the year. This is important because dissolved oxygen problems in the DWSC are not just restricted to summer. Eventually, the State must determine the principal oxygen demanding substances being imported to the DWSC at all times of the year and devise a control program to regulate them.

<u>Time Dependent Oxidation Rate</u>

Three water samples were collected from each UC Davis and U.S. Geological Survey sampling site (Figure 2 and 3) during the summer of 2000 for 30-day oxygen consumption measurements (40 analyses). Oxygen consumption was measured in each of these at 5, 10, 15, 20, 25 and 30-day intervals. The results for one site, Mossdale, are plotted in Figure 8. The Mossdale results demonstrate, like at all other sites, a “flattening-out” or decrease in oxygen consumption with increasing time in each of the three tests suggesting that much, but not all, of the labile organic material was oxidized within 30 days. Also, 30-day oxygen consumption rates varied from 5.4-13.8 mg/l in the three tests demonstrating the variable nature of oxygen demand in water from the upper

[18] The same as volatile suspended solids (VSS) in other TAC reports.

basin. These results were not unexpected as algal pigment concentrations, the primary oxygen requiring substance in river samples, also covaried from 12-54 µg/l in the same samples (Appendix A). King (2000) and McCarty (1969) both conducted a single long term BOD test with water collected at Mossdale and reported 30-day oxygen consumption rates of about 6 mg/l. These two values are within the range reported here.

Oxygen consumption rates were compared in all 30-day BOD tests to ascertain whether there was any relationship between oxygen demand at 10 days and at other time intervals. The results demonstrate a positive correlation in oxygen demand between 10-day and all other time intervals (Table 5). The strongest correlation was between the nearest time intervals (r=0.98 and 0.99 for 5 and 15-day BOD tests, respectively). Poorer correlations were obtained for 10 and 30-day values (r=0.97; Figure 9). These results are important as water residence time in the DWSC can vary up to 30 days depending upon flow (Jones and Stokes Associates, 1998). Results of the correlation analysis make it possible, if water residence time and BOD_{10} rates are known, to predict the oxygen demand[19] of each water parcel transiting the channel.

Seasonal Phytoplankton Pattern in San Joaquin River

Previously it was suggested that phytoplankton abundance is important as it is the primary oxygen requiring substance exported from the upper basin. The seasonal pattern of algal abundance in the San Joaquin River at Patterson, Maze Blvd, and Mossdale is presented in Figures 10 and 11 for 2000 and 2001. The Figures demonstrate a similar seasonal chlorophyll pattern at each of the three sites both years, though the magnitude of pigment concentration is variable both between sites and at the same location in different years. In general, chlorophyll concentration increases in late May or early June and remain high until August whereupon it begins to decline and reaches concentrations below 10 µg/l in October. Concentrations generally remain low until the following spring whereupon the cycle commences again. Phaeophytin, the primary degradation product of chlorophyll, mostly remains below 10 µg/l all year but does occasionally rise above this value during the largest blooms.

The seasonal river pattern for apparent BOD_{10} is also plotted on Figures 10 and 11. The apparent BOD_{10} line is a combination of solid and dashed parts. The solid lines are the predicted oxygen consumption rate during time periods used to develop the regression equation. The dashed line is the same relationship extrapolated to other unmeasured time periods. Care must be taken in extrapolating the apparent BOD_{10} regression to unmonitored times as it is not known whether the same relationship will continue to explain the oxygen consumption rate. It is suggested later that data needs to be collected at all times of the year to collaborate this relationship. The apparent seasonal BOD_{10} pattern is similar to that of chlorophyll as phaeophytin (the second term in the equation) is relatively constant and small throughout the sampling period.

[19] Presumably, these oxygen consumption relationships include the expression of all forms of oxidable material present in the sample: dissolved and particulate, nitrogenous and carbonaceous BOD.

The load of oxygen requiring substances from the upper basin is hypothesized to be responsible for the majority of the oxygen deficit in the DWSC in summer (McCarty, 1969;US EPA, 1971;Lee and Jones-Lee, 2000). Upstream channel oxygen demand can be approximated by the following formula[20]:

Oxygen Demand=(Apparent BOD_{10} concentration)(Channel Volume)(Conversion factor)

(mg O_2 consumed/x days)= (mg O_2 consumed/10 days/liter)(liter)($BOD_{10} \Rightarrow BOD_x$)

The equation states that the amount of oxygen consumed in the channel during any time interval "x" is equal to the multiplication of the apparent BOD_{10} concentration by channel volume and by a BOD conversion factor. The purpose of the conversion factor is to adjust the 10-day BOD value to the appropriate time interval. Conversion factors for time intervals between 5 and 30 days can be obtained from the row labelled "slope" in Table 5[21]. Presumably, the time interval (x) of most interest is the channel's residence time.

DWSC channel flows (and residence times) were relatively constant at 800-1200 CFS in the summer of 2000 and 2001. Therefore, the oxygen demand equation predicts that the oxygen consumed in the channel should primarily be a function of apparent Mossdale BOD_{10} concentration. To evaluate this, apparent Mossdale BOD_{10} concentrations and the daily minimum dissolved oxygen concentrations at Rough and Ready Island (a measure of the oxygen demand at one location in the channel) are presented for 2000 and 2001 in Figure 12. The summer pattern for apparent BOD_{10} and dissolved oxygen are almost the mirror image of each other. High BOD_{10} (or algal concentration) at Mossdale in June of 2000 and May of 2001 correspond with the commencement of the seasonal depression in oxygen concentration in the DWSC. Furthermore, the lowest annual dissolved oxygen values are coincident with the highest apparent BOD_{10} concentrations at Mossdale. Finally, the decrease in apparent BOD_{10} in September 2000 corresponds with the beginning of an improvement in channel oxygen concentrations. No DWSC dissolved oxygen data is yet available for the fall and winter of 2001. The results are consistent with both the oxygen demand equation and the hypothesis that the upper basin is a major source of oxidizable material to the DWSC in summer. As is apparent from the graphs, there is less correspondence between apparent BOD concentrations in winter and spring. It is hypothesized that this is because effluent from the Stockton wastewater treatment plant comprises a much greater proportion of the total load of oxidizable material in the channel making the portion of upstream oxygen demand less important.

Increased flow through the DWSC is hypothesized to be good because it decreases channel residence time and the amount of organic material that can be oxidized per unit time. However, inspection of the oxygen demand equation suggests otherwise. Oxygen demand for any change in residence time can be ascertained quantitatively from the oxygen demand equation after comparing the appropriate BOD_{10} slopes in Table 5. For example, if the flow through the DWSC increases from 500 to 1000 CFS then residence

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[20] Units are provided below the equation to help the reader follow the math.

[21] For example if water residence time in the channel is 20 days, then the BOD_{10} concentration should be multiplied by 1.5 to convert it to a 20-day value.

time is predicted to decrease from 15 to 10 days (as reported in Lee and Jones-Lee, 2000). According to the oxygen demand equation, channel oxygen consumption would increase by 15 percent per day[22]. This is because oxygen consumption per day increases as the duration of the BOD test decreases (see figure 8 as an example) and this increase is faster than the decrease in water residence time. It is clear, while some uncertainty may exist about DWSC water residence times and about the precise shape of the BOD response curve, that decreasing residence time is not the explanation for why higher flow rates increase daily minimum oxygen levels in the channel at Rough and Ready Island (Figure 6). Please note that this conclusion is contrary to both the results of the Systech Water Quality Model (Figure 5) and of our present conceptual model of how oxygen impairment works in the DWSC. An alternate explanation for why flow is important is provided in a following section.

A problem with the present data is that chlorophyll concentrations are only available every two weeks at Mossdale. If more frequent data were available, then it might be possible to determine a flow specific chlorophyll concentration corresponding to a summer DWSC oxygen minimum of 5 and 6-mg/l. Establishing such a value could be important as it would provide an indication of the amount of upstream algal reduction needed to eliminate the channel oxygen deficit at any flow. Ascertaining this should be given a high priority in the future and can probably best be determined by installing a continuous *in vivo* florescence meter at Mossdale and evaluating the data against the daily oxygen minima in the DWSC.

Change in Concentration of Organic Material between Vernalis and Mossdale.

Controversy has arisen within the TAC about how much of the organic load synthesized in the upper Basin and measured at Vernalis or Mossdale is actually delivered to the DWSC. As previously noted, the seasonal pattern of apparent BOD_{10} at Mossdale appears predictive, at least in 2000 and 2001, of oxygen levels in the DWSC. However, determining the precise amount of the Mossdale load delivered to the channel is important both for the development of an accurate computer model and for evaluating the relative significance of local versus upper Basin loads.

Previously, it had been assumed that the load of oxygen requiring substances measured at Vernalis was a reliable estimate of the amount of material delivered to the channel after subtracting out the amount exported down Old River (King, 2000; Jones & Stokes Associates, 1998). This assumption was based upon an analysis of chlorophyll data collected by DWR at both Vernalis and at Mossdale and the relatively short distance[23] and travel time[24] between these sites and the DWSC. An analysis of median monthly

[22] $((1.3)(BOD_{10})(\text{channel vol})/15 \text{ days}) – ((1) (BOD_{10}) (\text{channel vol})/10 \text{ days})/ ((1.3)(BOD_{10})(\text{channel vol})/15 \text{ days}) = (1.3/15-1.0/10)/(1.3/15) = -0.15$

[23] Vernalis is 16 river miles upstream of Mossdale and 31 miles from the DWSC (US Army Corps of Engineers, 1984).

[24] Jones & Stokes Associates (2001), using estimates of river volume, calculate a travel time between Vernalis and Mossdale of about half a day at a Vernalis river flow rate of 2,000 CFS and about 1 day between Mossdale and the DWSC at a Stockton UVM flow rate of 1,000 CFS

DWR chlorophyll concentrations from Vernalis and Mossdale for 18 years[25] demonstrate that Mossdale chlorophyll concentrations were always similar to or greater than the corresponding value at Vernalis (as reported in Jones & Stokes Associates, 1998). Typically, Mossdale concentrations were about 25 percent greater than those at Vernalis during summer[26] but similar at other times of the year.

The City of Stockton supplemented the earlier DWR data during the summer of 2000 by collecting water samples weekly at both Vernalis and Mossdale and measuring a suite of water quality parameters including chlorophyll and BOD_5 (Jones & Stokes Associates, 2001). As expected, Mossdale chlorophyll concentrations were greater than those recorded at Vernalis on 14 of 17 occasions with an average downstream increase of 30 percent. Similarly, Mossdale BOD_5 concentrations were greater than those recorded at Vernalis on 15 of 17 occasions. The average downstream increase was 25 percent.

Dr Lehman from DWR also collected water samples at Vernalis, Mossdale and the entrance to the DWSC during the summer of 2000 (Lehman, 2001). Dr Lehman reported that load estimates from either Vernalis or Mossdale were now a poor estimate of the amount of material imported into the DWSC from the upper Basin. A loss rate of 160-300 kg/day[27] was reported for chlorophyll between Vernalis and the DWSC. Much of this material appeared to disappear between Vernalis and Mossdale. Therefore, the conclusions reached by Dr Lehman and by the City of Stockton for the summer of 2000 appear to be in direct conflict with each other.

Dr Dahlgren also collected water samples at Vernalis and Mossdale during the summer of 2001 (Table 6). The concentration of chlorophyll, phaeophytin, BOD_{10}, dissolved organic nitrogen and dissolved organic carbon all increased between the two sites but not statistically so ($P>0.05$, paired T-Test). Only the concentration of particulate organic matter decreased, but again, the change was not significant. The lack of statistical significance may result from the small sample size ($n=7-10$). Regardless, the results support the observations of the City of Stockton in 2000 and of DWR in earlier years and suggest no decrease in either the concentration or load of oxidizable material between the two locations. Unfortunately, it is impossible from the Dahlgren data to determine the fate of material transported past Mossdale as this was their most downstream sampling site.

It is recommended that one or more Lagrangian studies (with a dye component) be undertaken between Vernalis and the DWSC in summer to verify travel time and ascertain whether changes in the concentration of oxygen requiring substances occur. If large inexplicable changes in either dye or oxidizable material are observed, then a follow up study should be undertaken to determine the responsible mechanism(s).

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[25] 1975-1993
[26] May through September.
[27] This represents a 70 to 80 percent decrease in chlorophyll load.

Origin of Summer Mossdale Algal Bloom

Understanding the origin and mechanism(s) controlling the summer phytoplankton bloom at Mossdale is important if the DWSC oxygen problem is to be solved by upstream load control. Primary production in the Central Valley is strongly influenced by solar radiation (Lehman, 2001). Algal production increases in May with increasing photoperiod, peaks in midsummer and declines as day length shortens in August and September.

Leland *et al*. (2001) examined the distribution of algae in the San Joaquin River basin and found that planktonic centric diatoms (Thalassiosirales) were dominant in the main river in summer. Pennate diatoms were proportionally more abundant (biomass) in autumn, winter and spring. Abundant taxa included the diatoms *Cyclotella meneghiniana, Skeletonema potamos, Cyclostephanos invisitatus, Thalassiosira weissflogii, Nitzschia acicularis*, N. *palea* and N. *reversa* and the chlorophytes *Chamydomonas* sp. and *Scenedesmus quadricauda*. In contrast, the three Eastside rivers had less plankton and more attached benthic algae. Important groups were the Achnanthales, Cybellales and Fragilarieales. This suggests that the rate, kind and seasonal pattern of primary production may differ by sub basin.

Seasonal algal concentration patterns were analyzed in all the major sources of water (Table 7) from the upper basin in both 2000 and 2001 to ascertain the origin of the Mossdale algal bloom. Two strategies were employed. First, seasonal pigment concentrations were examined at different locations in the San Joaquin River before, during and after[28] the summer bloom. It was assumed that the chlorophyll peak observed at Mossdale would not be present in river samples collected above the major source(s) of algae. Dr Dahlgren sampled chlorophyll every two weeks at two river locations above Mossdale. Both Maze Blvd and Patterson demonstrated the same pattern each year as Mossdale (Figures 10 and 11, Table 7) suggesting that the key algal tributaries were located above Patterson, the most upstream site sampled. The second strategy was to examine chlorophyll concentrations in each of the major tributary sources of water. It was assumed that the responsible sub basin(s) would have high standing algal concentrations (quantitatively similar to or greater than Mossdale) and would also demonstrate the same seasonal pattern. Only three sub basins fit this pattern: San Joaquin River above HWY 165, Mud and Salt Sloughs (Table 7, Figure 3). All three showed a significant increase and subsequent decline in chlorophyll at precisely the same time as Mossdale in both years ($P<0.05$, ANOVA and Tukey mean separation test). Also, algal abundance, though variable at the three locations in each year, was higher than at any other site measured in the watershed. Finally, all three locations are above Patterson.

Water from Orestimba Creek was sampled as representative of surface return flow[29] from agriculturally dominated natural creeks and man constructed drains. Surface return flow

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[28] Before: 31 March-9 June 2000 (N=6) and 6 February-16 May 2001 (N=8); During: 23 June-6 September 2000 (N=6) and 30 May-5 September 2001 (N=8); After: 20 September-23 November, 2000 (N=6) and 19 September-3 October 2001 (N=2)

[29] Irrigation return water from orchard, field and row crops.

is thought to comprise 18-20 percent of the summer volume of the San Joaquin River at Vernalis (Table 1 and 2). Mean summer chlorophyll concentrations in Orestimba Creek varied between 4-8 μg/l in both years and showed no change in abundance through the summer (Table 7). Additional sampling was conducted in 2001 by the U.S. Geological Survey at five other agriculturally dominated drains and creeks from the East and Westside of the valley. Purpose of this sampling was to ascertain whether their chlorophyll concentrations were similar to that at Orestimba Creek. Only part of the data has been returned but all values, with the exception of Hospital Creek, appear similar to Orestimba Creek (Table 8). The data suggests that irrigation tailwater is not likely to be the principal source of elevated chlorophyll concentrations at Mossdale. The cause of high algal abundance in Hospital Creek needs further evaluation.

The three Eastside Rivers (Merced, Tuolumne and Stanislaus) contribute 65-80 percent of the metered flow at Vernalis (Table 1 and 2). However, their discharge is not distributed evenly throughout the year (Figure 13). Reservoir releases are increased between 15 April and 15-May to push juvenile fall run Chinook salmon downstream (Vernalis Adaptive Management Program or VAMP) and again in October to attract spawning adults.

Chlorophyll concentrations in the three Eastside Rivers are consistently low throughout the year (Table 7 and Appendix A). Mean concentrations during the summer algal bloom time period at Mossdale ranged between 1.0-3.0 μg/l with no consistent seasonal pattern in either 2000 or 2001 (Table 7). However, the onset of the Mossdale algal bloom appeared in both years to coincide with the cessation of VAMP flow (Figure 13). Mossdale algal concentrations fell significantly in both years before the commencement of the October fish attracting flows (probably because of decreasing solar radiation) but the small increase in Eastside discharge drove chlorophyll concentrations down further at Mossdale each year. The underlying mechanism may be that increased flow from the Eastside Rivers acts to dilute the more algal concentrated water from the upper basin. If correct, the observation suggests a possible phytoplankton control strategy. Chlorophyll concentrations at Mossdale may either be reduced by decreasing algal concentrations at Salt and Mud Sloughs and the San Joaquin River at Hwy 165 or by increasing flow from the Eastside Rivers[30].

Algal Growth Model

An algal growth model was developed for the San Joaquin Basin to quantify the contribution of each sub basin to the phytoplankton bloom at Mossdale. The model used chlorophyll data collected by the U.S. Geological Survey and by UC Davis and was developed in three parts. First, the standing load from each sub basin was calculated. Second, the apparent doubling rate of plankton down the River was estimated. Finally, tributary chlorophyll loads were multiplied by their apparent growth rate to estimate their contribution to the total Mossdale load. Each step is described more fully below.

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[30]Regardless, under no circumstance should eastside flows through the DWSC be reduced further during the summer algal bloom season.

First, chlorophyll loads (kg/day)[31] from each sub basin were calculated using the UC Davis data for 2000 and 2001 (Appendix A). The values were arranged into time periods corresponding to the entire year and the algal bloom period at Mossdale. Next, the means for each time period were normalized against the Maze Blvd load (Table 9). This was accomplished by expressing each as a percentage of the Maze load. Maze Blvd was selected as it is the most downstream non-tidal UC Davis sampling location with a long chlorophyll record.

Eighteen-XX percent of the summer flow of the San Joaquin River at Vernalis in 2000 and 2001 was assumed to be agricultural surface return water (Table 1 and 2). Orestimba Creek was monitored as representative of this class of water. Estimated summer and annual loads from the Creek were insignificant as it has a much smaller discharge rate than the San Joaquin River at Maze Blvd. However, an attempt was made to estimate the contribution of all surface return flows by multiplying chlorophyll concentrations from Orestimba Creek by the Valley's estimated cumulative summer tail water discharge rate. The calculation suggests that tail water chlorophyll loads comprise about 1.5-XX percent of the Maze Blvd load (Table 9).

The only other large unaccounted for source(s) of San Joaquin River water are from groundwater and from sub surface tile drain water (Tables 1 and 2). Both are assumed to contain no chlorophyll at their point of origin and so have not been included in the analysis.

Algal growth in the River was assumed to be exponential:

$$B = A\ e^{X\ (\text{TRAVEL TIME})}$$

Where an upstream load (A) was expressed as a percentage of the downstream value (B) and travel time[32] was determined from a dye study conducted by the U.S. Geological Survey in June of 1994 (Kratzer and Biagtan, 1997). X is the doubling rate and was determined by solving the equation for known up and downstream loads.

Dr Dahlgren only has continuous chlorophyll data for the non-tidal river at Patterson and Maze Blvd. Mean algal-doubling rates for plankton moving between the two locations is presented in Table 10. The doubling rates were estimated using all the data collected in 2000 (n=26) and 2001 (n=23). Calculated doubling times varied between 41 and 58 hours.

The U.S. Geological Survey collected chlorophyll data in the main stem San Joaquin River (Figure 2) during both summers at four additional locations (San Joaquin River above the Merced River confluence, Crows Landing, Laird Park and Vernalis). The year 2000 data is posted on the IEP web page[33] and was used to supplement the UC Davis algal growth information. Loads were calculated for each river site and normalized to the

[31] Loads are calculated by multiplying concentration by flow.
[32] 0.81 miles per hour; Vernalis flow was 1,120 cfs.
[33] http://sarabande.water.ca.gov:8000/~bdtdb/sde8/calfedsjrdo_new.html

Vernalis value (Table 11). Doubling rates were calculated from this data by the same method as was employed with the UC Davis information (Table 10). Doubling times varied between 38-60 hours with a mean of 47 hours. The estimated U.S. Geological Survey doubling rate appears comparable to that determined from the UC Davis data. Much of the U.S. Geological Survey 2001 data is not yet available so no U.S. Geological Survey doubling rates for 2001 have been calculated.

Algal growth in natural and laboratory cultures is summarized as a function of temperature in U.S. EPA (1985). Algal doubling rates of 0-4 times per day are reported for temperatures of 20-25^{o}C. Most values cluster around 1-2 doubling per day. In contrast, the San Joaquin River's doubling rate of once every 1.5 to 2.5 days is low. Turbidity is assumed to be the primary factor inhibiting algal growth in the San Joaquin River (Lehman, 2001).

The "first cut type" exponential analysis used here assumes that the main change in chlorophyll load between river sites is due to algal growth. Other unaccounted for factors included in the apparent algal-doubling rate are tributary inputs, water diversions and algal herbivory. The first would increase the apparent growth rate value while the latter two would depress it. The Steering Committee may wish, as was done in this analysis, to not penalize upstream watersheds for algal loads that do not arrive at Mossdale either because they are lost to water diversions or herbivory. However, an accurate accounting of the size of the load from all unaccounted for tributary inputs would be desirable. This information does not exist at present although the analysis of the loads from Orestimba Creek and other agriculturally dominated small creeks and man constructed small drains do not suggest the loads are large. Information is presently being collected on herbivory and instream algal doubling rates (DWR) and on water diversion and return rates (Lawrence Berkeley Laboratory). These should be available for use by HydroQual and may result in the development of a more robust upstream algal growth model.

The final step in the development of the algal growth model was to calculate the potential contribution of each tributary to the total chlorophyll load at Maze Blvd. This was accomplished by multiplying standing loads by the exponential growth equation calculated with the UC Davis doubling rate of 41 and 58 hours for 2000 and 2001, respectively. The results are presented in Table 12 both as each tributaries potential load at Maze Blvd (kg/day) and as a percentage of the total Maze Blvd load. The results suggest that the three tributaries above the confluence of the Merced River (San Joaquin River at Hwy 165, Salt and Mud Sloughs)[34] account for more than 90 percent of the total chlorophyll load at Maze Blvd (and by extrapolation at Mossdale). The importance of the three upper tributaries result both from their high standing algal concentrations and from their long relative travel time to the DWSC. The conclusion about their relative importance is also consistent with the prior observation that these are the only waterbodies with seasonal algal abundance patterns similar to that of the San Joaquin at Mossdale. The results emphasize the need to understand the cause of their high chlorophyll concentrations if the DWSC oxygen deficit problem is to be solved, at least partially, by decreasing upstream algal loads.

[34] The three watersheds contribute about 10 percent of the metered flow at Vernalis (Tables 1 and 2).

In summary, regression analysis demonstrated that algae and algal derived material was responsible for most of the load of oxygen requiring substances from the upper basin at Mossdale. An inverse relationship exists between apparent BOD_{10} concentrations (or chlorophyll) at Mossdale and oxygen concentrations in the DWSC with the result that high concentrations at Mossdale co-occur with low dissolved oxygen concentrations in the channel and vice versa. Mechanisms responsible for the summer plankton bloom at Mossdale appear to be a combination of high algal export rates from Mud and Salt Sloughs and from the San Joaquin River at Hwy 165 and reduced Eastside reservoir releases. Potential algal control mechanisms include reducing the export of algal loads from the upper basin and/or increasing Eastside reservoir releases.

Nutrient Concentrations

Elevated nutrient concentrations are often implicated as one of the main causes of excess algal growth (Diaz, 2001; Boesch *et al*., 2001). Nitrogen[35] and/or phosphorus usually limit phytoplankton production in surface water. Flow-adjusted nitrate concentrations and loads in the San Joaquin River at Vernalis have increased steadily since 1950 while ammonia and phosphorus have not (Kratzer and Shelton, 1998). Nitrate concentrations[36] appear to have increased because of greater use of agricultural fertilizers, more land being brought into agricultural production and increased use of sub surface tile drainage. Loading studies conducted between 1986-88 suggest that 68 and 81 percent of the total load of nitrogen and phosphorous in the river at Vernalis is from non-point sources, mostly agriculture (Kratzer and Shelton, 1998). Mud and Salt Sloughs account for about half of the Vernalis nitrate load. The U.S. Geological Survey was funded in 2000 and in 2001 to again determine the primary sources of nitrogen and phosphorus in the watershed and to ascertain whether concentrations have changed since 1990. No report is available yet.

The nutrient concentration that limits[37] plankton algal growth is somewhat variable by water body type (U.S. EPA, 1985). Lee and Jones-Lee (2000) suggest that the concentration of bioavailable orthophosphorus should be about 5-µg/l-soluble P while bioavailable nitrogen should be about 37.5 µg/l-N[38] in flowing water to limit algal growth rates. These concentrations are used here as a benchmark for beginning an evaluation to determine whether further decreases might be a viable method of limiting algal growth. The assumption employed here was that it was likely to only be cost effective to attempt to reduce a nutrient that is already close to or at a rate limiting concentration. The target concentrations should be verified for key water bodies by conducting a combination of

[35] Ammonia, nitrite, and nitrate and soluble orthophosphates are the most bioavailable forms of nitrogen and phosphorus respectively.

[36] Flow adjusted nitrate concentrations have increase by a factor of 4 since 1950--from about 300 to 1400 µg/l.

[37] Limitation is defined here as a nutrient concentration that under normal environmental conditions would be predicted to reduce resident algal doubling rates. Obviously, a decrease in algal doubling time will decrease standing algal biomass if other physical and environmental conditions such as light, temperature and water residence time do not change.

[38] Based on an N:P algal mass stoichiometry balance of 7.5:1

laboratory and field nutrient addition and removal experiments if it is determined that nutrient control might be a possible best management alternative.

Three surveys were undertaken during the summer of 2001 to determine the nutrient concentration in each of the major tributaries of the San Joaquin River. The purpose of the sampling was to ascertain the origin of the nutrients and determine whether concentrations in any sub basin might be low enough to warrant attempting to control algal growth by limiting nutrient levels. The strategy consisted of sampling water in each tributary near its origin, about half way to the San Joaquin, and again just above its confluence with the main stem River (Figure 4).

Nutrient levels for the lower San Joaquin River between Patterson and Mossdale ranged from 2,300-43,700 μg/l-N and from 20-280 μg/l-P. The concentrations of available nitrogen and phosphorus exceed suggested growth limiting values by 60-1165 and 5-56 fold, respectively. This suggests that nutrient control on the main-stem San Joaquin River is not likely to be a cost-effective endeavor. As noted earlier, plankton growth on the main river is now assumed to be light limited. If correct, it is essential that turbidity not be allowed to decrease or the river may experience an acceleration in algal growth with the result that more algae is transported into the DWSC and oxygen levels are suppressed further.

Much of the water for the westside of the valley, including Salt and Mud Sloughs, comes from diversions out of the Delta at Tracy and subsequent transport south on the Delta Mendota Canal (DMC). Part of the water in the DMC comes from the San Joaquin River via Old River and the remainder from the Sacramento River. Water was sampled at Old River at Tracy and at 3 other locations down the DMC. Bioavailable nitrogen and phosphorus concentrations in the DMC ranged between 230-700 μg/l and 59-95 μg/l, respectively (Table 13).

One proposed solution to the oxygen deficit in the DWSC is to construct a series of barriers in the South Delta and pump additional water into and through Old River for discharge to the DWSC (Hildebrand, 2001). Chlorophyll concentrations in Old River at Tracy were similar to those at Mossdale on two of the three occasions sampled (Table 13). On the third occasion (19 September) Mossdale was twice as high. The present chlorophyll concentrations at Old River would not dilute algal levels at Mossdale during bloom conditions and, therefore, are not likely to ameliorate the oxygen deficit in the DWSC. An increase in chlorophyll concentration may actually exascerbate the oxygen deficit in the DWSC. Interestingly, chlorophyll concentrations in the DMC at Tracy were much lower, 2.8-3.8 μg/l, and could, if delivered, provide significant dilution at Mossdale. A key question is what the chlorophyll concentrations in Old River might be if Sacramento River water were pumped through for discharge to the DWSC.

Mud Slough was sampled at three locations. Nitrogen and phosphorus concentrations ranged between 140-350 μg/l-N and 160-250-P μg/l at Gun Club Road, the upper site (Table 13). The nitrogen levels are about half of what was transported south on the DMC while orthophosphate levels are about three times greater. Bioavailable nitrogen increased 20 to 64-fold between Gun Club Road and Hwy 140, the confluence with the San Joaquin. All nitrogen concentrations appear too elevated to make them worthwhile to attempt to control. In contrast, orthophosphate levels fell from 164-250 to 2-7 μg/l-P between Gun Club Road and Kesterson and Hwy 140 on two of the three occasions sampled. On the third occasion phosphorus concentration fell 6-fold but was probably not phytoplankton limiting. Other unreported UC Davis measurements confirm these data and suggest that phosphorus may routinely be limiting between May and August in lower Mud Slough. The loss of phosphorus could result from high biological productivity as similar patterns were not apparent in the winter UC Davis data. Studies should be undertaken to determine why orthophosphate concentrations are decreasing and whether any further decreases are cost-effective and might limit algal standing biomass exported out of Mud Slough to the San Joaquin River.

Salt Slough was also sampled at three locations. Available nitrogen and phosphorus levels ranged between 150-1600 μg/l-N and 66-210 μg/l-P. These values are 4-43 and 13-44 times limiting concentrations, respectively, suggesting that no cost effective algal control is likely by limiting nutrients. Other algal control strategies should be investigated for use in Salt Slough.

The San Joaquin River at Hwy 165 was also sampled on three occasions. Nitrogen and phosphorus levels ranged between 80-1680 μg/l-N and 18-67 μg/l-P. None of these values appear limiting to natural phytoplankton growth. Like at Salt Slough, other algal control methods need evaluation.

The three Eastside Rivers were sampled below their most downstream reservoir, half way to the San Joaquin River and immediately above the confluence. All three rivers reveal a similar pattern of increasing nitrate and orthophosphate concentrations with increasing distance from the Sierra Nevada Mountains. Nitrate and orthophosphate concentrations increase 3 to 100-fold. Concentrations of phosphorus are potentially limiting to algae in the headwaters but are clearly not so by the confluence with the San Joaquin. Algal concentrations also increase 2-10 fold between the Sierras and the valley floor. An effective phosphorus control program might be possible in the headwaters of the three Eastside Rivers. However, the present phytoplankton levels are already low and a further reduction is unlikely to be of value unless Eastside flows could be increased at key times to dilute algal concentrations from the upper basin.

In conclusion, nutrient concentrations were measured in each major San Joaquin River sub basin to determine whether primary production might be controlled in summer by restricting bioavailable nitrogen and phosphorus levels. Nutrient concentrations in Mud and Salt Sloughs and in the San Joaquin River at Hwy 165 were of particular interest as these three water bodies contribute more than 90 percent of the summer Maze Blvd algal load. Data from Mud Slough suggested that algal growth might be phosphorus limited in the lower part of the Slough. No nutrient limitation was apparent in the San Joaquin River at Hwy 165 or at Salt Slough. In contrast, phosphorus appeared potentially limiting to algal growth in the headwaters of the three Eastside Rivers. Evaluating the efficacy and cost-effectiveness of nutrient control in Mud Slough may be worthwhile. Other algal control methods should be investigated for use at Salt Slough and at the San Joaquin River at Hwy 165.

Recommendations For Additional Work

Seven recommendations for additional work are suggested. First, employ the new HydroQual model, once calibrated, to ascertain the cumulative impact of the creation of the Stockton DWSC on dissolved oxygen concentrations. Second, employ the HydroQual model to evaluate the effect, singly and in combination, of changes in upstream flow and of chlorophyll concentrations at Mossdale on channel oxygen levels. Third, fund UC Davis to continue collecting water quality data in the San Joaquin Basin. Fourth, install an *in vivo* florometer at Mossdale and evaluate its utility for predicting loads of chlorophyll from the upper basin. Fifth, conduct a Lagrangian study (with a dye component) in summer between Vernalis and the DWSC to ascertain whether changes in the concentration of oxygen requiring substances occur. If large inexplicable changes in either dye or oxidizable material are observed, then conduct a follow-up study to determine the responsible mechanism(s). Sixth, conduct field and laboratory phosphorus addition and removal experiments in water from Mud Slough to confirm algal nutrient limitation. If nutrient limitation is confirmed, ascertain why phosphorus levels are declining and whether this can be developed into a nutrient best management plan. Finally, evaluate non-nutrient algal control mechanisms for possible use in Salt Slough and in the San Joaquin River at Hwy 165.

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Table 1. Seasonal and annual metered flow (acre-feet) for the San Joaquin basin for water year 2000. Water year 2000 is defined as the time interval between 1 October 1999 and 30 September 2000. Data is from the San Joaquin River Input-Output model.

	ANNUAL		JUNE-NOVEMBER	
	FLOW	(%)	FLOW	(%)
East-side Tributaries	2,324,011	79.4	625,369	65.7
Salt Slough	155,991	5.3	62,058	6.5
Mud Slough	90,639	3.1	35,307	3.7
Groundwater	89,115	3.0	50,785	5.3
Surface Return flows[1]	257,385	8.8	171,662	18.0
Subsurface return flows	10,444	0.4	6,091	0.6
Total for Basin	2,927,585	100.0	951,270	100.0

1/Surface return flows from agriculturally dominated natural creeks and man constructed drains.

Table 2. Seasonal and annual metered flow (acre-feet) for the San Joaquin basin for water year 2001. Water year 2001 is defined as the time interval between 1 October 2000 and 30 September 2001. Data is from the San Joaquin River Input-Output model.

	ANNUAL		JUNE-NOVEMBER	
	FLOW	(%)	FLOW	(%)
East-side Tributaries				
Salt Slough				
Mud Slough				
Groundwater				
Surface Return flows[1]				
Subsurface return flows				
Total for Basin				

1/Surface return flows from agriculturally dominated natural creeks and man constructed drains.

Table 3. Oxygen concentration (mg/l) in the San Joaquin River 10 miles upstream of the DWSC at Bowman Road, half a mile above the channel entrance, and 3 miles down the DWSC off Rough and Ready Island during the summer of 1999, 2000, and 2001. The data were collected by the City of Stockton at mid depth and demonstrate a consistent decrease in oxygen concentration down channel.

	Dissolved Oxygen Concentration (mg/l)		
Date	**R1**	**R2**	**R5**
6/2/99	9.0	9.0	7.0
6/8/99	10.0	10.0	9.0
6/15/99	9.0	9.0	7.0
6/22/99	9.0	9.0	7.0
7/1/99	10.0	10.0	5.0
7/6/99	9.0	7.0	5.0
7/13/99	8.0	5.0	4.0
7/20/99	8.0	8.0	5.0
7/27/99	9.0	7.0	5.0
8/5/99	8.0	8.0	6.0
8/10/99	8.0	7.0	5.0
8/17/99	8.0	8.0	5.0
8/24/99	7.0	6.0	5.0
8/31/99	8.0	7.0	5.0
9/7/99	7.0	7.0	6.0
9/14/99	8.0	7.0	5.0
9/21/99	7.0	7.0	5.0
9/28/99	6.0	6.0	4.0
10/5/99	6.0	6.0	3.0
10/12/99	6.0	6.0	4.0
10/19/99	8.0	8.0	4.0
10/26/99	8.0	7.0	5.0
11/4/99	8.0	8.0	5.0
11/9/99	8.0	8.0	6.0
11/16/99	8.0	7.0	5.0
11/24/99	8.0	8.0	5.0
average	**8.0**	**7.5**	**5.3**
6/6/00	9.0	10.0	7.0
6/13/00	9.0	9.0	8.0
6/20/00	8.0	8.0	5.0
6/27/00	11.0	8.0	5.0
7/5/00	8.0	5.0	5.0
7/11/00	8.0	8.0	5.0
7/18/00	10.0	7.0	4.0
7/25/00	9.0	9.0	5.0
8/1/00	10.0	8.0	5.0
8/8/00	8.0	7.0	5.0

Table 3 (continued).

	Dissolved Oxygen Concentration (mg/l)		
Date	**R1**	**R2**	**R5**
8/15/00	10.0	7.0	5.0
8/22/00	8.0	7.0	6.0
8/29/00	10.0	9.0	6.0
9/5/00	8.0	8.0	8.0
9/12/00	11.0	10.0	8.0
9/19/00	8.0	8.0	6.0
9/26/00	9.0	9.0	8.0
10/3/00	8.0	8.0	5.0
10/12/00	8.0	8.0	7.0
10/17/00	9.0	8.0	7.0
10/24/00	8.0	9.0	8.0
10/31/00	9.0	8.0	8.0
11/7/00	9.0	9.0	9.0
11/14/00	10.0	10.0	9.0
11/21/00	10.0	9.0	9.0
11/30/00	10.0	8.0	6.0
average	**9.0**	**8.2**	**6.5**
6/12/01	10.2	7.2	4.2
6/19/01	9.9	7.1	4.8
6/26/01	8.1	6.3	3.1
7/10/01	8.2	5.6	3.3
7/17/01	8.6	6.9	4.4
7/24/01	7.4	4.6	3.4
7/31/01	7	6.2	4.0
8/7/01	6.2	5.9	3.9
8/14/01	6.6	6.4	4.0
8/21/01	6.4	5.8	3.4
8/28/01	7.6	5.9	4.9
average	**7.8**	**6.2**	**3.9**

Table 4. Results of stepwise multiple linear regressions of BOD_{10} (mg/l) as the dependent variable and chlorophyll a (Chloro, μg/l), phaephytin (Phaeo, μg/l), dissolved organic carbon (DOC, mg/l), particulate organic matter (POM, mg/l), ammonia (mg/l) and dissolved organic nitrogen (mg/l) as independent variables. Water was collected from the San Joaquin basin during the summer of 2000 and 2001. Data are from Dr Dahlgren, UC Davis

Location	**Equation**	**N**	**R^2**
Maze Blvd	BOD_{10}=0.111(Chloro)+2.076	15	0.70
Mossdale	BOD_{10}=0.651(POM)-0.805	15	0.69
Maze, Vernalis and Mossdale	BOD_{10}=0.083(Chloro) +0.140(Phaeo)+1.94	37	0.76

Table 5. Correlation between 10-day and other length oxygen consumption rate tests for water collected in the San Joaquin Basin during the summer of 2000.

BOD_{10}	**BOD_5**	**BOD_{15}**	**BOD_{20}**	**BOD_{25}**	**BOD_{30}**
Slope	0.65	1.30	1.50	1.71	1.85
Correlation coefficient[39]	0.98	0.99	0.97	0.96	0.93
Sample size	40	40	40	40	40
Probability	P<0.001	P<0.001	P<0.001	P<0.001	P<0.001

[39] Pierson Correlation Coefficient

Table 6. Change in concentration of oxygen requiring substances between Vernalis and Mossdale during the summer of 2001. No significant difference was noted for any constituent (P>0.05, paired T-Test).

Constituent	Mean concentration				
	Mossdale	**Vernalis**	**N**	**Percent difference[1]/**	**P-value[2]/**
Chlorophyll a (µg/l)	30.34	24.4	10	20	0.14
Phaeophytin (µg/l)	9.07	5.48	10	40	0.10
Chlorophyll +Phaeophytin (µg/l)	39.41	29.88	10	24	0.06
BOD_{10} (mg/l)	6.67	4.63	7	44	0.06
Dissolved Organic Nitrogen (mg/l)	0.71	0.60	10	18	0.49
Ammonia (mg/l)	0.22	0.10	10	120	0.12
Particulate Organic Matter (mg/l)	9.81	10.5	10	-6	0.46
Dissolved Organic Carbon (mg/l)	3.23	2.87	9	11	0.06
Electrical Conductivity (µmos/cm)					

1/ (Mossdale-Vernalis)/Vernalis X 100
2/ Paired two tailed T-Test

Table 7. Mean chlorophyll concentration (µg/l) in the San Joaquin River and in upstream tributaries before, during and after the summer phytoplankton bloom at Mossdale in 2000 and 2001. Values with the same letter in the same line are not significantly different (ANOVA and Tukey mean separation test).

SITE	YEAR	BEFORE[1/]	DURING[2/]	AFTER[3/]	PROBABILITY
San Joaquin R @ Mossdale	2000	7.0+/-1.4 A	38.0+/-4.8 B	5.2+/-1.0 A	P<0.001
San Joaquin R. @ Maze Blvd		6.9+/-1.3 A	30.8+/-4.6 B	5.3+/-0.5 A	P<0.001
San Joaquin R @ Patterson		11.2+/-2.2 A	46.3+/-6.3 B	6.0+/-1.4 A	P<0.001
Stanislaus R.		1.2+/-0.1 A	1.0+/-0.1 A	0.7+/-0.1 B	P<0.01
Tuolumne R.		1.4+/-0.2 A	1.0+/-0.2 B	0.7+/-0.1 B	P<0.05
Merced R.		1.0+/-0.1 A	1.0+/-0.1 A	0.8+/-0.2 A	NS[4/]
Orestimba Ck		5.8+/-1.6 A	4.0+/-0.8 A	3.0+/-0.9 A	NS
San Joaquin R @ Hwy 165		52.6+/-12.3 A	154.9+/-5.7 B	20.4+/-6.9 A	P<0.05
Mud Slough		24.7+/-4.7 A	47.4+/-7.0 B	7.7+/-1.8 A	P<0.01
Salt Slough		7.7+/-2.9 A	17.3+/-1.6 B	8.7+/-1.1 A	P<0.05
San Joaquin R @ Mossdale	2001	9.3+/-2.2 A	49.8+/-5.1 B	20.5+/-4.7 A	P<0.001
San Joaquin R. @ Maze Blvd		7.1+/-1.0 A	42.5+/-4.8 B	18.5+/-5.0 A	P<0.001
San Joaquin R @ Patterson		9.5+/-2.0 A	34.2+/-5.7 B	14.5+/-0.3 A	P<0.001
Stanislaus R.		2.8+/-0.7 A	2.1+/-0.8 A	1.2+/-0.1 A	NS
Tuolumne R.		1.8+/-0.2 A	3.0+/-0.3 B	2.9+/-0.3 B	P<0.001
Merced R.		1.4+/-0.4 A	2.5+/-0.5 A	1.6+/-0.1 A	NS
Orestimba Ck		3.6+/-0.5 A	8.1+/-2.9 A	2.9+/-0.6 A	NS
San Joaquin R @ Hwy 165		58.8+/-17.5 A	186.0+/-42 B	103.0+/-22 A	P<0.05
Mud Slough		36.5+/-10.1 A	39.1+/-6.5 A	15.5+/-1.7 A	NS
Salt Slough		7.3+/-1.0 A	15.8+/-1.9 B	10.9+/-1.6 A	P<0.01

[1/] Mean +/- standard error of samples taken between 31 March-9 June 2000 (N=6) and 6 Feb-16 May 2001 (N=8)
[2/] Samples taken between 23 June-6 Sept 2000 (N=6) and 30 May-5 Sept 2001 (N=8)
[3/] Samples taken between 20 Sept-23 Nov 2000 (N=6) and 19 Sept-3 Oct 2001 (N=2)
[4/] Not significant

Table 8. Chlorophyll concentrations (µg/l) in selected agriculturally dominated creeks and man-constructed drains in the San Joaquin Basin during the summer of 2001. Not all values are reported yet. Data is from the U.S. Geological Survey (personal communication Dileanis).

	DATE				
LOCATION	13 June	11 July	6 August	4 September	2 October
Spanish Grant Main Drain	14.4	5.4			
Turlock Irrigation District 5	4.4	1.7	13.3		
Westport Drain	1.7	1.8	2.5		
Hospital Creek	81.5	16.7	12.1		
Lone Tree Creek	2.8	2.2	3.0		

Table 9 Summary of mean tributary chlorophyll loads expressed as a percentage of the Maze Blvd load for the entire year and for the summer algal bloom in 2000 and 2001. Data from UC Davis (Appendix A).

SITE	YEAR	Annual[1/]	Bloom [2/]
San Joaquin R. @ Maze Blvd	2000	100.0	100.0
San Joaquin R @ Patterson		64	79
Stanislaus R.		19	1
Tuolumne R.		15	2
Merced R.		4	1
Orestimba Ck		1	0
Surface Return Flow			1.5
San Joaquin R @ Hwy 165		19	20
Mud Slough		13	7
Salt Slough		9	6
San Joaquin R. @ Maze Blvd	2001	100	100
San Joaquin R @ Patterson		73	63
Stanislaus R.		12	3
Tuolumne R.		8	3
Merced R.		3	1
Orestimba Ck		1	0
Surface Return Flow			?
San Joaquin R @ Hwy 165		26	12
Mud Slough		24	7
Salt Slough		12	7

[1/] Samples taken between 8 January-29 December 2000 (n=26) and 9 January-14 November 2001 (n=23)
[2/] Samples taken between 23 June-6 Sept 2000 (N=6) and 30 May-5 Sept 2001 (N=8)

Table 10. Estimated doubling rate of chlorophyll a in the San Joaquin River between Patterson and Maze Blvd in 2000 and 2001. Data is from UC Davis.

Year	% Maze Blvd Load[1/]	Travel time (days)	X[2/]	Doubling Time (Hr)[3/]
2000	64	1.1	0.406	41
2001	73	1.1	0.286	58

[1/]Chlorophyll load at Patterson as a percentage of that at Maze Blvd.
[2/] Calculated by solving the following equation for "X": Maze Blvd Load = Patterson Load $e^{x\text{ (travel time)}}$
[3/] Estimated algal-doubling time between Patterson and Maze Blvd by season.

Table 11. Estimated doubling time of chlorophyll in the San Joaquin between each river location and Vernalis in the summer of 2000. Data is from the U.S. Geological Survey.

Location	% Vernalis Load	Travel Time (days)	X[1/]	Doubling Time (Hr)
Merced R.	36	2.3	0.444	38
Crows Landing	53	1.8	0.353	47
Laird Park	78	0.9	0.276	60
		Mean	0.358	47

[1]Vernalis Load = River Load $e^{x \text{ travel time}}$

Table 12. Estimate of the potential chlorophyll contribution of each tributary to the total Maze Blvd load after considering river growth for the algal bloom period[1] in 2000 and 2001. Also presented is the percentage that each tributary contributes to the total load at Maze Blvd.

SITE	YR	% Maze Load	Travel Time (days)	Potential Chloro Load[3/]	Potential Chloro Load as % Maze Load
San Joaquin R. @ Maze Blvd	2000	100.0	0.0		
San Joaquin R @ Patterson			1.1		
Stanislaus R.		(1.0)	-0.1	-	
Tuolumne R.		2	0.3	3	3
Merced R.		1	2.0	2	2
Surface Return flows[2/]		1.5	1.6	3	3
San Joaquin R @ Hwy 165		20	2.8	62	60
Mud Slough		7	2.2	17	16
Salt Slough		6	2.7	18	17
San Joaquin R. @ Maze Blvd	2001	100	0.0		
San Joaquin R @ Patterson			1.1		
Stanislaus R.		3	-0.1	-	
Tuolumne R.		3	0.3	3	5
Merced R.		1	2.0	2	3
Surface Return flows[2/]			1.6	?	
San Joaquin R @ Hwy 165		12	2.8	27	45
Mud Slough		7	2.2	13	22
Salt Slough		7	2.7	15	25

[1/] 23 June-6 Sept 2000 and 30 May-5 Sept 2001

[2/] Tailwater discharges are located all along the River. For simplicity their average discharge point was assumed to be located near Patterson, halfway down the River. Estimated by multiplying the mean chlorophyll concentration from Orestimba by the mean summer surface return flow from Table 1 and 2.

[3/] Potential chlorophyll load = (% Maze load) $e^{x \text{ travel time}}$ where x = 0.406 for 2000 and 0.286 for 2001 (Table 10).

Table 13. Nutrient concentrations in San Joaquin sub basins in 2001. Locations are listed from up to down stream. Data is from U.C. Davis.

			Flow	**EC**	**NH_3-N**	**NO_3-N**	**TP[1/]**	**PO_4-P**	**Chloro**
Watershed	**Site**	**Date**	**cfs**	**μmohs/cm**	**μg/l**	**μg/l**	**μg/l**	**μg/l**	**μg/l**
Lower SJR[2/]	Patterson	22 Aug			110	4,030	373	19	28.8
	Maze Blvd		921		50	3,070	294	119	25.2
	Vernalis		1340		20	2,300	240	104	21.6
	Mossdale		1340		40	2,090	218	102	25.4
Lower SJR	Patterson	6 Sept			20	43,700	372	218	24.5
	Maze Blvd		887		50	24,500	266	91	48.7
	Vernalis		1280		20	17,700	228	63	50.4
	Mossdale		1280		50	15,400	218	82	47.0
Lower SJR	Patterson	19 Sept			270	35,300	414	282	14.3
	Maze Blvd		980		40	29,100	220	110	23.5
	Vernalis		1330		40	23,600	215	103	15.1
	Mossdale		1330		300	20,500	225	128	25.2
DMC[3/]	Old R. @ Tracy Blvd	22 Aug		815	300	20,800	322	209	20.9
	Tracy Pumps			456	50	420	119	66	3.9
	Volta			466	40	700	177	95	3.2
	Mendota Pool			557	40	540	192	76	4.0

[1/]Total phosphorus
[2/]San Joaquin River below confluence of Merced River
[3/]Delta Mendota Canal

Table 13. (Continued).

Watershed	Site	Date	Flow cfs	EC μmohs/cm	NH_3-N μg/l	NO_3-N μg/l	TP μg/l	PO_4-P μg/l	Chloro μg/l
DMC	Old R. @ Tracy Blvd	6 Sept		855	140	1,580	232	167	46.2
	Tracy Pumps			523	90	470	145	59	3.0
	Volta			624	20	560	119	63	2.8
	Mendota Pool			611	100	610	127	70	3.7
DMC	Old R. @ Tracy Blvd	19 Sept		794	20	1,810	296	177	53.3
	Tracy Pumps			702	100	330	130	67	3.2
	Volta			718	180	230	105	71	2.9
	Mendota Pool			701	40	450	120	71	4.0
Mud Slough	Gun Club Rd	22 Aug		1076	30	110	384	164	14.8
	Kesterson				50	110	62	4	31.3
	Hwy 140			3040	10	7,040	106	4	16.7
Mud Slough	Gun Club Rd	6 Sept		981	110	240	456	252	8.6
	Kesterson				20	6,130	153	2	15.6
	Hwy 140			2810	80	5,680	136	7	19.1

Table 13. (Continued).

			Flow	EC	NH_3-N	NO_3-N	TP	PO_4-P	Chloro
Watershed	**Site**	**Date**	**cfs**	**μmohs/cm**	**μg/l**	**μg/l**	**μg/l**	**μg/l**	**μg/l**
Mud Slough	Gun Club Rd	19 Sept		926	80	100	357	223	9.6
	Kesterson				50	3,640	192	63	13.7
	Hwy 140			2370	30	3,090	127	40	9.1
Salt Slough	Hereford Rd	22 Aug		773	80	1,540	518	198	5.8
	Wolfsen Rd			973	80	1,400	451	157	8.6
	Hwy 165				60	1,260	384	164	13.0
Salt Slough	Hereford Rd	6 Sept		1106	10	780	402	210	7.2
	Wolfsen Rd			1484	60	350	245	110	8.4
	Hwy 165				50	170	274	167	9.4
Salt Slough	Hereford Rd	19 Sept		939	30	150	291	108	2.1
	Wolfsen Rd			1476	20	320	146	66	7.9
	Hwy 165				40	140	176	103	12.5
Upper SJR[2/]	Bear Ck	22 Aug		76	150	590	177	77	4.3
	Hwy 165		24		530	1,150	473	18	347.8

[2/]San Joaquin River above confluence of Merced River

Table 13. (Continued).

			Flow	EC	NH_3-N	NO_3-N	TP	PO_4-P	Chloro
Watershed	**Site**	**Date**	**cfs**	**μmohs/cm**	**μg/l**	**μg/l**	**μg/l**	**μg/l**	**μg/l**
Upper SJR	Bear Ck	6 Sept		151	110	1,160	104	54	3.1
	Hwy 165		23		380	30	372	67	196.6
Upper SJR	Bear Ck	19 Sept		172	20	1,100	76	50	4.2
	Hwy 165		18		60	20	192	32	125.3
Merced R.	Snelling	22 Aug	166	35	30	60	17	2	0.7
	Livingston			49	40	90	25	8	0.6
	River Rd		119		30	3,450	66	32	1.5
Merced R.	Snelling	6 Sept	169	32	90	30	17	2	0.9
	Livingston			47	100	60	22	8	0.6
	River Rd		76		40	2,930	425	24	1.6
Merced R.	Snelling		179	31	30	260	16	4	0.7
	Livingston	19 Sept		46	40	40	28	28	0.6
	River Rd		153		50	2,250	55	157	1.7

Table 13. (Continued).

Watershed	Site	Date	Flow Cfs	EC µmohs/cm	NH_3-N µg/l	NO_3-N µg/l	TP µg/l	PO_4-P µg/l	Chloro µg/l
Tuolumne R.	La Grange	22 Aug	142	37	20	50	11	4	0.5
	Modesto		327	187	70	95	60	28	1.4
	Shiloh		327		10	1,850	243	157	3.7
Tuolumne R.	La Grange	6 Sept	125	39	90	60	10	2	0.7
	Modesto		335	207	80	1,110	68	36	1.7
	Shiloh		327		10	1,870	218	162	2.1
Tuolumne R.	La Grange	19 Sept	122	37	30	34	9	0	0.2
	Modesto		336	195	10	1,050	55	34	1.8
	Shiloh		336		20	1,700	169	106	2.5
Stanislaus R.	O. Blossom[1/]	22 Aug	354	61	20	70	12	8	0.5
	Escalon Rd		419	74	20	180	41	15	0.6
	Caswell Park		419		30	230	96	44	1.4
Stanislaus R.	O. Blossom	6 Sept	331	64	10	90	17	7	0.8
	Escalon Rd		393	81	10	260	33	15	0.7
	Caswell Park		393		30	260	96	54	1.2

[1/] Orange Blossom Road

Table 13. (Continued).

			Flow	EC	NH_3-N	NO_3-N	TP	PO_4-P	Chloro
Watershed	**Site**	**Date**	**Cfs**	**μmohs/cm**	**μg/l**	**μg/l**	**μg/l**	**μg/l**	**μg/l**
Stanislaus R.	O. Blossom	19 Sept	292	66	40	20	17	3	0.5
	Escalon Rd		350	82	10	240	67	45	1.0
	Caswell Park		350		50	270	98	65	1.2

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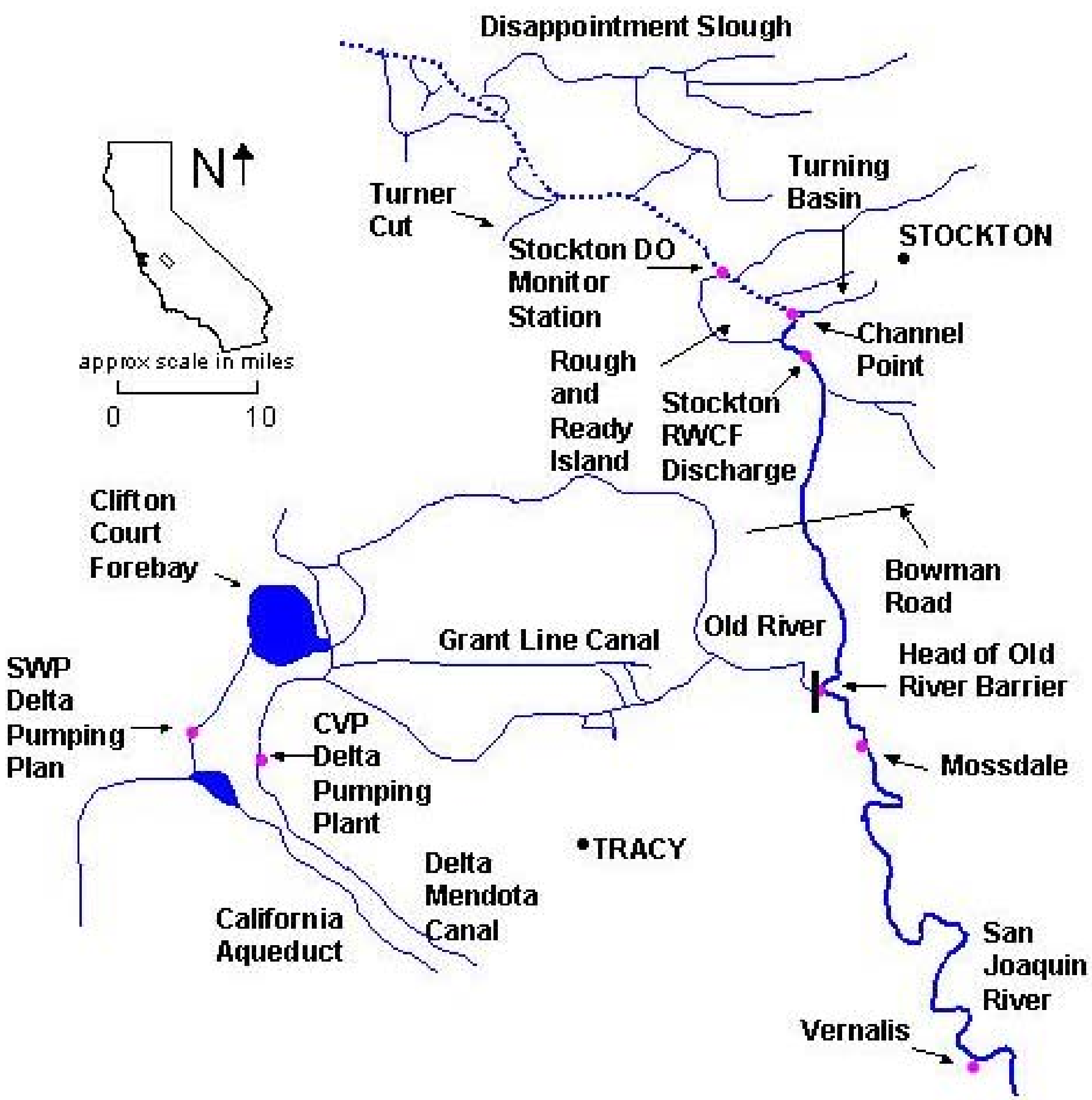


Figure 1. Map of Stockton deep water ship channel (dashed lines) and vicinity.

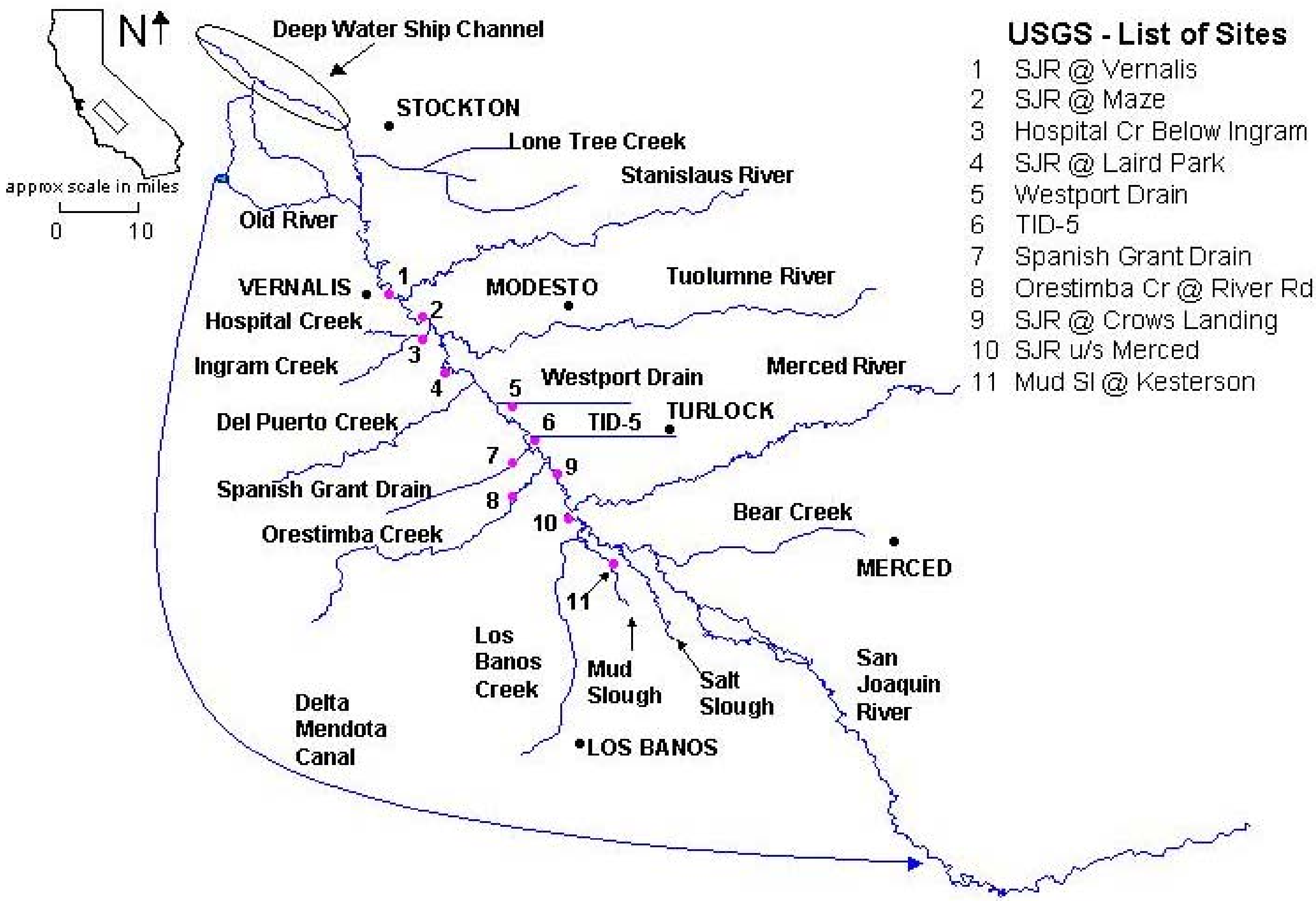


Figure 2. USGS sampling sites.

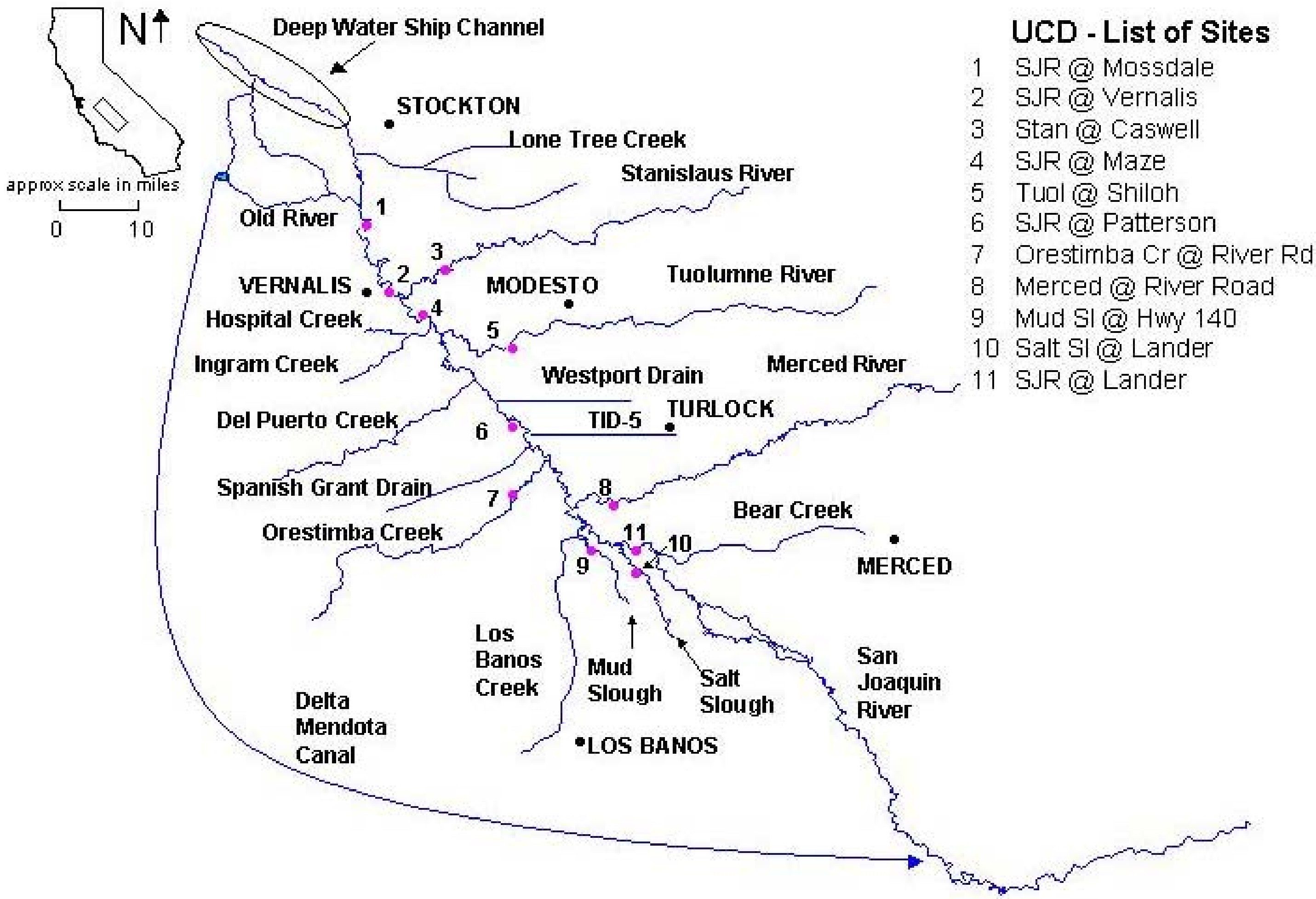


Figure 3. UC Davis sampling sites.

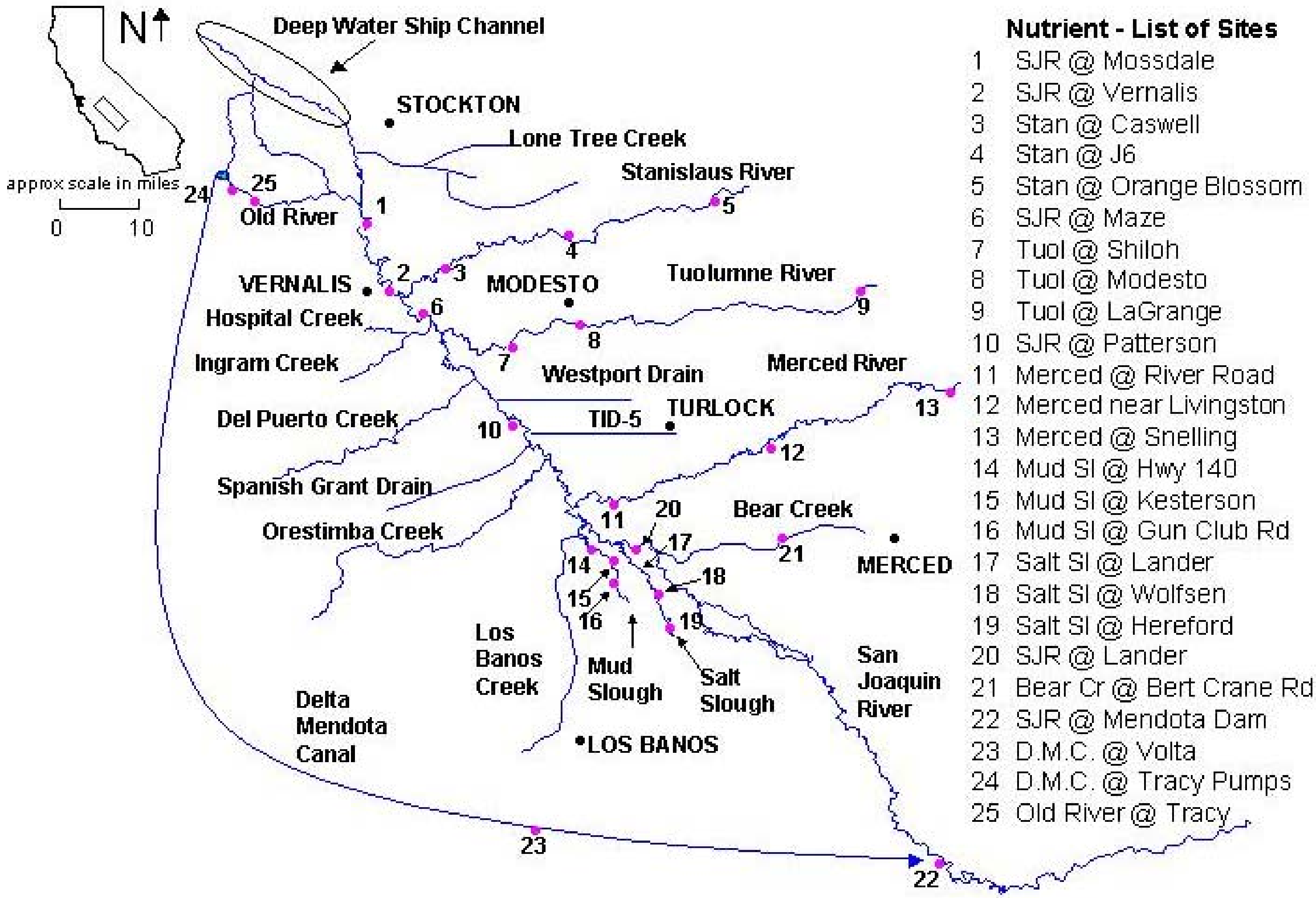


Figure 4. Nutrient study sampling sites.

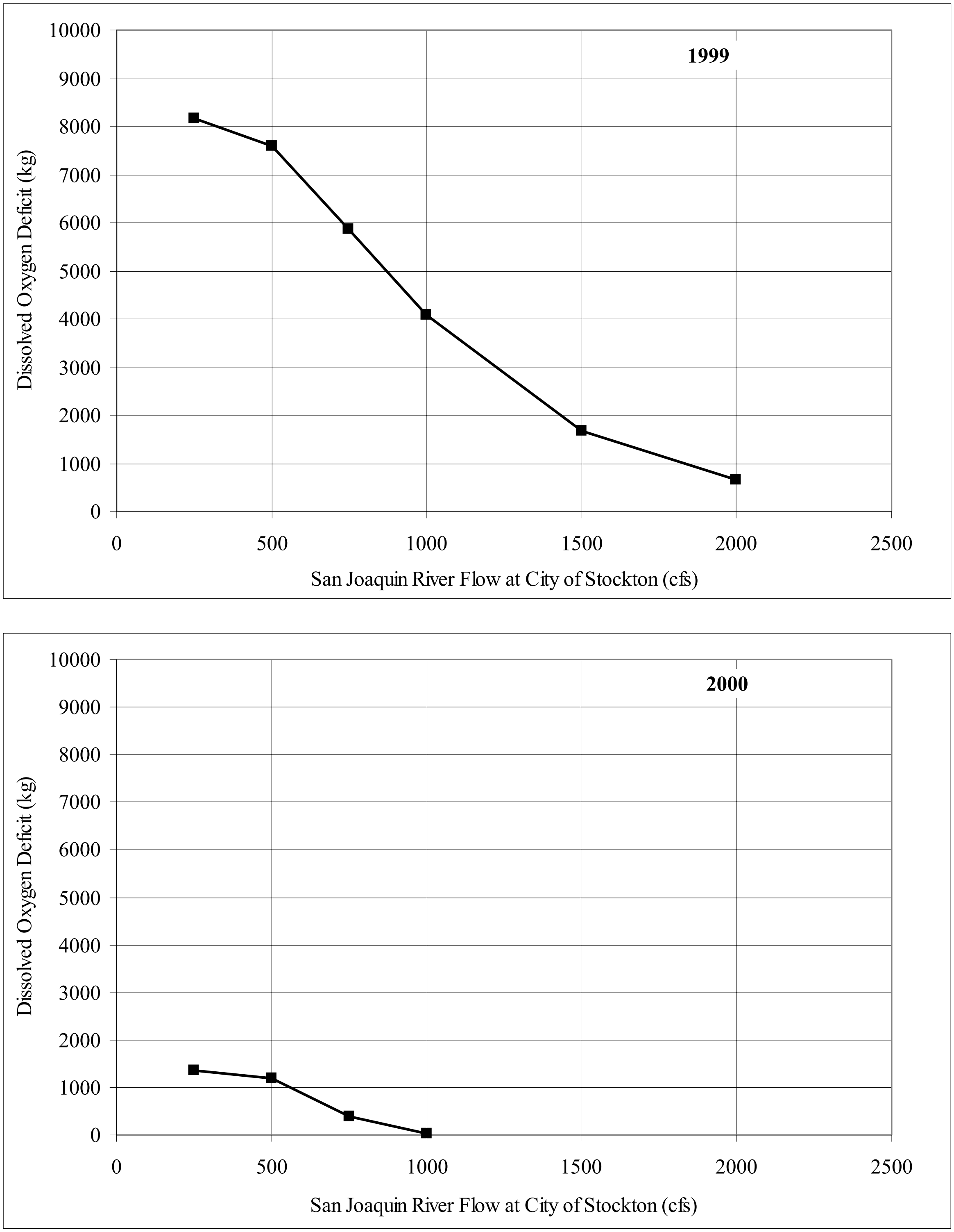


Figure 5. Cumulative oxygen deficit predicted by the Systech model for the time period of July to October 1999 and 2000 as a function of increasing river flow.

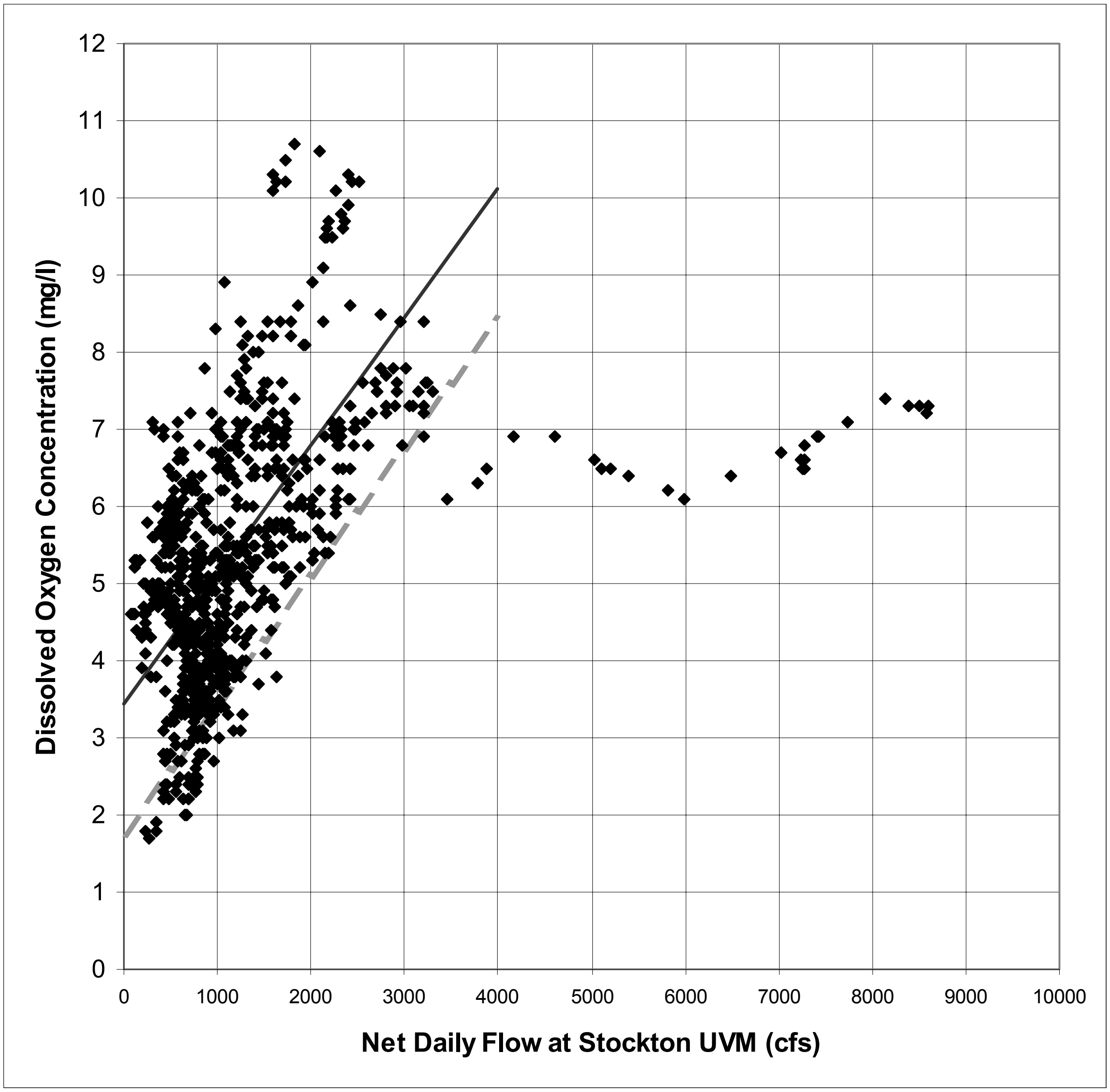


Figure 6. Plot of minimum daily dissolved oxygen concentration at the Rough & Ready Island meter against net daily flow at the Stockton UVM station for June through December of 1994 to 2001. Correlation (solid) and 90% lower prediction band (dashed) for flows less than 3000 cfs.

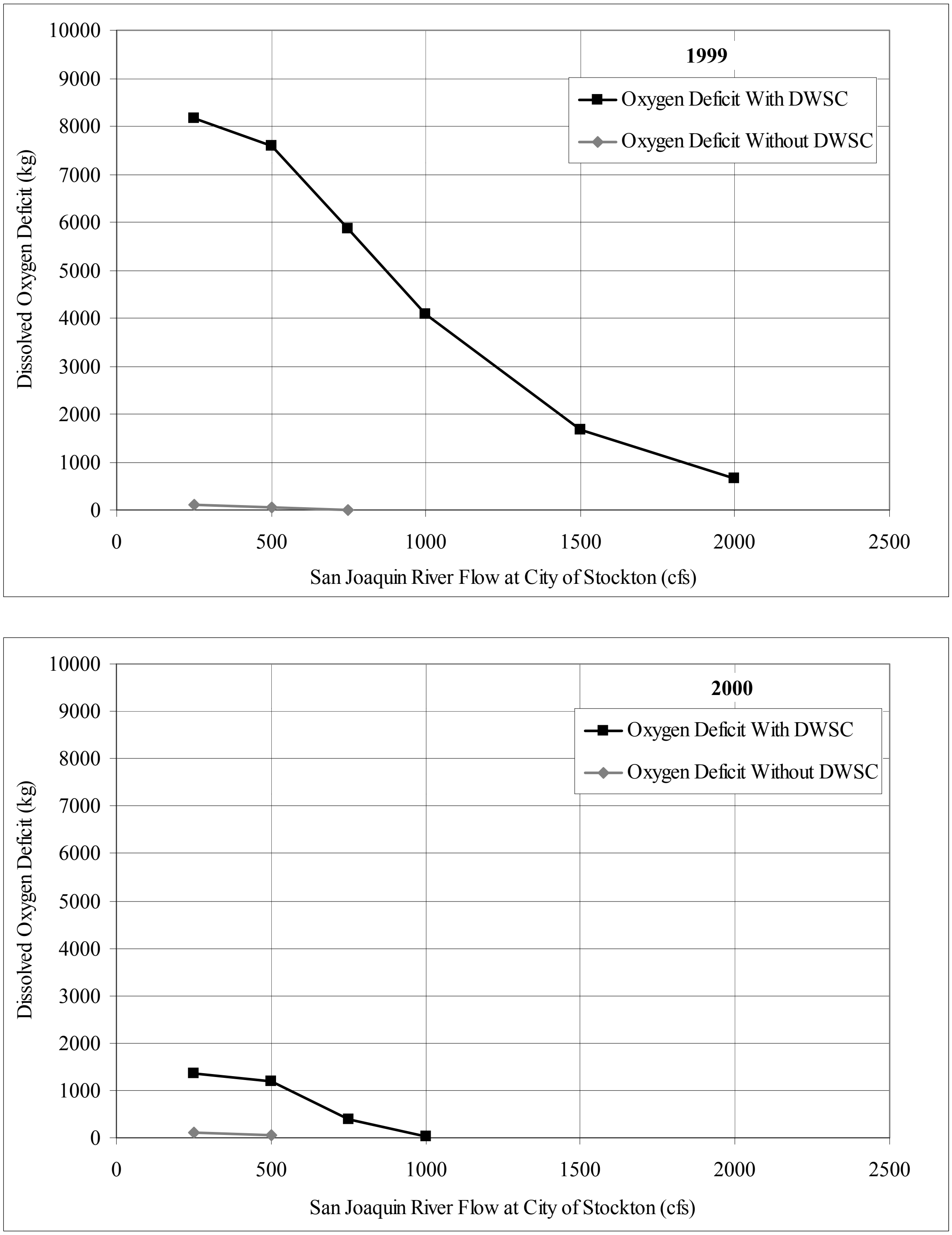


Figure 7. Cumulative oxygen deficit predicted by the Systech model for the time period of July to October 1999 and 2000 as a function of increasing river flow, with and without the Stockton Deep Water Ship Channel (DWSC).

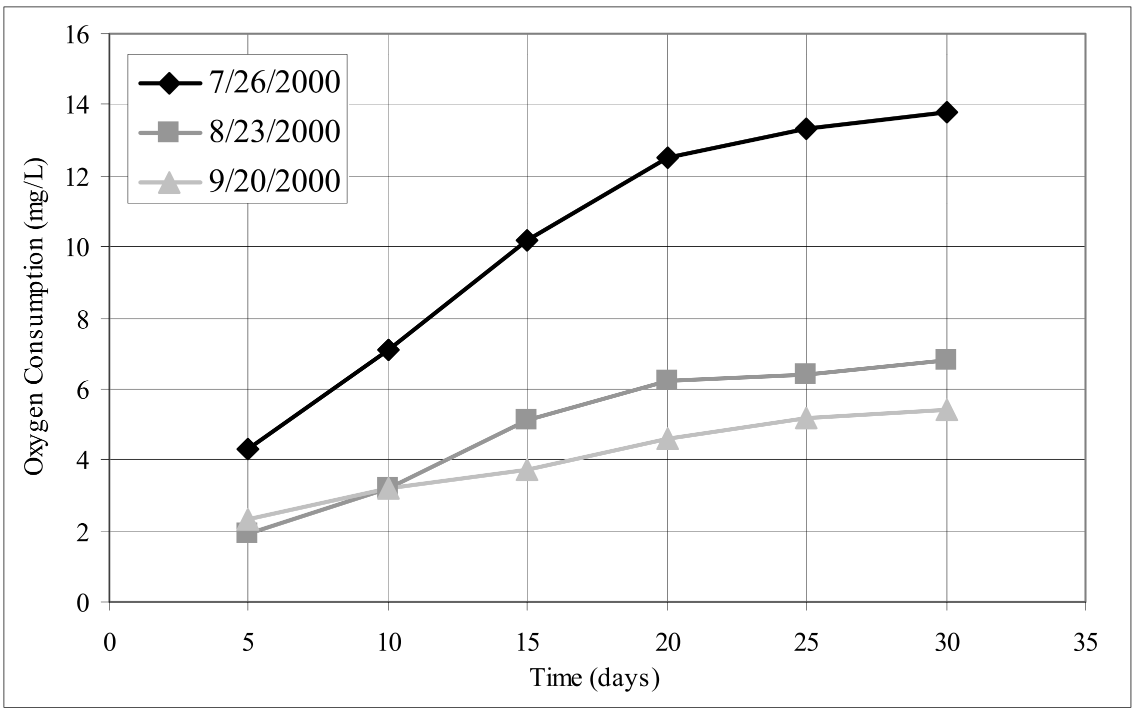


Figure 8. Oxygen consumption as a function of time in water collected from the San Joaquin River at Mossdale.

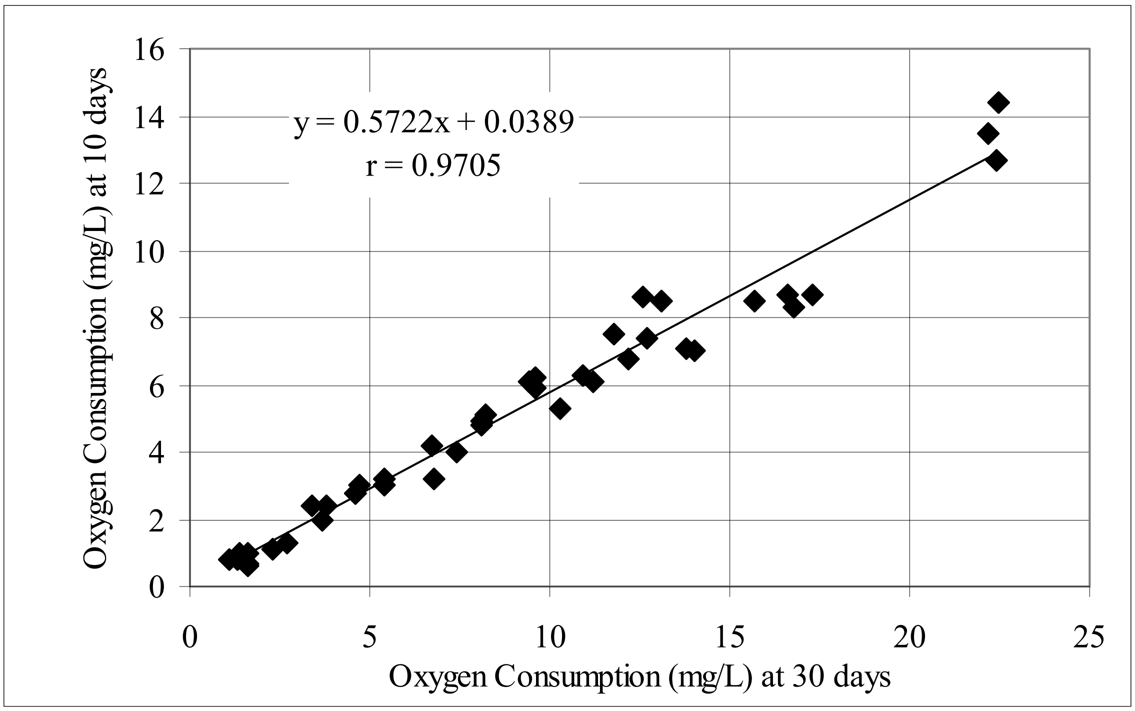


Figure 9. Correlation between oxygen consumption rates after 10 and 30 days in water samples collected for the San Joaquin River basin during the summer of 2000.

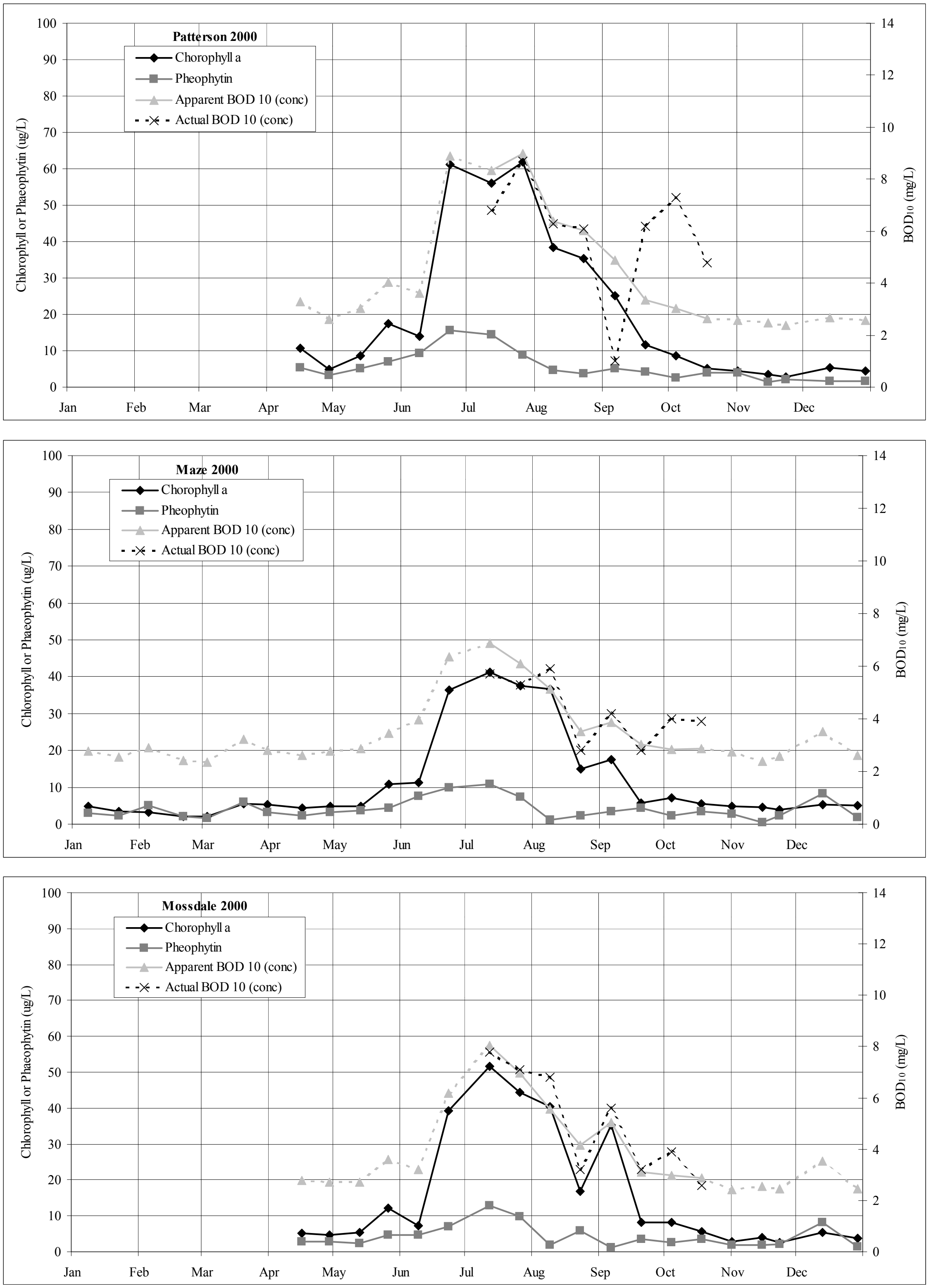


Figure 10. Chlorophyll a, pheophytin, apparent and actual BOD_{10} concentrations at 3 locations on the San Joaquin River in the year 2000. Data from UC Davis (Appendix A).

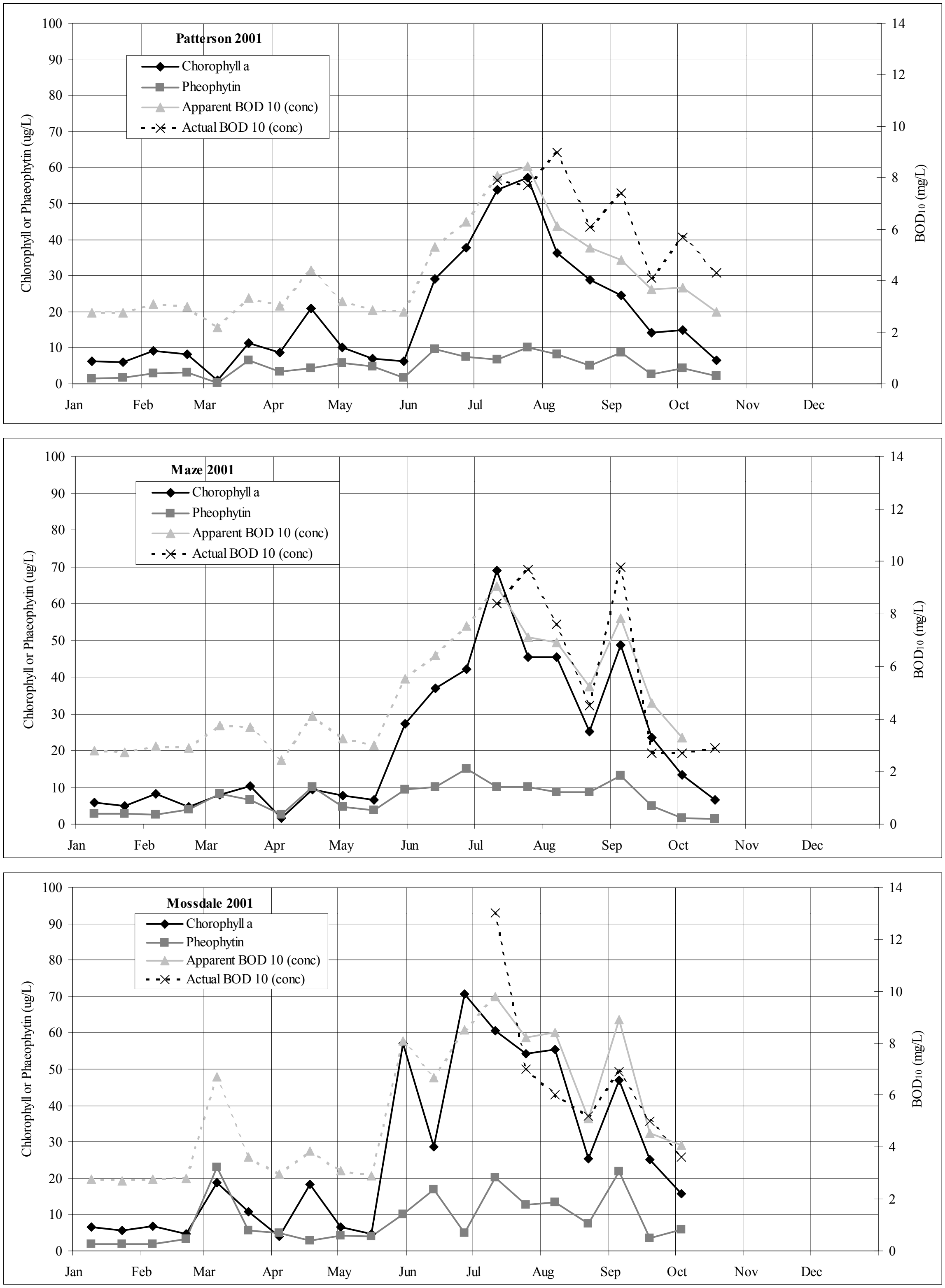
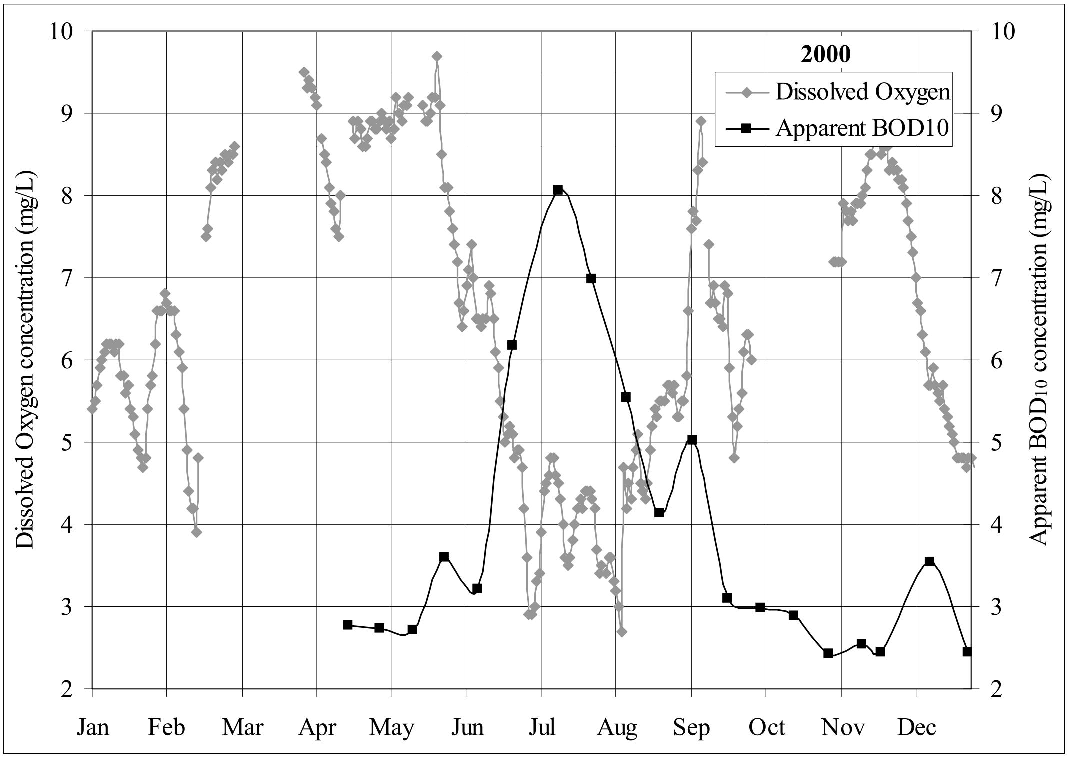


Figure 11. Chlorophyll a, pheophytin, apparent and actual BOD_{10} concentrations at 3 locations on the San Joaquin River in the year 2001. Data from UC Davis (Appendix A).



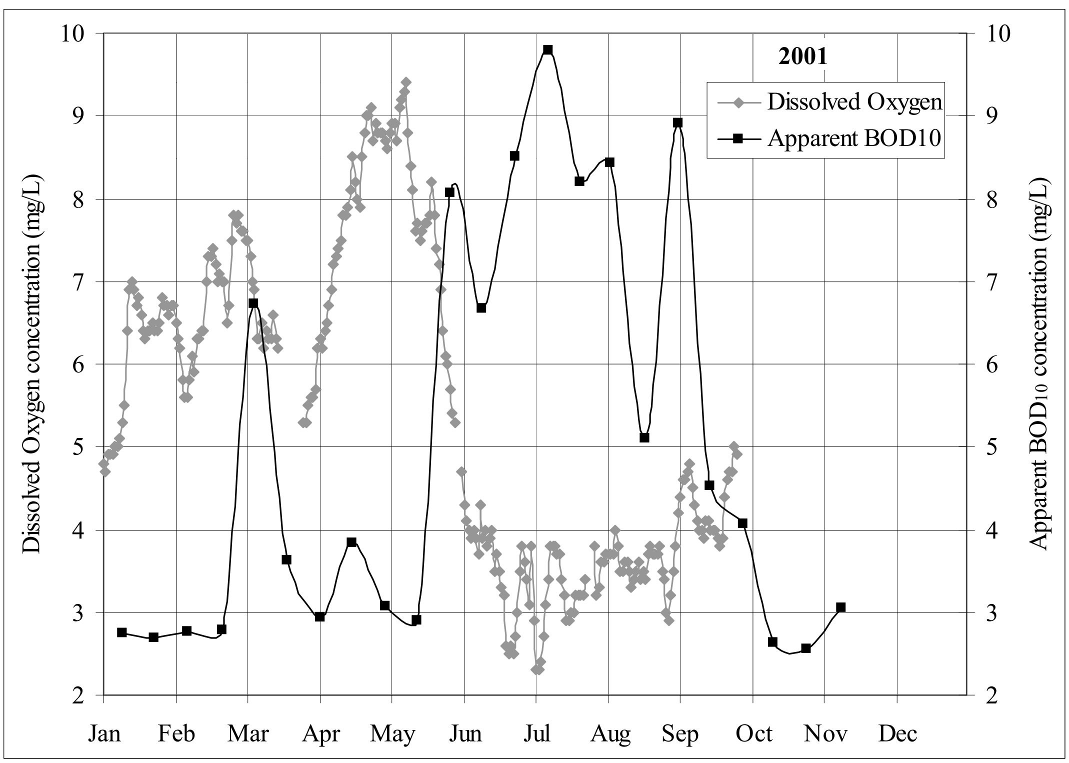


Figure 12. Comparison of apparent BOD_{10} concentration at Mossdale and the daily minimum dissolved oxygen reading at Rough and Ready Island for years 2000 and 2001. No dissolved oxygen measurements are available after September 2001.

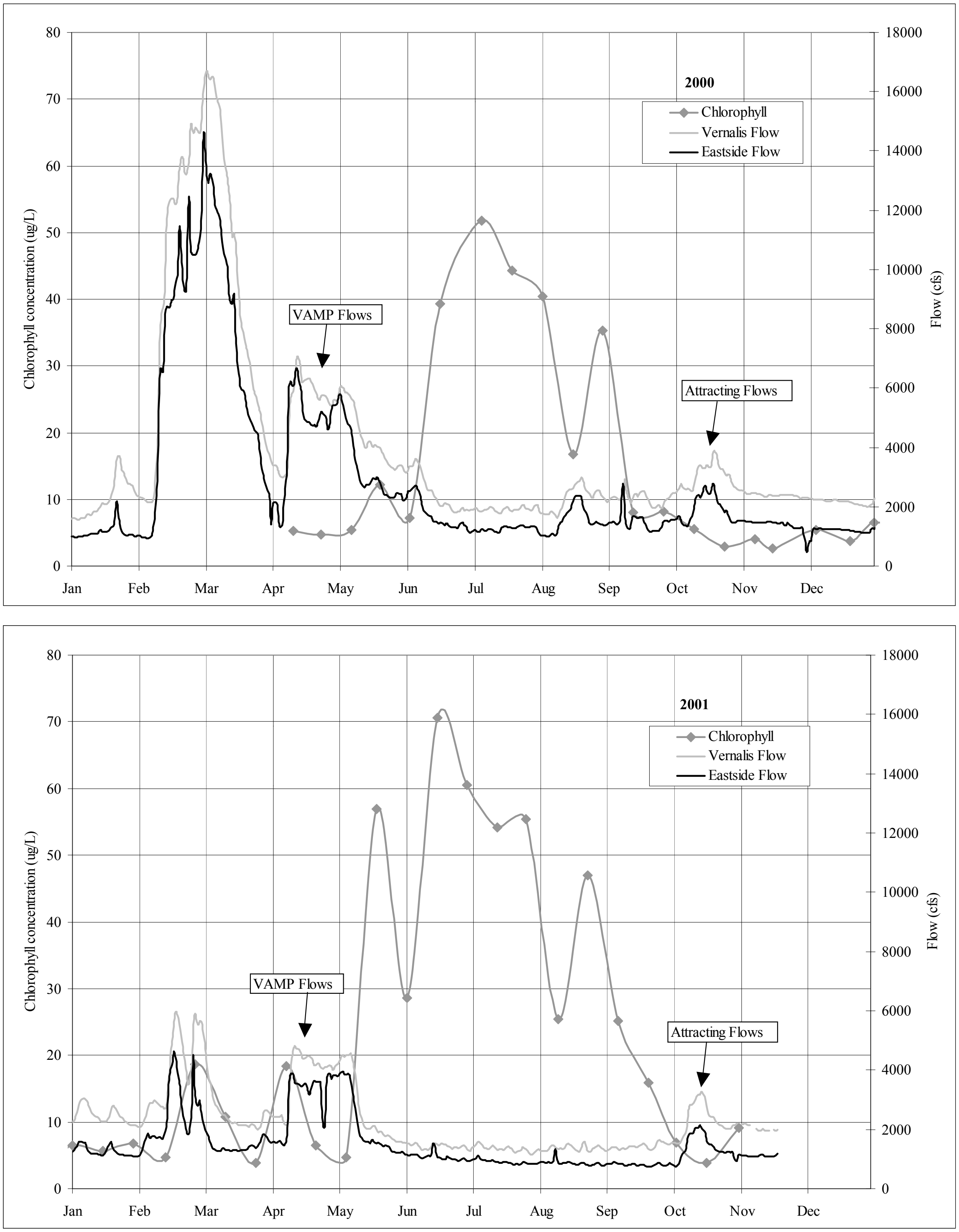


Figure 13. Comparison of chlorophyll concentration at Mossdale with the sum of the flows from the three eastside tributaries (Merced, Tuolumne, and Stanislaus Rivers) and with San Joaquin River flow at Vernalis for the years 2000-2001.

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
10/12/99	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.4	N/A	14.1	N/A	9.0	N/A
10/26/99	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.8	N/A	4.7	N/A	3.5	N/A
11/09/99	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.5	N/A	2.9	N/A	2.2	N/A
11/30/99	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.4	N/A	14.4	N/A	1.6	N/A
12/21/99	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.0	N/A	9.9	N/A	1.4	N/A
01/08/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.8	N/A	20.1	N/A	8.2	N/A
01/22/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.4	N/A	2.5	N/A	1.7	N/A
02/05/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.7	N/A	10.0	N/A	6.4	N/A
02/21/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.8	N/A	22.0	N/A	7.2	N/A
03/03/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.4	N/A	9.2	N/A	4.8	N/A
03/20/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	5.5	N/A	17.0	N/A	15.2	N/A
03/31/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	5.1	N/A	27.8	N/A	5.9	N/A
04/16/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	6.7	N/A	27.6	N/A	17.9	N/A
04/29/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.4	N/A	10.5	N/A	4.0	N/A
05/13/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.7	N/A	17.2	N/A	9.2	N/A
05/26/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.9	N/A	22.7	N/A	7.7	N/A
06/09/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.2	N/A	23.5	N/A	1.9	N/A
06/23/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	19.9	N/A	134.8	N/A	48.5	N/A
07/12/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	9.7	N/A	66.7	N/A	15.6	N/A
07/26/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	7.8	N/A	50.1	N/A	12.3	N/A
08/09/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.9	N/A	13.9	N/A	5.6	N/A
08/23/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	5.2	N/A	19.6	N/A	11.6	N/A
09/06/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.6	N/A	15.1	N/A	3.1	N/A
09/20/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.1	N/A	9.7	N/A	2.8	N/A
10/04/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.4	N/A	11.0	N/A	3.9	N/A
10/18/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.5	N/A	3.2	N/A	2.0	N/A
11/01/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.8	N/A	6.4	N/A	2.5	N/A
11/15/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.2	N/A	2.3	N/A	0.8	N/A
11/23/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.1	N/A	0.9	N/A	0.7	N/A
12/13/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.3	N/A	2.3	N/A	1.4	N/A
12/29/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.3	N/A	2.0	N/A	1.4	N/A
01/09/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.3	N/A	2.2	N/A	1.2	N/A
01/23/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.3	N/A	3.0	N/A	1.2	N/A
02/06/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.6	N/A	4.2	N/A	2.1	N/A
02/21/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.8	N/A	4.6	N/A	3.1	N/A
03/07/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.7	N/A	3.3	N/A	3.3	N/A
03/21/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.6	N/A	8.9	N/A	6.3	N/A
04/04/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.5	N/A	13.0	N/A	10.8	N/A
04/18/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.2	N/A	18.7	N/A	5.0	N/A
05/02/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	8.8	N/A	54.1	N/A	16.8	N/A
05/16/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.7	N/A	16.7	N/A	9.7	N/A
05/30/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	9.7	N/A	51.8	N/A	24.5	N/A

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
06/13/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	10.0	N/A	66.1	N/A	18.3	N/A
06/27/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	6.7	N/A	41.0	N/A	9.7	N/A
07/11/01	Los Banos Creek @Hwy 140	N/A	N/A	16.1	N/A	10.2	N/A	65.5	N/A	20.2	N/A
07/25/01	Los Banos Creek @Hwy 140	N/A	N/A	25.3	N/A	5.9	N/A	33.7	N/A	8.6	N/A
08/07/01	Los Banos Creek @Hwy 140	N/A	N/A	28.4	N/A	6.0	N/A	47.5	N/A	1.1	N/A
08/22/01	Los Banos Creek @Hwy 140	N/A	N/A	12.5	N/A	6.7	N/A	33.1	N/A	14.4	N/A
09/05/01	Los Banos Creek @Hwy 140	N/A	N/A	8.4	N/A	4.6	N/A	17.3	N/A	8.6	N/A
09/19/01	Los Banos Creek @Hwy 140	N/A	N/A	6.3	N/A	3.2	N/A	9.1	N/A	3.5	N/A
10/03/01	Los Banos Creek @Hwy 140	N/A	N/A	9.8	N/A	3.5	N/A	15.4	N/A	1.9	N/A
10/16/01	Los Banos Creek @Hwy 140	N/A	N/A	6.4	N/A	3.4	N/A	7.9	N/A	5.8	N/A
10/30/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.4	N/A	3.8	N/A	1.4	N/A
11/14/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.6	N/A	3.6	N/A	2.4	N/A
10/12/99	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	213	N/A	N/A	2.3	1.2	1.4	0.7	1.9	1.0
10/26/99	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	343	N/A	N/A	2.3	1.9	1.7	1.4	1.6	1.3
11/09/99	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	275	N/A	N/A	2.2	1.4	1.1	0.7	0.9	0.6
11/30/99	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	247	N/A	N/A	2.2	1.3	1.9	1.1	1.0	0.6
12/21/99	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	245	N/A	N/A	2.6	1.6	4.0	2.4	2.7	1.6
01/08/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	220	N/A	N/A	2.1	1.1	1.0	0.5	0.6	0.3
01/22/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	289	N/A	N/A	2.3	1.6	3.7	2.6	0.6	0.4
02/05/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	261	N/A	N/A	2.2	1.4	0.8	0.5	1.6	1.0
02/21/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	2,739	N/A	N/A	2.2	14.5	1.1	7.2	1.0	6.4
03/03/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	3,058	N/A	N/A	2.1	15.7	1.0	7.3	0.6	4.4
03/20/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	2,225	N/A	N/A	2.7	14.5	3.2	17.2	3.3	18.2
03/31/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	669	N/A	N/A	2.3	3.7	1.3	2.1	1.7	2.9
04/16/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	343	N/A	N/A	2.2	1.8	1.0	0.8	1.2	1.0
04/29/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	1,601	N/A	N/A	2.2	8.4	1.1	4.2	0.9	3.6
05/13/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	989	N/A	N/A	2.1	5.2	0.7	1.7	1.1	2.6
05/26/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	402	N/A	N/A	2.1	2.1	1.2	1.2	0.6	0.6
06/09/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	300	N/A	N/A	2.0	1.5	0.8	0.6	0.1	0.0
06/23/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	174	N/A	N/A	2.1	0.9	1.0	0.4	0.7	0.3
07/12/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	189	N/A	N/A	2.2	1.0	1.0	0.5	1.0	0.5
07/26/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	167	N/A	N/A	2.1	0.9	0.7	0.3	0.9	0.4
08/09/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	139	N/A	N/A	2.2	0.7	1.4	0.5	0.8	0.3
08/23/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	165	N/A	N/A	2.2	0.9	1.3	0.5	1.2	0.5
09/06/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	188	N/A	N/A	2.1	1.0	0.7	0.3	0.7	0.3
09/20/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	186	N/A	N/A	2.1	1.0	0.8	0.4	0.7	0.3
10/04/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	163	N/A	N/A	2.1	0.8	0.8	0.3	0.7	0.3
10/18/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	773	N/A	N/A	2.3	4.3	1.1	2.1	1.8	3.5
11/01/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	676	N/A	N/A	2.1	3.5	1.4	2.3	0.7	1.1
11/15/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	578	N/A	N/A	2.0	2.9	0.7	1.0	0.2	0.3
11/23/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	573	N/A	N/A	2.0	2.8	0.3	0.4	0.4	0.6
12/13/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	394	N/A	N/A	2.0	1.9	0.5	0.5	0.3	0.3

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
12/29/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	366	N/A	N/A	2.0	1.8	0.6	0.5	0.3	0.3
01/09/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	344	N/A	N/A	2.1	1.8	1.1	0.9	0.6	0.5
01/23/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	321	N/A	N/A	2.0	1.6	0.7	0.5	0.4	0.3
02/06/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	305	N/A	N/A	2.2	1.6	1.1	0.8	1.2	0.9
02/21/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	305	N/A	N/A	2.2	1.6	0.8	0.6	1.2	0.9
03/07/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	694	N/A	N/A	2.5	4.3	3.6	6.1	2.0	3.4
03/21/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	319	N/A	N/A	2.3	1.8	1.9	1.5	1.8	1.4
04/04/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	244	N/A	N/A	2.1	1.3	0.8	0.5	0.8	0.5
04/18/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	395	N/A	N/A	2.3	2.2	1.5	1.5	1.4	1.3
05/02/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	557	N/A	N/A	2.2	3.0	0.9	1.2	1.4	1.9
05/16/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	1,166	N/A	N/A	2.1	6.1	0.6	1.8	1.1	3.1
05/30/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	351	N/A	N/A	2.1	1.8	1.1	0.9	0.8	0.7
06/13/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	240	N/A	N/A	2.5	1.5	3.1	1.8	2.1	1.2
06/27/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	157	N/A	N/A	2.4	0.9	3.0	1.1	1.6	0.6
07/11/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	152	1.1	0.4	2.3	0.9	2.2	0.8	1.3	0.5
07/25/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	126	2.1	0.6	2.7	0.8	5.6	1.7	2.2	0.7
08/07/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	132	0.8	0.3	2.2	0.7	1.7	0.6	0.9	0.3
08/22/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	119	0.7	0.2	2.2	0.7	1.5	0.4	1.3	0.4
09/05/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	76	0.8	0.1	2.2	0.4	1.6	0.3	0.6	0.1
09/19/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	153	0.8	0.3	2.2	0.8	1.7	0.6	0.9	0.3
10/03/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	88	0.5	0.1	2.1	0.5	1.5	0.3	0.3	0.1
10/16/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	124	0.8	0.2	2.3	0.7	1.9	0.6	1.7	0.5
10/30/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	796	N/A	N/A	2.3	4.4	1.4	2.7	1.6	3.1
11/14/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	505	N/A	N/A	2.3	2.9	2.2	2.7	1.6	2.0
10/26/99	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	196	N/A	N/A	3.3	1.6	6.9	3.3	5.9	2.8
11/09/99	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	182	N/A	N/A	3.4	1.5	8.6	3.8	5.3	2.4
11/30/99	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	126	N/A	N/A	3.1	1.0	7.2	2.2	4.0	1.2
12/21/99	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	117	N/A	N/A	3.0	0.9	7.7	2.2	2.9	0.8
01/08/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	147	N/A	N/A	3.6	1.3	9.6	3.5	6.4	2.3
01/22/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	177	N/A	N/A	5.5	2.4	35.2	15.2	4.6	2.0
02/05/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	184	N/A	N/A	3.4	1.5	6.4	2.9	6.4	2.9
02/21/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	343	N/A	N/A	2.3	2.0	3.0	2.5	1.1	0.9
03/03/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	332	N/A	N/A	3.5	2.9	8.8	7.2	6.3	5.1
03/20/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	166	N/A	N/A	2.3	0.9	2.2	0.9	1.5	0.6
03/31/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	89	N/A	N/A	4.1	0.9	16.9	3.7	5.6	1.2
04/16/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	78	N/A	N/A	7.6	1.4	42.7	8.2	15.0	2.9
04/29/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	56	N/A	N/A	6.9	1.0	34.8	4.8	15.1	2.1
05/13/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	104	N/A	N/A	4.3	1.1	18.0	4.6	6.2	1.6
05/26/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	102	N/A	N/A	3.8	0.9	14.6	3.6	4.4	1.1
06/09/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	94	N/A	N/A	3.8	0.9	21.0	4.8	1.0	0.2
06/23/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	82	N/A	N/A	7.8	1.6	60.1	12.0	6.2	1.2
07/12/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	72	N/A	N/A	5.1	0.9	33.7	5.9	2.7	0.5

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
07/26/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	63	N/A	N/A	4.0	0.6	20.4	3.1	2.7	0.4
08/09/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	63	N/A	N/A	7.7	1.2	62.9	9.7	3.6	0.6
08/23/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	59	N/A	N/A	6.6	1.0	47.3	6.8	5.5	0.8
09/06/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	56	N/A	N/A	9.3	1.3	60.1	8.2	16.9	2.3
09/20/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	52	N/A	N/A	3.6	0.5	13.6	1.7	3.5	0.5
10/04/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	88	N/A	N/A	3.2	0.7	11.8	2.5	2.2	0.5
10/18/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	194	N/A	N/A	3.0	1.4	7.2	3.4	3.7	1.8
11/01/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	236	N/A	N/A	2.4	1.4	3.5	2.0	1.3	0.7
11/15/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	131	N/A	N/A	2.8	0.9	7.9	2.5	1.4	0.5
11/23/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	127	N/A	N/A	2.4	0.8	2.0	0.6	2.4	0.8
12/13/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	159	N/A	N/A	2.7	1.0	5.0	2.0	2.3	0.9
12/29/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	127	N/A	N/A	2.5	0.8	4.1	1.3	1.9	0.6
01/09/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	142	N/A	N/A	2.7	0.9	6.5	2.2	1.8	0.6
01/23/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	200	N/A	N/A	3.1	1.5	9.9	4.9	2.2	1.1
02/06/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	197	N/A	N/A	3.8	1.8	19.7	9.5	1.9	0.9
02/21/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	215	N/A	N/A	3.9	2.1	14.3	7.5	5.6	2.9
03/07/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	411	N/A	N/A	4.4	4.5	17.3	17.4	7.6	7.6
03/21/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	154	N/A	N/A	5.1	1.9	32.6	12.3	3.3	1.2
04/04/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	77	N/A	N/A	10.2	1.9	78.6	14.8	12.1	2.3
04/18/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	57	N/A	N/A	11.8	1.6	85.7	11.9	19.3	2.7
05/02/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	68	N/A	N/A	5.2	0.9	25.9	4.3	7.8	1.3
05/16/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	99	N/A	N/A	4.2	1.0	18.0	4.4	5.8	1.4
05/30/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	91	N/A	N/A	4.4	1.0	19.0	4.2	6.0	1.3
06/13/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	65	N/A	N/A	7.5	1.2	58.8	9.3	5.0	0.8
06/27/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	61	N/A	N/A	7.5	1.1	55.4	8.3	6.7	1.0
07/11/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	71	7.0	1.2	5.4	0.9	24.5	4.2	10.1	1.7
07/25/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	62	9.7	1.5	6.9	1.0	55.4	8.4	2.5	0.4
08/07/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	73	7.0	1.2	7.0	1.3	52.9	9.4	5.0	0.9
08/22/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	61	7.8	1.2	5.1	0.8	31.3	4.7	4.3	0.6
09/05/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	43	9.0	0.9	4.7	0.5	15.6	1.6	10.4	1.1
09/19/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	49	6.8	0.8	3.6	0.4	13.7	1.6	3.6	0.4
10/03/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	99	10.3	2.5	4.0	1.0	17.3	4.2	4.3	1.0
10/16/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	163	8.0	3.2	3.3	1.3	8.6	3.4	4.3	1.7
10/30/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	111	N/A	N/A	3.5	1.0	12.6	3.4	4.0	1.1
11/14/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	243	N/A	N/A	3.3	2.0	12.3	7.3	2.5	1.5
10/12/99	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	7	N/A	N/A	2.4	0.0	2.4	0.0	1.9	0.0
10/26/99	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	19	N/A	N/A	3.3	0.2	9.6	0.4	4.2	0.2
11/09/99	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	28	N/A	N/A	2.3	0.2	3.2	0.2	1.0	0.1
11/30/99	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	59	N/A	N/A	2.4	0.3	2.1	0.3	1.7	0.3
12/21/99	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	18	N/A	N/A	2.1	0.1	0.8	0.0	0.9	0.0
01/08/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	43	N/A	N/A	2.7	0.3	7.1	0.7	1.4	0.1
01/22/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	12	N/A	N/A	3.3	0.1	8.6	0.3	4.6	0.1

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
02/05/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	6	N/A	N/A	2.3	0.0	1.6	0.0	1.6	0.0
02/21/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	10	N/A	N/A	2.0	0.0	0.3	0.0	0.2	0.0
03/03/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	39	N/A	N/A	2.0	0.2	0.3	0.0	0.3	0.0
03/20/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	3	N/A	N/A	3.0	0.0	4.5	0.0	4.9	0.0
03/31/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	9	N/A	N/A	3.0	0.1	6.1	0.1	3.9	0.1
04/16/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	20	N/A	N/A	2.9	0.1	5.8	0.3	3.7	0.2
04/29/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	17	N/A	N/A	2.5	0.1	3.2	0.1	1.8	0.1
05/13/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	62	N/A	N/A	2.6	0.4	2.6	0.4	3.4	0.5
05/26/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	13	N/A	N/A	3.5	0.1	13.3	0.4	3.1	0.1
06/09/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	81	N/A	N/A	2.4	0.5	3.9	0.8	1.3	0.3
06/23/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	8	N/A	N/A	2.4	0.0	2.7	0.1	1.7	0.0
07/12/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	14	N/A	N/A	2.4	0.1	2.0	0.1	2.0	0.1
07/26/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	18	N/A	N/A	2.5	0.1	4.0	0.2	2.0	0.1
08/09/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	27	N/A	N/A	2.7	0.2	6.0	0.4	2.1	0.1
08/23/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	11	N/A	N/A	2.7	0.1	2.9	0.1	3.6	0.1
09/06/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	29	N/A	N/A	2.7	0.2	6.6	0.5	1.6	0.1
09/20/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	22	N/A	N/A	2.8	0.2	5.8	0.3	2.7	0.1
10/04/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.4	N/A	2.1	N/A	1.8	N/A
10/18/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.9	N/A	5.6	N/A	3.4	N/A
11/01/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	1.8	N/A	0.1	N/A
11/15/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.2	N/A	2.0	N/A	0.9	N/A
11/23/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	0.6	N/A	0.5	N/A
12/13/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	2.2	N/A	0.2	N/A
12/29/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	0.9	N/A	0.3	N/A
01/09/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	1.0	N/A	0.4	N/A
01/23/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.5	N/A	4.4	N/A	1.3	N/A
02/06/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.3	N/A	3.5	N/A	0.3	N/A
02/21/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.3	N/A	2.7	N/A	1.1	N/A
03/07/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	1.2	N/A	0.7	N/A
03/21/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.6	N/A	3.3	N/A	2.9	N/A
04/04/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.5	N/A	4.0	N/A	1.8	N/A
04/18/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.8	N/A	5.3	N/A	3.4	N/A
05/02/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	3.3	N/A	4.3	N/A	7.2	N/A
05/16/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.5	N/A	4.9	N/A	1.1	N/A
05/30/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	4.7	N/A	22.3	N/A	6.5	N/A
06/13/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	3.7	N/A	8.6	N/A	7.2	N/A
06/27/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	4.7	N/A	18.9	N/A	8.7	N/A
07/11/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	12.2	N/A	2.4	N/A	4.0	N/A	1.0	N/A
07/25/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	2.3	N/A	2.1	N/A	1.1	N/A	0.7	N/A
08/07/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	1.4	N/A	2.5	N/A	4.4	N/A	1.1	N/A
08/22/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	4.3	N/A	2.3	N/A	2.4	N/A	1.3	N/A
09/05/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	2.8	N/A	2.3	N/A	3.1	N/A	0.7	N/A

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
09/19/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	2.6	N/A	2.4	N/A	2.3	N/A	1.6	N/A
10/03/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	2.6	N/A	2.4	N/A	3.5	N/A	1.4	N/A
10/16/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	2.6	N/A	2.4	N/A	2.7	N/A	1.5	N/A
10/30/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.3	N/A	2.6	N/A	1.1	N/A
11/14/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.2	N/A	2.1	N/A	0.7	N/A
10/12/99	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	130	N/A	N/A	5.3	1.7	19.2	6.1	12.8	4.1
10/26/99	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	166	N/A	N/A	12.4	5.1	72.5	29.4	32.0	13.0
11/09/99	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	226	N/A	N/A	2.6	1.4	3.8	2.1	2.1	1.2
11/30/99	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	142	N/A	N/A	4.5	1.6	20.4	7.1	6.0	2.1
12/21/99	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	93	N/A	N/A	2.4	0.6	3.7	0.8	1.3	0.3
01/08/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	84	N/A	N/A	3.6	0.7	9.6	2.0	6.4	1.3
01/22/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	117	N/A	N/A	4.0	1.1	7.9	2.3	9.9	2.8
02/05/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	203	N/A	N/A	3.6	1.8	7.2	3.6	7.2	3.6
02/21/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	251	N/A	N/A	2.9	1.8	5.1	3.1	3.9	2.4
03/03/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	360	N/A	N/A	2.8	2.5	6.7	5.9	2.1	1.9
03/20/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	397	N/A	N/A	2.4	2.3	2.2	2.1	2.1	2.0
03/31/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	295	N/A	N/A	3.3	2.4	5.0	3.6	7.1	5.1
04/16/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	262	N/A	N/A	3.7	2.4	7.0	4.5	8.5	5.4
04/29/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	173	N/A	N/A	2.8	1.2	4.6	1.9	3.8	1.6
05/13/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	226	N/A	N/A	3.3	1.8	6.8	3.7	6.0	3.3
05/26/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	115	N/A	N/A	4.1	1.2	11.2	3.1	8.9	2.5
06/09/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	149	N/A	N/A	3.4	1.2	11.6	4.2	3.5	1.3
06/23/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	172	N/A	N/A	4.6	1.9	18.1	7.6	8.5	3.6
07/12/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	230	N/A	N/A	4.1	2.3	14.2	8.0	6.9	3.9
07/26/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	179	N/A	N/A	4.5	2.0	24.6	10.8	3.9	1.7
08/09/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	206	N/A	N/A	3.9	2.0	16.4	8.3	4.1	2.1
08/23/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	166	N/A	N/A	3.7	1.5	14.2	5.8	3.9	1.6
09/06/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	104	N/A	N/A	3.6	0.9	16.1	4.1	2.6	0.7
09/20/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	91	N/A	N/A	3.3	0.7	11.9	2.6	2.8	0.6
10/04/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	86	N/A	N/A	3.2	0.7	10.2	2.2	2.8	0.6
10/18/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	113	N/A	N/A	3.8	1.0	10.2	2.8	7.2	2.0
11/01/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	180	N/A	N/A	2.8	1.2	5.2	2.3	3.1	1.4
11/15/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	126	N/A	N/A	3.0	0.9	9.3	2.9	1.9	0.6
11/23/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	120	N/A	N/A	2.7	0.8	5.5	1.6	2.3	0.7
12/13/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	156	N/A	N/A	2.9	1.1	9.6	3.7	1.2	0.5
12/29/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	113	N/A	N/A	3.0	0.8	9.8	2.7	1.7	0.5
01/09/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	221	N/A	N/A	3.2	1.7	11.6	6.3	2.3	1.3
01/23/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	144	N/A	N/A	2.9	1.0	9.4	3.3	1.4	0.5
02/06/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	216	N/A	N/A	3.1	1.6	9.0	4.8	2.9	1.5
02/21/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	244	N/A	N/A	3.2	1.9	5.8	3.4	5.8	3.4
03/07/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	685	N/A	N/A	2.5	4.2	4.3	7.2	1.4	2.4
03/21/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	266	N/A	N/A	3.3	2.1	9.4	6.1	4.0	2.6

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
04/04/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	292	N/A	N/A	3.0	2.1	6.3	4.5	3.7	2.7
04/18/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	157	N/A	N/A	3.1	1.2	7.5	2.9	4.1	1.6
05/02/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	143	N/A	N/A	2.9	1.0	4.0	1.4	4.3	1.5
05/16/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	222	N/A	N/A	3.5	1.9	11.9	6.4	4.3	2.3
05/30/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	140	N/A	N/A	3.7	1.3	13.4	4.6	4.8	1.6
06/13/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	139	N/A	N/A	4.3	1.4	12.5	4.2	9.1	3.1
06/27/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	200	N/A	N/A	4.4	2.1	16.3	8.0	7.7	3.8
07/11/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	191	5.7	2.7	4.3	2.0	23.0	10.8	2.9	1.3
07/25/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	193	4.8	2.3	4.3	2.0	15.1	7.1	7.6	3.6
08/07/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	157	3.2	1.2	4.1	1.6	23.5	9.0	1.2	0.5
08/22/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	205	2.5	1.3	3.6	1.8	13.0	6.5	4.0	2.0
09/05/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	50	4.3	0.5	4.0	0.5	9.4	1.1	9.4	1.1
09/19/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	52	3.1	0.4	3.7	0.5	12.5	1.6	5.2	0.7
10/03/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	48	2.6	0.3	3.0	0.3	9.3	1.1	1.9	0.2
10/16/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	158	3.3	1.3	3.5	1.4	7.9	3.1	6.5	2.5
10/30/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	78	N/A	N/A	3.7	0.7	14.0	2.7	4.0	0.8
11/14/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	205	N/A	N/A	3.3	1.6	10.4	5.2	3.5	1.7
07/11/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	58	6.2	0.9	N/A	N/A	N/A	N/A	N/A	N/A
07/25/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	54	8.6	1.1	N/A	N/A	N/A	N/A	N/A	N/A
08/08/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	59	6.6	1.0	N/A	N/A	N/A	N/A	N/A	N/A
08/22/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	53	6.6	0.9	N/A	N/A	N/A	N/A	N/A	N/A
09/05/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	32	7.2	0.6	N/A	N/A	N/A	N/A	N/A	N/A
09/19/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	15	5.7	0.2	N/A	N/A	N/A	N/A	N/A	N/A
10/03/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	9	6.5	0.1	N/A	N/A	N/A	N/A	N/A	N/A
03/20/00	San Luis Drain-Terminous	San Luis Drain (USGS)	45	N/A	N/A	4.1	0.5	13.4	1.5	7.8	0.9
03/31/00	San Luis Drain-Terminous	San Luis Drain (USGS)	40	N/A	N/A	5.0	0.5	30.0	2.9	3.9	0.4
04/16/00	San Luis Drain-Terminous	San Luis Drain (USGS)	41	N/A	N/A	5.8	0.6	31.3	3.1	9.2	0.9
04/29/00	San Luis Drain-Terminous	San Luis Drain (USGS)	39	N/A	N/A	6.7	0.6	33.8	3.2	14.0	1.3
05/13/00	San Luis Drain-Terminous	San Luis Drain (USGS)	47	N/A	N/A	4.7	0.5	21.8	2.5	6.9	0.8
05/26/00	San Luis Drain-Terminous	San Luis Drain (USGS)	50	N/A	N/A	3.7	0.4	14.2	1.7	3.9	0.5
06/09/00	San Luis Drain-Terminous	San Luis Drain (USGS)	67	N/A	N/A	5.2	0.8	21.7	3.5	10.1	1.7
06/23/00	San Luis Drain-Terminous	San Luis Drain (USGS)	61	N/A	N/A	6.4	1.0	45.5	6.8	4.8	0.7
07/12/00	San Luis Drain-Terminous	San Luis Drain (USGS)	67	N/A	N/A	4.9	0.8	31.0	5.1	2.7	0.4
07/26/00	San Luis Drain-Terminous	San Luis Drain (USGS)	57	N/A	N/A	3.8	0.5	20.8	2.9	1.2	0.2
08/09/00	San Luis Drain-Terminous	San Luis Drain (USGS)	55	N/A	N/A	7.0	0.9	53.9	7.2	4.0	0.5
08/23/00	San Luis Drain-Terminous	San Luis Drain (USGS)	56	N/A	N/A	6.5	0.9	30.9	4.2	14.6	2.0
09/06/00	San Luis Drain-Terminous	San Luis Drain (USGS)	47	N/A	N/A	9.2	1.1	75.5	8.7	7.2	0.8
09/20/00	San Luis Drain-Terminous	San Luis Drain (USGS)	21	N/A	N/A	3.3	0.2	12.4	0.6	2.5	0.1
10/04/00	San Luis Drain-Terminous	San Luis Drain (USGS)	19	N/A	N/A	4.0	0.2	20.7	1.0	2.6	0.1
10/18/00	San Luis Drain-Terminous	San Luis Drain (USGS)	20	N/A	N/A	3.5	0.2	14.0	0.7	3.0	0.1
11/01/00	San Luis Drain-Terminous	San Luis Drain (USGS)	21	N/A	N/A	2.9	0.1	8.1	0.4	1.8	0.1
11/15/00	San Luis Drain-Terminous	San Luis Drain (USGS)	17	N/A	N/A	5.1	0.2	31.5	1.3	3.7	0.2

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
11/23/00	San Luis Drain-Terminous	San Luis Drain (USGS)	22	N/A	N/A	3.0	0.2	8.2	0.4	3.1	0.2
12/13/00	San Luis Drain-Terminous	San Luis Drain (USGS)	24	N/A	N/A	3.8	0.2	13.4	0.8	5.2	0.3
12/29/00	San Luis Drain-Terminous	San Luis Drain (USGS)	22	N/A	N/A	2.6	0.1	6.3	0.3	0.9	0.0
01/09/01	San Luis Drain-Terminous	San Luis Drain (USGS)	27	N/A	N/A	3.5	0.2	14.7	1.0	2.2	0.1
01/23/01	San Luis Drain-Terminous	San Luis Drain (USGS)	30	N/A	N/A	3.5	0.3	17.5	1.3	1.0	0.1
02/06/01	San Luis Drain-Terminous	San Luis Drain (USGS)	53	N/A	N/A	7.4	1.0	40.3	5.2	15.1	2.0
02/21/01	San Luis Drain-Terminous	San Luis Drain (USGS)	58	N/A	N/A	3.9	0.5	15.8	2.2	4.3	0.6
03/07/01	San Luis Drain-Terminous	San Luis Drain (USGS)	79	N/A	N/A	3.6	0.7	16.4	3.2	2.2	0.4
03/21/01	San Luis Drain-Terminous	San Luis Drain (USGS)	55	N/A	N/A	11.1	1.5	69.6	9.4	24.2	3.3
04/04/01	San Luis Drain-Terminous	San Luis Drain (USGS)	38	N/A	N/A	8.6	0.8	57.5	5.3	13.4	1.2
04/18/01	San Luis Drain-Terminous	San Luis Drain (USGS)	34	N/A	N/A	9.6	0.8	75.6	6.3	10.1	0.8
05/02/01	San Luis Drain-Terminous	San Luis Drain (USGS)	30	N/A	N/A	5.1	0.4	29.2	2.1	5.4	0.4
05/16/01	San Luis Drain-Terminous	San Luis Drain (USGS)	40	N/A	N/A	4.7	0.5	23.8	2.3	5.8	0.6
05/30/01	San Luis Drain-Terminous	San Luis Drain (USGS)	46	N/A	N/A	4.4	0.5	19.0	2.1	6.0	0.7
06/13/01	San Luis Drain-Terminous	San Luis Drain (USGS)	59	N/A	N/A	8.0	1.2	62.2	9.0	6.7	1.0
06/27/01	San Luis Drain-Terminous	San Luis Drain (USGS)	50	N/A	N/A	8.3	1.0	55.1	6.7	12.7	1.6
07/11/01	San Luis Drain-Terminous	San Luis Drain (USGS)	58	N/A	N/A	5.6	0.8	24.5	3.5	11.5	1.6
07/25/01	San Luis Drain-Terminous	San Luis Drain (USGS)	54	N/A	N/A	6.6	0.9	47.9	6.3	5.0	0.7
08/07/01	San Luis Drain-Terminous	San Luis Drain (USGS)	61	N/A	N/A	6.9	1.0	57.1	8.5	1.7	0.3
08/22/01	San Luis Drain-Terminous	San Luis Drain (USGS)	53	N/A	N/A	5.4	0.7	32.8	4.3	5.2	0.7
09/05/01	San Luis Drain-Terminous	San Luis Drain (USGS)	32	N/A	N/A	4.1	0.3	16.8	1.3	5.2	0.4
09/19/01	San Luis Drain-Terminous	San Luis Drain (USGS)	15	N/A	N/A	3.6	0.1	10.8	0.4	5.2	0.2
10/03/01	San Luis Drain-Terminous	San Luis Drain (USGS)	9	N/A	N/A	4.0	0.1	17.8	0.4	4.3	0.1
10/16/01	San Luis Drain-Terminous	San Luis Drain (USGS)	19	N/A	N/A	4.3	0.2	21.6	1.0	4.3	0.2
10/30/01	San Luis Drain-Terminous	San Luis Drain (USGS)	17	N/A	N/A	N/A	N/A	75.6	3.1	N/A	N/A
11/14/01	San Luis Drain-Terminous	San Luis Drain (USGS)	37	N/A	N/A	N/A	N/A	67.0	6.1	N/A	N/A
10/12/99	SJR @Hwy 4	N/A	N/A	N/A	N/A	3.3	N/A	6.4	N/A	5.8	N/A
10/26/99	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.9	N/A	4.5	N/A	4.2	N/A
11/09/99	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.5	N/A	2.7	N/A	2.7	N/A
11/30/99	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.6	N/A	2.3	N/A	3.5	N/A
12/21/99	SJR @Hwy 4	N/A	N/A	N/A	N/A	3.0	N/A	6.1	N/A	4.0	N/A
01/08/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	3.9	N/A	7.7	N/A	9.6	N/A
01/22/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.3	N/A	1.7	N/A	1.5	N/A
02/05/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.6	N/A	3.7	N/A	2.2	N/A
02/21/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.6	N/A	3.0	N/A	3.1	N/A
03/03/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.3	N/A	2.1	N/A	1.5	N/A
03/20/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.3	N/A	1.5	N/A	1.8	N/A
03/31/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.9	N/A	5.3	N/A	3.6	N/A
10/12/99	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	56	N/A	N/A	12.6	1.7	80.0	11.0	28.8	3.9
10/26/99	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	59	N/A	N/A	3.3	0.5	7.3	1.1	5.5	0.8
11/09/99	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	25	N/A	N/A	9.3	0.6	48.0	2.9	24.0	1.5
11/30/99	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	22	N/A	N/A	9.2	0.5	53.0	2.9	20.1	1.1

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
12/21/99	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	34	N/A	N/A	5.6	0.5	39.7	3.3	2.6	0.2
01/08/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	13	N/A	N/A	7.0	0.2	29.9	0.9	18.1	0.6
01/22/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	12	N/A	N/A	4.7	0.1	19.5	0.6	7.9	0.2
02/05/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	71	N/A	N/A	4.1	0.7	6.9	1.2	11.2	1.9
02/21/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	941	N/A	N/A	3.5	8.1	8.5	19.6	6.1	14.1
03/03/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	1,576	N/A	N/A	3.5	13.4	10.6	40.8	4.6	17.9
03/20/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	563	N/A	N/A	9.9	13.6	88.8	122.3	3.8	5.2
03/31/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	36	N/A	N/A	5.8	0.5	36.6	3.2	5.7	0.5
04/16/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	43	N/A	N/A	14.6	1.5	52.1	5.5	59.8	6.3
04/29/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	180	N/A	N/A	3.8	1.7	7.7	3.4	8.7	3.8
05/13/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	98	N/A	N/A	9.1	2.2	47.6	11.4	22.6	5.4
05/26/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	81	N/A	N/A	15.2	3.0	88.6	17.5	42.4	8.4
06/09/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	53	N/A	N/A	13.4	1.7	83.2	10.8	32.3	4.2
06/23/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	59	N/A	N/A	11.7	1.7	66.8	9.6	30.2	4.4
07/12/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	122	N/A	N/A	8.5	2.5	56.6	16.9	13.5	4.0
07/26/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	54	N/A	N/A	26.4	3.5	285.7	37.7	5.4	0.7
08/09/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	56	N/A	N/A	34.8	4.8	377.3	51.7	10.8	1.5
08/23/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	57	N/A	N/A	15.7	2.2	75.5	10.5	53.4	7.4
09/06/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	79	N/A	N/A	8.2	1.6	67.8	13.1	4.6	0.9
09/20/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	16	N/A	N/A	3.8	0.1	15.1	0.6	4.4	0.2
10/04/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	22	N/A	N/A	3.9	0.2	17.1	0.9	3.6	0.2
10/18/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	39	N/A	N/A	4.6	0.4	16.7	1.6	9.0	0.9
11/01/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	237	N/A	N/A	3.1	1.8	5.6	3.3	5.0	2.9
11/15/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	41	N/A	N/A	3.6	0.4	14.3	1.4	3.6	0.4
11/23/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	30	N/A	N/A	6.9	0.5	53.8	3.9	3.4	0.2
12/13/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	16	N/A	N/A	7.0	0.3	41.6	1.6	11.3	0.4
12/29/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	21	N/A	N/A	5.5	0.3	30.2	1.6	7.6	0.4
01/09/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	44	N/A	N/A	6.1	0.7	33.3	3.6	10.3	1.1
01/23/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	35	N/A	N/A	4.1	0.3	14.4	1.2	6.7	0.6
02/06/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	65	N/A	N/A	5.0	0.8	21.6	3.4	8.9	1.4
02/21/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	48	N/A	N/A	3.7	0.4	9.3	1.1	7.4	0.9
03/07/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	338	N/A	N/A	3.0	2.4	3.4	2.8	5.3	4.4
03/21/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	104	N/A	N/A	5.7	1.5	28.8	7.3	10.1	2.6
04/04/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	73	N/A	N/A	10.7	1.9	105.8	18.9	0.0	0.0
04/18/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	54	N/A	N/A	14.5	1.9	121.0	16.0	18.1	2.4
05/02/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	42	N/A	N/A	16.8	1.7	116.0	11.9	37.1	3.8
05/16/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	27	N/A	N/A	9.4	0.6	64.3	4.2	15.1	1.0
05/30/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	8	N/A	N/A	13.5	0.3	110.9	2.2	16.8	0.3
06/13/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	14	N/A	N/A	14.9	0.5	119.9	4.1	21.6	0.7
06/27/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	26	N/A	N/A	14.0	0.9	113.4	7.2	19.1	1.2
07/11/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	59	16.6	2.4	14.1	2.0	121.0	17.4	15.1	2.2
07/25/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	27	23.8	1.6	11.9	0.8	85.7	5.7	20.2	1.3

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
08/07/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	19	32.6	1.5	36.0	1.7	393.1	18.3	10.1	0.5
08/22/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	24	38.5	2.3	35.1	2.1	347.8	20.4	30.2	1.8
09/05/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	23	39.2	2.2	22.5	1.3	196.6	11.1	30.2	1.7
09/19/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	18	9.4	0.4	18.4	0.8	125.3	5.5	43.2	1.9
10/03/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	29	17.4	1.2	10.8	0.8	80.6	5.7	15.4	1.1
10/16/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	37	10.2	0.9	5.2	0.5	32.4	2.9	4.3	0.4
10/30/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	15	N/A	N/A	7.6	0.3	38.9	1.4	17.3	0.6
11/14/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	21	N/A	N/A	8.2	0.4	58.0	3.0	10.1	0.5
10/12/99	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,820	N/A	N/A	4.6	20.4	14.7	65.5	10.2	45.6
10/26/99	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,920	N/A	N/A	3.6	17.1	6.6	30.8	8.3	39.1
11/09/99	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,770	N/A	N/A	2.6	11.3	3.1	13.2	3.1	13.2
11/30/99	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,360	N/A	N/A	3.3	11.0	8.1	26.9	5.0	16.7
12/21/99	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,170	N/A	N/A	2.4	7.0	2.4	6.9	2.1	6.1
01/08/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,150	N/A	N/A	2.8	7.8	4.9	13.9	3.1	8.6
01/22/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,750	N/A	N/A	2.6	10.9	3.4	14.5	2.4	10.2
02/05/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,860	N/A	N/A	2.9	13.2	3.2	14.6	5.0	22.7
02/21/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	9,690	N/A	N/A	2.4	57.2	2.1	49.6	2.2	51.2
03/03/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	11,100	N/A	N/A	2.3	63.5	2.1	55.7	1.7	45.4
03/20/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	9,160	N/A	N/A	3.2	72.6	5.6	124.9	6.0	134.6
03/31/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	4,440	N/A	N/A	2.8	30.6	5.2	56.6	3.2	34.7
04/16/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	5,120	N/A	N/A	2.6	32.6	4.3	53.6	2.2	28.0
04/29/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	4,290	N/A	N/A	2.8	29.2	4.8	50.1	3.2	33.9
05/13/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	4,120	N/A	N/A	2.9	28.8	4.9	49.4	3.7	37.4
05/26/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	2,290	N/A	N/A	3.5	19.3	10.8	60.4	4.4	24.9
06/09/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,740	N/A	N/A	4.0	16.8	11.3	48.0	7.7	32.8
06/23/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,170	N/A	N/A	6.3	18.1	36.3	103.8	9.9	28.3
07/12/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,360	N/A	N/A	6.9	22.9	41.3	137.4	10.8	35.8
07/26/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,390	N/A	N/A	6.1	20.7	37.6	127.8	7.3	24.7
08/09/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,340	N/A	N/A	5.1	16.8	36.7	120.1	1.1	3.5
08/23/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	2,250	N/A	N/A	3.5	19.3	15.0	82.6	2.3	12.7
09/06/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,850	N/A	N/A	3.9	17.5	17.5	79.2	3.5	15.7
09/20/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,810	N/A	N/A	3.0	13.4	5.8	25.8	4.4	19.4
10/04/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,676	N/A	N/A	2.9	11.7	7.2	29.5	2.3	9.3
10/18/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,147	N/A	N/A	2.9	15.1	5.6	29.5	3.4	18.0
11/01/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,661	N/A	N/A	2.7	17.8	4.8	31.5	2.8	18.4
11/15/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,061	N/A	N/A	2.4	12.0	4.5	22.7	0.5	2.7
11/23/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,976	N/A	N/A	2.6	12.5	3.9	18.9	2.4	11.6
12/13/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,834	N/A	N/A	3.5	15.8	5.4	24.1	8.2	36.8
12/29/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,775	N/A	N/A	2.6	11.3	5.0	21.9	1.8	7.8
01/09/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,886	N/A	N/A	2.8	13.0	5.9	27.0	2.8	12.8
01/23/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,903	N/A	N/A	2.7	12.7	4.9	22.7	2.8	13.0
02/06/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,799	N/A	N/A	3.0	13.1	8.3	36.4	2.5	11.1

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
02/21/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,310	N/A	N/A	2.9	16.4	4.8	27.1	4.0	22.6
03/07/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	5,308	N/A	N/A	3.8	48.7	7.9	102.8	8.3	107.5
03/21/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,056	N/A	N/A	3.7	18.6	10.4	52.1	6.5	32.6
04/04/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,532	N/A	N/A	2.4	9.1	1.6	5.9	2.6	9.7
04/18/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,516	N/A	N/A	4.1	15.3	9.4	34.7	10.1	37.4
05/02/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,633	N/A	N/A	3.2	20.9	7.8	50.1	4.8	30.6
05/16/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,912	N/A	N/A	3.0	21.4	6.5	46.1	3.8	26.9
05/30/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,256	N/A	N/A	5.5	17.0	27.4	84.0	9.4	28.7
06/13/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	952	N/A	N/A	6.4	14.9	37.0	86.0	10.1	23.5
06/27/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	913	N/A	N/A	7.6	16.9	42.1	94.0	15.1	33.8
07/11/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	788	8.4	16.2	9.1	17.5	68.9	132.7	10.1	19.4
07/25/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	840	9.7	19.9	7.1	14.6	45.4	93.2	10.1	20.7
08/07/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	915	7.6	17.0	6.9	15.5	45.4	101.5	8.6	19.3
08/22/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	921	4.5	10.1	5.2	11.8	25.2	56.7	8.6	19.5
09/05/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	887	9.8	21.3	7.8	17.0	48.7	105.7	13.2	28.5
09/19/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	980	2.7	6.5	4.6	11.0	23.5	56.4	5.0	12.1
10/03/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	992	2.7	6.5	3.3	8.0	13.5	32.7	1.6	3.9
10/16/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,202	2.9	8.5	2.7	7.8	6.5	19.0	1.3	3.8
10/30/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,281	N/A	N/A	3.0	16.6	5.0	28.1	4.5	25.1
11/14/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,840	N/A	N/A	3.1	14.0	7.7	34.6	3.8	17.3
04/16/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	5,900	N/A	N/A	2.8	40.1	5.2	75.2	2.9	42.1
04/29/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	5,730	N/A	N/A	2.7	38.2	4.7	66.5	2.8	39.6
05/13/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	5,640	N/A	N/A	2.7	37.3	5.4	74.3	2.3	31.9
05/26/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	4,000	N/A	N/A	3.6	35.1	12.1	118.8	4.6	45.2
06/09/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	3,360	N/A	N/A	3.2	26.3	7.2	59.5	4.8	39.2
06/23/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,010	N/A	N/A	6.2	30.3	39.3	193.0	6.9	34.1
07/12/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,840	N/A	N/A	8.0	36.2	51.7	232.8	12.9	58.2
07/26/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,850	N/A	N/A	7.0	31.6	44.3	200.3	9.7	43.9
08/09/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,760	N/A	N/A	5.5	23.9	40.4	174.0	1.8	7.7
08/23/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,610	N/A	N/A	4.1	26.4	16.7	106.9	5.8	37.2
09/06/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,330	N/A	N/A	5.0	28.6	35.3	201.1	1.1	6.2
09/20/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,290	N/A	N/A	3.1	17.3	8.1	45.3	3.5	19.4
10/04/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,080	N/A	N/A	3.0	15.1	8.1	41.3	2.6	13.4
10/18/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,730	N/A	N/A	2.9	19.3	5.5	36.9	3.6	23.7
11/01/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	3,140	N/A	N/A	2.4	18.6	2.8	21.8	1.8	13.5
11/15/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,460	N/A	N/A	2.5	15.3	4.1	24.4	2.0	11.8
11/23/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,380	N/A	N/A	2.4	14.2	2.6	15.3	2.0	11.8
12/13/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,240	N/A	N/A	3.5	19.3	5.4	29.4	8.2	45.0
12/29/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,150	N/A	N/A	2.4	12.8	3.8	19.9	1.4	7.1
01/09/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,280	N/A	N/A	2.7	15.3	6.5	36.1	1.9	10.8
01/23/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,260	N/A	N/A	2.7	14.8	5.6	31.2	2.0	11.0
02/06/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,150	N/A	N/A	2.8	14.5	6.8	35.7	1.9	9.7

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
02/21/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,700	N/A	N/A	2.8	18.3	4.7	30.9	3.2	21.4
03/07/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	5,900	N/A	N/A	6.7	96.9	18.7	270.0	23.0	332.4
03/21/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,450	N/A	N/A	3.6	21.7	10.8	64.7	5.6	33.6
04/04/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,040	N/A	N/A	2.9	14.7	3.9	19.4	4.9	24.4
04/18/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,130	N/A	N/A	3.8	20.0	18.4	95.6	2.7	14.1
05/02/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	4,180	N/A	N/A	3.1	31.5	6.5	66.2	4.3	44.2
05/16/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	4,510	N/A	N/A	2.9	32.0	4.8	52.4	4.1	45.3
05/30/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,980	N/A	N/A	8.1	39.1	57.0	275.7	10.0	48.4
06/13/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,530	N/A	N/A	6.7	24.9	28.6	106.8	16.8	62.8
06/27/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,480	N/A	N/A	8.5	30.8	70.6	255.3	5.0	18.2
07/11/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,350	13.0	42.9	9.8	32.3	60.5	199.6	20.2	66.5
07/25/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,300	7.0	22.2	8.2	26.1	54.2	172.2	12.6	40.0
08/07/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,350	6.0	19.8	8.4	27.8	55.4	183.0	13.4	44.4
08/22/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,340	5.2	17.0	5.1	16.7	25.4	83.2	7.6	24.8
09/05/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,280	6.9	21.6	8.9	27.9	47.0	147.2	21.8	68.4
09/19/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,330	5.0	16.3	4.5	14.7	25.2	81.9	3.6	11.7
10/03/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,330	3.6	11.7	4.1	13.2	15.8	51.5	5.8	18.7
10/16/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,510	4.5	16.6	2.6	9.7	6.9	25.5	0.9	3.2
10/30/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,800	N/A	N/A	2.6	17.5	3.9	26.6	2.2	14.8
11/14/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,220	N/A	N/A	3.1	16.6	9.1	49.2	2.6	14.1
04/16/00	SJR @Patterson	SJR @Patterson (CDEC)	1,084	N/A	N/A	3.6	9.5	10.8	28.6	5.3	14.1
04/29/00	SJR @Patterson	SJR @Patterson (CDEC)	2,203	N/A	N/A	2.8	15.1	4.9	26.2	3.3	17.8
05/13/00	SJR @Patterson	SJR @Patterson (CDEC)	1,939	N/A	N/A	3.4	15.9	8.6	40.7	5.1	24.0
05/26/00	SJR @Patterson	SJR @Patterson (CDEC)	1,101	N/A	N/A	4.4	11.7	17.5	47.0	6.9	18.7
06/09/00	SJR @Patterson	SJR @Patterson (CDEC)	919	N/A	N/A	4.4	9.8	13.9	31.1	9.2	20.8
06/23/00	SJR @Patterson	SJR @Patterson (CDEC)	767	N/A	N/A	9.2	17.2	61.1	114.6	15.6	29.2
07/12/00	SJR @Patterson	SJR @Patterson (CDEC)	863	N/A	N/A	8.6	18.1	56.1	118.3	14.3	30.2
07/26/00	SJR @Patterson	SJR @Patterson (CDEC)	830	N/A	N/A	8.3	16.8	61.9	125.6	8.7	17.7
08/09/00	SJR @Patterson	SJR @Patterson (CDEC)	800	N/A	N/A	5.8	11.3	38.5	75.3	4.7	9.2
08/23/00	SJR @Patterson	SJR @Patterson (CDEC)	780	N/A	N/A	5.4	10.3	35.4	67.4	3.6	6.9
09/06/00	SJR @Patterson	SJR @Patterson (CDEC)	884	N/A	N/A	4.7	10.2	25.0	54.1	5.0	10.8
09/20/00	SJR @Patterson	SJR @Patterson (CDEC)	657	N/A	N/A	3.5	5.6	11.6	18.6	4.3	6.9
10/04/00	SJR @Patterson	SJR @Patterson (CDEC)	660	N/A	N/A	3.0	4.8	8.5	13.7	2.5	4.0
10/18/00	SJR @Patterson	SJR @Patterson (CDEC)	1,442	N/A	N/A	2.9	10.2	5.1	18.1	3.9	13.6
11/01/00	SJR @Patterson	SJR @Patterson (CDEC)	1,599	N/A	N/A	2.9	11.2	4.5	17.6	3.9	15.2
11/15/00	SJR @Patterson	SJR @Patterson (CDEC)	1,183	N/A	N/A	2.4	7.0	3.6	10.3	1.5	4.2
11/23/00	SJR @Patterson	SJR @Patterson (CDEC)	1,088	N/A	N/A	2.4	6.5	2.8	7.4	2.0	5.3
12/13/00	SJR @Patterson	SJR @Patterson (CDEC)	973	N/A	N/A	2.6	6.2	5.3	12.7	1.7	4.1
12/29/00	SJR @Patterson	SJR @Patterson (CDEC)	893	N/A	N/A	2.5	5.5	4.4	9.7	1.7	3.7
01/09/01	SJR @Patterson	SJR @Patterson (CDEC)	885	N/A	N/A	2.7	5.8	6.2	13.4	1.5	3.3
01/23/01	SJR @Patterson	SJR @Patterson (CDEC)	990	N/A	N/A	2.7	6.5	6.1	14.8	1.8	4.4
02/06/01	SJR @Patterson	SJR @Patterson (CDEC)	995	N/A	N/A	3.1	7.5	9.1	22.2	2.9	7.0

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
02/21/01	SJR @Patterson	SJR @Patterson (CDEC)	1,055	N/A	N/A	3.1	7.9	8.1	20.9	3.2	8.4
03/07/01	SJR @Patterson	SJR @Patterson (CDEC)	2,484	N/A	N/A	2.1	12.6	1.1	6.6	0.3	1.8
03/21/01	SJR @Patterson	SJR @Patterson (CDEC)	1,199	N/A	N/A	3.8	11.1	11.3	33.2	6.5	19.0
04/04/01	SJR @Patterson	SJR @Patterson (CDEC)	909	N/A	N/A	3.1	7.0	8.6	19.2	3.5	7.7
04/18/01	SJR @Patterson	SJR @Patterson (CDEC)	1,184	N/A	N/A	4.3	12.4	20.9	60.4	4.3	12.5
05/02/01	SJR @Patterson	SJR @Patterson (CDEC)	1,192	N/A	N/A	3.6	10.4	10.1	29.4	5.8	16.8
05/16/01	SJR @Patterson	SJR @Patterson (CDEC)	1,766	N/A	N/A	3.2	13.8	7.0	30.3	4.9	21.0
05/30/01	SJR @Patterson	SJR @Patterson (CDEC)	832	N/A	N/A	2.7	5.5	6.3	12.9	1.7	3.5
06/13/01	SJR @Patterson	SJR @Patterson (CDEC)	805	N/A	N/A	5.7	11.3	29.2	57.4	9.7	19.1
06/27/01	SJR @Patterson	SJR @Patterson (CDEC)	647	N/A	N/A	6.1	9.7	37.8	59.8	7.6	12.0
07/11/01	SJR @Patterson	SJR @Patterson (CDEC)	691	7.9	13.3	7.3	12.4	53.8	90.8	6.7	11.4
07/25/01	SJR @Patterson	SJR @Patterson (CDEC)	730	7.7	13.7	8.1	14.4	57.1	102.0	10.1	18.0
08/07/01	SJR @Patterson	SJR @Patterson (CDEC)	680	9.0	15.0	6.1	10.1	36.2	60.3	8.1	13.4
08/22/01	SJR @Patterson	SJR @Patterson (CDEC)	741	6.1	11.1	5.0	9.1	28.8	52.2	5.0	9.1
09/05/01	SJR @Patterson	SJR @Patterson (CDEC)	518	7.4	9.4	5.2	6.6	24.5	31.0	8.6	10.9
09/19/01	SJR @Patterson	SJR @Patterson (CDEC)	361	4.1	3.6	3.5	3.1	14.3	12.6	2.6	2.3
10/03/01	SJR @Patterson	SJR @Patterson (CDEC)	362	5.7	5.0	3.8	3.3	14.8	13.1	4.3	3.8
10/16/01	SJR @Patterson	SJR @Patterson (CDEC)	487	4.3	5.1	2.8	3.4	8.1	9.6	1.6	1.9
10/30/01	SJR @Patterson	SJR @Patterson (CDEC)	966	N/A	N/A	2.8	6.7	5.8	13.6	2.9	6.8
11/14/01	SJR @Patterson	SJR @Patterson (CDEC)	936	N/A	N/A	2.9	6.7	9.4	21.4	1.4	3.3
07/11/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,350	5.9	19.5	5.6	18.5	25.9	85.6	10.8	35.6
07/25/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,300	5.5	17.5	6.5	20.6	39.3	125.0	9.1	28.8
08/07/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,350	5.6	18.5	7.4	24.5	60.5	199.6	3.4	11.1
08/22/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,340	3.2	10.5	5.0	16.5	21.6	70.8	9.4	30.7
09/05/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,280	7.2	22.5	7.0	21.8	50.4	157.7	6.0	18.9
09/19/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,330	2.9	9.4	3.7	12.1	15.1	49.2	3.8	12.3
10/03/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,330	2.1	6.8	3.1	10.0	10.8	35.1	1.7	5.6
10/16/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,510	2.4	8.9	2.8	10.3	6.5	23.9	2.2	8.0
10/30/01	SJR @Vernalis	SJR @Vernalis (USGS)	2,800	N/A	N/A	3.3	22.7	8.6	59.1	4.7	32.0
11/14/01	SJR @Vernalis	SJR @Vernalis (USGS)	2,220	N/A	N/A	2.9	15.7	5.3	29.0	3.7	20.1
03/20/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,652	N/A	N/A	2.1	8.6	0.8	3.3	0.9	3.5
03/31/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	971	N/A	N/A	2.3	5.5	1.6	3.7	1.7	4.1
04/16/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,255	N/A	N/A	2.4	7.3	1.5	4.6	2.2	6.6
04/29/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,565	N/A	N/A	2.2	8.3	1.4	5.2	0.9	3.4
05/13/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,552	N/A	N/A	2.2	8.2	1.1	4.1	0.9	3.4
05/26/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,510	N/A	N/A	2.2	8.0	1.1	4.2	1.0	3.6
06/09/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,596	N/A	N/A	2.1	8.3	0.8	3.0	0.9	3.6
06/23/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	517	N/A	N/A	2.1	2.7	1.0	1.2	0.8	1.0
07/12/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	432	N/A	N/A	2.2	2.3	1.1	1.2	0.9	1.0
07/26/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	420	N/A	N/A	2.2	2.3	1.4	1.4	1.2	1.2
08/09/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	402	N/A	N/A	2.2	2.2	1.2	1.2	1.4	1.4
08/23/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	388	N/A	N/A	2.2	2.1	0.8	0.7	1.5	1.4

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
09/06/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	392	N/A	N/A	2.1	2.0	0.7	0.7	1.0	0.9
09/20/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	395	N/A	N/A	2.1	2.1	0.7	0.6	1.0	1.0
10/04/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	404	N/A	N/A	2.1	2.1	0.8	0.8	1.0	1.0
10/18/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	583	N/A	N/A	2.2	3.1	0.9	1.2	1.1	1.6
11/01/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	479	N/A	N/A	2.1	2.5	0.8	0.9	0.9	1.0
11/15/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	399	N/A	N/A	2.1	2.1	0.8	0.8	0.7	0.7
11/23/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	404	N/A	N/A	2.1	2.0	0.4	0.4	0.7	0.7
12/13/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	406	N/A	N/A	2.1	2.1	1.3	1.3	0.7	0.7
12/29/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	375	N/A	N/A	2.2	2.0	1.6	1.5	0.8	0.7
01/09/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	394	N/A	N/A	2.3	2.2	3.2	3.1	0.6	0.6
01/23/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	357	N/A	N/A	2.2	1.9	1.4	1.3	0.8	0.7
02/06/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	351	N/A	N/A	2.3	2.0	2.4	2.0	1.3	1.1
02/21/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	390	N/A	N/A	2.4	2.3	2.4	2.3	1.9	1.9
03/07/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	592	N/A	N/A	2.7	3.9	2.0	2.9	4.2	6.0
03/21/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	394	N/A	N/A	2.9	2.8	3.7	3.6	4.9	4.8
04/04/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	508	N/A	N/A	3.0	3.8	7.2	8.9	3.6	4.5
04/18/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	614	N/A	N/A	2.3	3.4	1.7	2.5	1.3	1.9
05/02/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,547	N/A	N/A	2.3	8.6	1.4	5.2	1.6	6.0
05/16/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,598	N/A	N/A	2.3	8.9	1.4	5.6	1.6	6.2
05/30/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	724	N/A	N/A	2.3	4.0	1.4	2.5	1.6	2.8
06/13/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	578	N/A	N/A	2.4	3.4	2.4	3.5	2.1	3.0
06/27/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	567	N/A	N/A	3.7	5.1	7.5	10.3	7.9	10.9
07/11/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	562	0.6	0.8	2.2	3.1	1.1	1.5	1.5	2.1
07/25/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	460	1.0	1.1	2.1	2.4	0.9	1.0	0.8	0.9
08/07/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	435	0.7	0.7	2.2	2.3	1.0	1.1	0.9	1.0
08/22/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	419	0.9	0.9	2.3	2.4	1.4	1.5	1.8	1.8
09/05/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	393	0.9	0.9	2.1	2.0	1.2	1.1	0.5	0.5
09/19/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	350	0.9	0.8	2.1	1.8	1.2	1.0	0.6	0.6
10/03/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	338	1.0	0.8	2.1	1.8	1.2	1.0	0.6	0.5
10/16/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	308	0.4	0.3	2.1	1.6	0.8	0.6	0.7	0.5
10/30/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	519	N/A	N/A	2.3	3.0	2.5	3.2	1.3	1.6
11/14/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	380	N/A	N/A	2.2	2.1	1.7	1.6	1.2	1.1
10/12/99	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	660	N/A	N/A	2.5	4.0	1.7	2.7	2.7	4.4
10/26/99	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	454	N/A	N/A	2.4	2.7	1.6	1.8	2.6	2.8
11/09/99	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	454	N/A	N/A	2.3	2.6	0.4	0.4	2.4	2.6
11/30/99	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	411	N/A	N/A	2.2	2.2	1.8	1.8	0.8	0.8
12/21/99	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	379	N/A	N/A	2.1	2.0	0.4	0.4	1.1	1.0
01/08/00	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	355	N/A	N/A	2.3	2.0	1.9	1.7	1.1	1.0
01/22/00	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	377	N/A	N/A	3.6	3.3	5.5	5.1	8.7	8.0
02/05/00	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	411	N/A	N/A	2.3	2.3	1.2	1.2	1.6	1.6
02/21/00	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	2,318	N/A	N/A	7.7	43.8	32.0	181.4	22.4	127.0
03/03/00	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	3,322	N/A	N/A	2.1	16.7	0.6	4.9	0.5	3.8

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
10/12/99	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	553	N/A	N/A	2.3	3.1	1.1	1.5	1.8	2.4
10/26/99	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	515	N/A	N/A	2.7	3.4	2.6	3.2	3.8	4.8
11/09/99	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	506	N/A	N/A	2.2	2.7	1.1	1.3	1.1	1.3
11/30/99	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	424	N/A	N/A	2.7	2.8	4.2	4.4	3.1	3.2
12/21/99	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	417	N/A	N/A	2.4	2.4	2.2	2.2	1.8	1.8
01/08/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	416	N/A	N/A	2.2	2.2	1.6	1.6	0.9	0.9
01/22/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	503	N/A	N/A	2.5	3.1	3.0	3.7	2.5	3.1
02/05/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	362	N/A	N/A	2.2	1.9	0.8	0.7	1.2	1.0
02/21/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	3,930	N/A	N/A	4.3	41.3	10.3	98.6	10.8	103.8
03/03/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	4,245	N/A	N/A	2.1	21.5	0.6	6.4	0.6	6.2
03/20/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	5,290	N/A	N/A	2.4	30.8	1.9	24.7	2.1	26.6
03/31/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	2,769	N/A	N/A	2.2	14.6	1.0	7.0	1.0	6.7
04/16/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	4,481	N/A	N/A	2.2	24.1	1.2	13.0	1.2	13.2
04/29/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	2,027	N/A	N/A	2.2	11.0	1.5	7.5	1.1	5.4
05/13/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	2,025	N/A	N/A	2.1	10.6	1.1	5.7	0.8	4.1
05/26/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	881	N/A	N/A	2.2	4.8	2.1	4.5	0.9	2.0
06/09/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	617	N/A	N/A	2.3	3.5	1.7	2.6	1.5	2.3
06/23/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	762	N/A	N/A	2.3	4.2	2.0	3.7	1.1	2.0
07/12/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	627	N/A	N/A	2.2	3.4	1.1	1.7	1.6	2.4
07/26/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	692	N/A	N/A	2.1	3.6	0.7	1.2	0.8	1.4
08/09/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	478	N/A	N/A	2.1	2.4	0.5	0.6	0.7	0.9
08/23/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,629	N/A	N/A	2.1	8.5	0.9	3.4	1.0	3.8
09/06/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	825	N/A	N/A	2.1	4.3	0.8	1.5	0.9	1.8
09/20/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,093	N/A	N/A	2.2	5.8	0.8	2.2	1.2	3.2
10/04/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	928	N/A	N/A	2.1	4.9	1.0	2.3	0.9	2.1
10/18/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	588	N/A	N/A	2.2	3.2	1.0	1.5	1.4	2.0
11/01/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	652	N/A	N/A	2.0	3.2	0.4	0.7	0.4	0.6
11/15/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	487	N/A	N/A	2.1	2.5	0.7	0.9	0.5	0.6
11/23/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	497	N/A	N/A	2.0	2.5	0.3	0.4	0.4	0.5
12/13/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	455	N/A	N/A	2.1	2.3	0.6	0.7	0.5	0.6
12/29/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	442	N/A	N/A	2.1	2.3	1.4	1.6	0.5	0.6
01/09/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	510	N/A	N/A	2.2	2.7	1.7	2.2	0.9	1.1
01/23/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	456	N/A	N/A	2.2	2.4	1.6	1.8	0.9	1.0
02/06/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	442	N/A	N/A	2.2	2.4	1.6	1.7	1.0	1.1
02/21/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,271	N/A	N/A	2.2	7.0	1.2	3.8	1.4	4.5
03/07/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,850	N/A	N/A	2.5	11.1	1.9	8.5	2.6	11.7
03/21/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	607	N/A	N/A	2.2	3.3	1.8	2.7	0.9	1.3
04/04/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	605	N/A	N/A	2.3	3.4	1.9	2.8	1.4	2.1
04/18/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	566	N/A	N/A	2.4	3.3	3.2	4.4	1.1	1.6
05/02/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,507	N/A	N/A	2.2	8.1	1.2	4.5	1.2	4.5
05/16/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,078	N/A	N/A	2.3	6.0	1.5	4.0	1.4	3.8
05/30/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	433	N/A	N/A	2.3	2.4	2.7	2.8	1.0	1.1

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
06/13/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	336	N/A	N/A	2.6	2.1	2.4	2.0	3.0	2.5
06/27/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	340	N/A	N/A	2.8	2.4	4.3	3.6	3.8	3.2
07/11/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	215	1.0	0.5	2.2	1.2	2.4	1.3	0.5	0.3
07/25/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	315	1.2	0.9	2.3	1.8	3.3	2.6	0.6	0.4
08/07/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	303	1.4	1.0	2.5	1.8	3.2	2.4	1.9	1.4
08/22/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	327	1.5	1.2	2.6	2.1	3.7	2.9	2.4	1.9
09/05/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	327	1.0	0.8	2.3	1.8	2.1	1.7	1.0	0.8
09/19/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	336	1.3	1.1	2.3	1.9	2.5	2.1	1.4	1.2
10/03/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	327	1.0	0.8	2.3	1.9	3.2	2.5	0.9	0.7
10/16/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	328	0.7	0.6	2.4	1.9	2.9	2.3	1.7	1.4
10/30/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	289	N/A	N/A	2.5	1.8	3.6	2.5	1.9	1.4
11/14/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	269	N/A	N/A	2.2	1.5	1.9	1.2	1.0	0.7

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
10/12/99	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.4	N/A	14.1	N/A	9.0	N/A
10/26/99	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.8	N/A	4.7	N/A	3.5	N/A
11/09/99	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.5	N/A	2.9	N/A	2.2	N/A
11/30/99	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.4	N/A	14.4	N/A	1.6	N/A
12/21/99	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.0	N/A	9.9	N/A	1.4	N/A
01/08/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.8	N/A	20.1	N/A	8.2	N/A
01/22/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.4	N/A	2.5	N/A	1.7	N/A
02/05/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.7	N/A	10.0	N/A	6.4	N/A
02/21/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.8	N/A	22.0	N/A	7.2	N/A
03/03/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.4	N/A	9.2	N/A	4.8	N/A
03/20/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	5.5	N/A	17.0	N/A	15.2	N/A
03/31/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	5.1	N/A	27.8	N/A	5.9	N/A
04/16/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	6.7	N/A	27.6	N/A	17.9	N/A
04/29/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.4	N/A	10.5	N/A	4.0	N/A
05/13/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.7	N/A	17.2	N/A	9.2	N/A
05/26/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.9	N/A	22.7	N/A	7.7	N/A
06/09/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.2	N/A	23.5	N/A	1.9	N/A
06/23/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	19.9	N/A	134.8	N/A	48.5	N/A
07/12/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	9.7	N/A	66.7	N/A	15.6	N/A
07/26/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	7.8	N/A	50.1	N/A	12.3	N/A
08/09/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.9	N/A	13.9	N/A	5.6	N/A
08/23/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	5.2	N/A	19.6	N/A	11.6	N/A
09/06/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.6	N/A	15.1	N/A	3.1	N/A
09/20/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.1	N/A	9.7	N/A	2.8	N/A
10/04/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.4	N/A	11.0	N/A	3.9	N/A
10/18/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.5	N/A	3.2	N/A	2.0	N/A
11/01/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.8	N/A	6.4	N/A	2.5	N/A
11/15/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.2	N/A	2.3	N/A	0.8	N/A
11/23/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.1	N/A	0.9	N/A	0.7	N/A
12/13/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.3	N/A	2.3	N/A	1.4	N/A
12/29/00	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.3	N/A	2.0	N/A	1.4	N/A
01/09/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.3	N/A	2.2	N/A	1.2	N/A
01/23/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.3	N/A	3.0	N/A	1.2	N/A
02/06/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.6	N/A	4.2	N/A	2.1	N/A
02/21/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.8	N/A	4.6	N/A	3.1	N/A
03/07/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.7	N/A	3.3	N/A	3.3	N/A
03/21/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	3.6	N/A	8.9	N/A	6.3	N/A
04/04/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.5	N/A	13.0	N/A	10.8	N/A
04/18/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.2	N/A	18.7	N/A	5.0	N/A
05/02/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	8.8	N/A	54.1	N/A	16.8	N/A
05/16/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	4.7	N/A	16.7	N/A	9.7	N/A
05/30/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	9.7	N/A	51.8	N/A	24.5	N/A

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
06/13/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	10.0	N/A	66.1	N/A	18.3	N/A
06/27/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	6.7	N/A	41.0	N/A	9.7	N/A
07/11/01	Los Banos Creek @Hwy 140	N/A	N/A	16.1	N/A	10.2	N/A	65.5	N/A	20.2	N/A
07/25/01	Los Banos Creek @Hwy 140	N/A	N/A	25.3	N/A	5.9	N/A	33.7	N/A	8.6	N/A
08/07/01	Los Banos Creek @Hwy 140	N/A	N/A	28.4	N/A	6.0	N/A	47.5	N/A	1.1	N/A
08/22/01	Los Banos Creek @Hwy 140	N/A	N/A	12.5	N/A	6.7	N/A	33.1	N/A	14.4	N/A
09/05/01	Los Banos Creek @Hwy 140	N/A	N/A	8.4	N/A	4.6	N/A	17.3	N/A	8.6	N/A
09/19/01	Los Banos Creek @Hwy 140	N/A	N/A	6.3	N/A	3.2	N/A	9.1	N/A	3.5	N/A
10/03/01	Los Banos Creek @Hwy 140	N/A	N/A	9.8	N/A	3.5	N/A	15.4	N/A	1.9	N/A
10/16/01	Los Banos Creek @Hwy 140	N/A	N/A	6.4	N/A	3.4	N/A	7.9	N/A	5.8	N/A
10/30/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.4	N/A	3.8	N/A	1.4	N/A
11/14/01	Los Banos Creek @Hwy 140	N/A	N/A	N/A	N/A	2.6	N/A	3.6	N/A	2.4	N/A
10/12/99	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	213	N/A	N/A	2.3	1.2	1.4	0.7	1.9	1.0
10/26/99	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	343	N/A	N/A	2.3	1.9	1.7	1.4	1.6	1.3
11/09/99	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	275	N/A	N/A	2.2	1.4	1.1	0.7	0.9	0.6
11/30/99	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	247	N/A	N/A	2.2	1.3	1.9	1.1	1.0	0.6
12/21/99	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	245	N/A	N/A	2.6	1.6	4.0	2.4	2.7	1.6
01/08/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	220	N/A	N/A	2.1	1.1	1.0	0.5	0.6	0.3
01/22/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	289	N/A	N/A	2.3	1.6	3.7	2.6	0.6	0.4
02/05/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	261	N/A	N/A	2.2	1.4	0.8	0.5	1.6	1.0
02/21/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	2,739	N/A	N/A	2.2	14.5	1.1	7.2	1.0	6.4
03/03/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	3,058	N/A	N/A	2.1	15.7	1.0	7.3	0.6	4.4
03/20/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	2,225	N/A	N/A	2.7	14.5	3.2	17.2	3.3	18.2
03/31/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	669	N/A	N/A	2.3	3.7	1.3	2.1	1.7	2.9
04/16/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	343	N/A	N/A	2.2	1.8	1.0	0.8	1.2	1.0
04/29/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	1,601	N/A	N/A	2.2	8.4	1.1	4.2	0.9	3.6
05/13/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	989	N/A	N/A	2.1	5.2	0.7	1.7	1.1	2.6
05/26/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	402	N/A	N/A	2.1	2.1	1.2	1.2	0.6	0.6
06/09/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	300	N/A	N/A	2.0	1.5	0.8	0.6	0.1	0.0
06/23/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	174	N/A	N/A	2.1	0.9	1.0	0.4	0.7	0.3
07/12/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	189	N/A	N/A	2.2	1.0	1.0	0.5	1.0	0.5
07/26/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	167	N/A	N/A	2.1	0.9	0.7	0.3	0.9	0.4
08/09/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	139	N/A	N/A	2.2	0.7	1.4	0.5	0.8	0.3
08/23/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	165	N/A	N/A	2.2	0.9	1.3	0.5	1.2	0.5
09/06/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	188	N/A	N/A	2.1	1.0	0.7	0.3	0.7	0.3
09/20/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	186	N/A	N/A	2.1	1.0	0.8	0.4	0.7	0.3
10/04/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	163	N/A	N/A	2.1	0.8	0.8	0.3	0.7	0.3
10/18/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	773	N/A	N/A	2.3	4.3	1.1	2.1	1.8	3.5
11/01/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	676	N/A	N/A	2.1	3.5	1.4	2.3	0.7	1.1
11/15/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	578	N/A	N/A	2.0	2.9	0.7	1.0	0.2	0.3
11/23/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	573	N/A	N/A	2.0	2.8	0.3	0.4	0.4	0.6
12/13/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	394	N/A	N/A	2.0	1.9	0.5	0.5	0.3	0.3

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
12/29/00	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	366	N/A	N/A	2.0	1.8	0.6	0.5	0.3	0.3
01/09/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	344	N/A	N/A	2.1	1.8	1.1	0.9	0.6	0.5
01/23/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	321	N/A	N/A	2.0	1.6	0.7	0.5	0.4	0.3
02/06/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	305	N/A	N/A	2.2	1.6	1.1	0.8	1.2	0.9
02/21/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	305	N/A	N/A	2.2	1.6	0.8	0.6	1.2	0.9
03/07/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	694	N/A	N/A	2.5	4.3	3.6	6.1	2.0	3.4
03/21/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	319	N/A	N/A	2.3	1.8	1.9	1.5	1.8	1.4
04/04/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	244	N/A	N/A	2.1	1.3	0.8	0.5	0.8	0.5
04/18/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	395	N/A	N/A	2.3	2.2	1.5	1.5	1.4	1.3
05/02/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	557	N/A	N/A	2.2	3.0	0.9	1.2	1.4	1.9
05/16/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	1,166	N/A	N/A	2.1	6.1	0.6	1.8	1.1	3.1
05/30/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	351	N/A	N/A	2.1	1.8	1.1	0.9	0.8	0.7
06/13/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	240	N/A	N/A	2.5	1.5	3.1	1.8	2.1	1.2
06/27/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	157	N/A	N/A	2.4	0.9	3.0	1.1	1.6	0.6
07/11/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	152	1.1	0.4	2.3	0.9	2.2	0.8	1.3	0.5
07/25/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	126	2.1	0.6	2.7	0.8	5.6	1.7	2.2	0.7
08/07/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	132	0.8	0.3	2.2	0.7	1.7	0.6	0.9	0.3
08/22/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	119	0.7	0.2	2.2	0.7	1.5	0.4	1.3	0.4
09/05/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	76	0.8	0.1	2.2	0.4	1.6	0.3	0.6	0.1
09/19/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	153	0.8	0.3	2.2	0.8	1.7	0.6	0.9	0.3
10/03/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	88	0.5	0.1	2.1	0.5	1.5	0.3	0.3	0.1
10/16/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	124	0.8	0.2	2.3	0.7	1.9	0.6	1.7	0.5
10/30/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	796	N/A	N/A	2.3	4.4	1.4	2.7	1.6	3.1
11/14/01	Merced @River Rd (J18)	Merced @Stevinson (CDEC)	505	N/A	N/A	2.3	2.9	2.2	2.7	1.6	2.0
10/26/99	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	196	N/A	N/A	3.3	1.6	6.9	3.3	5.9	2.8
11/09/99	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	182	N/A	N/A	3.4	1.5	8.6	3.8	5.3	2.4
11/30/99	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	126	N/A	N/A	3.1	1.0	7.2	2.2	4.0	1.2
12/21/99	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	117	N/A	N/A	3.0	0.9	7.7	2.2	2.9	0.8
01/08/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	147	N/A	N/A	3.6	1.3	9.6	3.5	6.4	2.3
01/22/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	177	N/A	N/A	5.5	2.4	35.2	15.2	4.6	2.0
02/05/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	184	N/A	N/A	3.4	1.5	6.4	2.9	6.4	2.9
02/21/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	343	N/A	N/A	2.3	2.0	3.0	2.5	1.1	0.9
03/03/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	332	N/A	N/A	3.5	2.9	8.8	7.2	6.3	5.1
03/20/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	166	N/A	N/A	2.3	0.9	2.2	0.9	1.5	0.6
03/31/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	89	N/A	N/A	4.1	0.9	16.9	3.7	5.6	1.2
04/16/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	78	N/A	N/A	7.6	1.4	42.7	8.2	15.0	2.9
04/29/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	56	N/A	N/A	6.9	1.0	34.8	4.8	15.1	2.1
05/13/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	104	N/A	N/A	4.3	1.1	18.0	4.6	6.2	1.6
05/26/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	102	N/A	N/A	3.8	0.9	14.6	3.6	4.4	1.1
06/09/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	94	N/A	N/A	3.8	0.9	21.0	4.8	1.0	0.2
06/23/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	82	N/A	N/A	7.8	1.6	60.1	12.0	6.2	1.2
07/12/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	72	N/A	N/A	5.1	0.9	33.7	5.9	2.7	0.5

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
07/26/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	63	N/A	N/A	4.0	0.6	20.4	3.1	2.7	0.4
08/09/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	63	N/A	N/A	7.7	1.2	62.9	9.7	3.6	0.6
08/23/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	59	N/A	N/A	6.6	1.0	47.3	6.8	5.5	0.8
09/06/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	56	N/A	N/A	9.3	1.3	60.1	8.2	16.9	2.3
09/20/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	52	N/A	N/A	3.6	0.5	13.6	1.7	3.5	0.5
10/04/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	88	N/A	N/A	3.2	0.7	11.8	2.5	2.2	0.5
10/18/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	194	N/A	N/A	3.0	1.4	7.2	3.4	3.7	1.8
11/01/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	236	N/A	N/A	2.4	1.4	3.5	2.0	1.3	0.7
11/15/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	131	N/A	N/A	2.8	0.9	7.9	2.5	1.4	0.5
11/23/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	127	N/A	N/A	2.4	0.8	2.0	0.6	2.4	0.8
12/13/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	159	N/A	N/A	2.7	1.0	5.0	2.0	2.3	0.9
12/29/00	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	127	N/A	N/A	2.5	0.8	4.1	1.3	1.9	0.6
01/09/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	142	N/A	N/A	2.7	0.9	6.5	2.2	1.8	0.6
01/23/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	200	N/A	N/A	3.1	1.5	9.9	4.9	2.2	1.1
02/06/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	197	N/A	N/A	3.8	1.8	19.7	9.5	1.9	0.9
02/21/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	215	N/A	N/A	3.9	2.1	14.3	7.5	5.6	2.9
03/07/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	411	N/A	N/A	4.4	4.5	17.3	17.4	7.6	7.6
03/21/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	154	N/A	N/A	5.1	1.9	32.6	12.3	3.3	1.2
04/04/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	77	N/A	N/A	10.2	1.9	78.6	14.8	12.1	2.3
04/18/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	57	N/A	N/A	11.8	1.6	85.7	11.9	19.3	2.7
05/02/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	68	N/A	N/A	5.2	0.9	25.9	4.3	7.8	1.3
05/16/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	99	N/A	N/A	4.2	1.0	18.0	4.4	5.8	1.4
05/30/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	91	N/A	N/A	4.4	1.0	19.0	4.2	6.0	1.3
06/13/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	65	N/A	N/A	7.5	1.2	58.8	9.3	5.0	0.8
06/27/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	61	N/A	N/A	7.5	1.1	55.4	8.3	6.7	1.0
07/11/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	71	7.0	1.2	5.4	0.9	24.5	4.2	10.1	1.7
07/25/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	62	9.7	1.5	6.9	1.0	55.4	8.4	2.5	0.4
08/07/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	73	7.0	1.2	7.0	1.3	52.9	9.4	5.0	0.9
08/22/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	61	7.8	1.2	5.1	0.8	31.3	4.7	4.3	0.6
09/05/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	43	9.0	0.9	4.7	0.5	15.6	1.6	10.4	1.1
09/19/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	49	6.8	0.8	3.6	0.4	13.7	1.6	3.6	0.4
10/03/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	99	10.3	2.5	4.0	1.0	17.3	4.2	4.3	1.0
10/16/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	163	8.0	3.2	3.3	1.3	8.6	3.4	4.3	1.7
10/30/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	111	N/A	N/A	3.5	1.0	12.6	3.4	4.0	1.1
11/14/01	Mud Slough @Kesterson	Mud Slough @Gustine (USGS)	243	N/A	N/A	3.3	2.0	12.3	7.3	2.5	1.5
10/12/99	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	7	N/A	N/A	2.4	0.0	2.4	0.0	1.9	0.0
10/26/99	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	19	N/A	N/A	3.3	0.2	9.6	0.4	4.2	0.2
11/09/99	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	28	N/A	N/A	2.3	0.2	3.2	0.2	1.0	0.1
11/30/99	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	59	N/A	N/A	2.4	0.3	2.1	0.3	1.7	0.3
12/21/99	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	18	N/A	N/A	2.1	0.1	0.8	0.0	0.9	0.0
01/08/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	43	N/A	N/A	2.7	0.3	7.1	0.7	1.4	0.1
01/22/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	12	N/A	N/A	3.3	0.1	8.6	0.3	4.6	0.1

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
02/05/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	6	N/A	N/A	2.3	0.0	1.6	0.0	1.6	0.0
02/21/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	10	N/A	N/A	2.0	0.0	0.3	0.0	0.2	0.0
03/03/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	39	N/A	N/A	2.0	0.2	0.3	0.0	0.3	0.0
03/20/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	3	N/A	N/A	3.0	0.0	4.5	0.0	4.9	0.0
03/31/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	9	N/A	N/A	3.0	0.1	6.1	0.1	3.9	0.1
04/16/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	20	N/A	N/A	2.9	0.1	5.8	0.3	3.7	0.2
04/29/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	17	N/A	N/A	2.5	0.1	3.2	0.1	1.8	0.1
05/13/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	62	N/A	N/A	2.6	0.4	2.6	0.4	3.4	0.5
05/26/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	13	N/A	N/A	3.5	0.1	13.3	0.4	3.1	0.1
06/09/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	81	N/A	N/A	2.4	0.5	3.9	0.8	1.3	0.3
06/23/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	8	N/A	N/A	2.4	0.0	2.7	0.1	1.7	0.0
07/12/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	14	N/A	N/A	2.4	0.1	2.0	0.1	2.0	0.1
07/26/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	18	N/A	N/A	2.5	0.1	4.0	0.2	2.0	0.1
08/09/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	27	N/A	N/A	2.7	0.2	6.0	0.4	2.1	0.1
08/23/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	11	N/A	N/A	2.7	0.1	2.9	0.1	3.6	0.1
09/06/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	29	N/A	N/A	2.7	0.2	6.6	0.5	1.6	0.1
09/20/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	22	N/A	N/A	2.8	0.2	5.8	0.3	2.7	0.1
10/04/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.4	N/A	2.1	N/A	1.8	N/A
10/18/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.9	N/A	5.6	N/A	3.4	N/A
11/01/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	1.8	N/A	0.1	N/A
11/15/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.2	N/A	2.0	N/A	0.9	N/A
11/23/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	0.6	N/A	0.5	N/A
12/13/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	2.2	N/A	0.2	N/A
12/29/00	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	0.9	N/A	0.3	N/A
01/09/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	1.0	N/A	0.4	N/A
01/23/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.5	N/A	4.4	N/A	1.3	N/A
02/06/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.3	N/A	3.5	N/A	0.3	N/A
02/21/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.3	N/A	2.7	N/A	1.1	N/A
03/07/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.1	N/A	1.2	N/A	0.7	N/A
03/21/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.6	N/A	3.3	N/A	2.9	N/A
04/04/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.5	N/A	4.0	N/A	1.8	N/A
04/18/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.8	N/A	5.3	N/A	3.4	N/A
05/02/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	3.3	N/A	4.3	N/A	7.2	N/A
05/16/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.5	N/A	4.9	N/A	1.1	N/A
05/30/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	4.7	N/A	22.3	N/A	6.5	N/A
06/13/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	3.7	N/A	8.6	N/A	7.2	N/A
06/27/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	4.7	N/A	18.9	N/A	8.7	N/A
07/11/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	12.2	N/A	2.4	N/A	4.0	N/A	1.0	N/A
07/25/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	2.3	N/A	2.1	N/A	1.1	N/A	0.7	N/A
08/07/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	1.4	N/A	2.5	N/A	4.4	N/A	1.1	N/A
08/22/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	4.3	N/A	2.3	N/A	2.4	N/A	1.3	N/A
09/05/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	2.8	N/A	2.3	N/A	3.1	N/A	0.7	N/A

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
09/19/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	2.6	N/A	2.4	N/A	2.3	N/A	1.6	N/A
10/03/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	2.6	N/A	2.4	N/A	3.5	N/A	1.4	N/A
10/16/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	2.6	N/A	2.4	N/A	2.7	N/A	1.5	N/A
10/30/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.3	N/A	2.6	N/A	1.1	N/A
11/14/01	Orestimba Crk @River Rd	Orestimba @River Road (USGS)	N/A	N/A	N/A	2.2	N/A	2.1	N/A	0.7	N/A
10/12/99	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	130	N/A	N/A	5.3	1.7	19.2	6.1	12.8	4.1
10/26/99	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	166	N/A	N/A	12.4	5.1	72.5	29.4	32.0	13.0
11/09/99	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	226	N/A	N/A	2.6	1.4	3.8	2.1	2.1	1.2
11/30/99	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	142	N/A	N/A	4.5	1.6	20.4	7.1	6.0	2.1
12/21/99	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	93	N/A	N/A	2.4	0.6	3.7	0.8	1.3	0.3
01/08/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	84	N/A	N/A	3.6	0.7	9.6	2.0	6.4	1.3
01/22/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	117	N/A	N/A	4.0	1.1	7.9	2.3	9.9	2.8
02/05/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	203	N/A	N/A	3.6	1.8	7.2	3.6	7.2	3.6
02/21/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	251	N/A	N/A	2.9	1.8	5.1	3.1	3.9	2.4
03/03/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	360	N/A	N/A	2.8	2.5	6.7	5.9	2.1	1.9
03/20/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	397	N/A	N/A	2.4	2.3	2.2	2.1	2.1	2.0
03/31/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	295	N/A	N/A	3.3	2.4	5.0	3.6	7.1	5.1
04/16/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	262	N/A	N/A	3.7	2.4	7.0	4.5	8.5	5.4
04/29/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	173	N/A	N/A	2.8	1.2	4.6	1.9	3.8	1.6
05/13/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	226	N/A	N/A	3.3	1.8	6.8	3.7	6.0	3.3
05/26/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	115	N/A	N/A	4.1	1.2	11.2	3.1	8.9	2.5
06/09/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	149	N/A	N/A	3.4	1.2	11.6	4.2	3.5	1.3
06/23/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	172	N/A	N/A	4.6	1.9	18.1	7.6	8.5	3.6
07/12/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	230	N/A	N/A	4.1	2.3	14.2	8.0	6.9	3.9
07/26/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	179	N/A	N/A	4.5	2.0	24.6	10.8	3.9	1.7
08/09/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	206	N/A	N/A	3.9	2.0	16.4	8.3	4.1	2.1
08/23/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	166	N/A	N/A	3.7	1.5	14.2	5.8	3.9	1.6
09/06/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	104	N/A	N/A	3.6	0.9	16.1	4.1	2.6	0.7
09/20/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	91	N/A	N/A	3.3	0.7	11.9	2.6	2.8	0.6
10/04/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	86	N/A	N/A	3.2	0.7	10.2	2.2	2.8	0.6
10/18/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	113	N/A	N/A	3.8	1.0	10.2	2.8	7.2	2.0
11/01/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	180	N/A	N/A	2.8	1.2	5.2	2.3	3.1	1.4
11/15/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	126	N/A	N/A	3.0	0.9	9.3	2.9	1.9	0.6
11/23/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	120	N/A	N/A	2.7	0.8	5.5	1.6	2.3	0.7
12/13/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	156	N/A	N/A	2.9	1.1	9.6	3.7	1.2	0.5
12/29/00	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	113	N/A	N/A	3.0	0.8	9.8	2.7	1.7	0.5
01/09/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	221	N/A	N/A	3.2	1.7	11.6	6.3	2.3	1.3
01/23/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	144	N/A	N/A	2.9	1.0	9.4	3.3	1.4	0.5
02/06/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	216	N/A	N/A	3.1	1.6	9.0	4.8	2.9	1.5
02/21/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	244	N/A	N/A	3.2	1.9	5.8	3.4	5.8	3.4
03/07/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	685	N/A	N/A	2.5	4.2	4.3	7.2	1.4	2.4
03/21/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	266	N/A	N/A	3.3	2.1	9.4	6.1	4.0	2.6

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
04/04/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	292	N/A	N/A	3.0	2.1	6.3	4.5	3.7	2.7
04/18/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	157	N/A	N/A	3.1	1.2	7.5	2.9	4.1	1.6
05/02/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	143	N/A	N/A	2.9	1.0	4.0	1.4	4.3	1.5
05/16/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	222	N/A	N/A	3.5	1.9	11.9	6.4	4.3	2.3
05/30/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	140	N/A	N/A	3.7	1.3	13.4	4.6	4.8	1.6
06/13/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	139	N/A	N/A	4.3	1.4	12.5	4.2	9.1	3.1
06/27/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	200	N/A	N/A	4.4	2.1	16.3	8.0	7.7	3.8
07/11/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	191	5.7	2.7	4.3	2.0	23.0	10.8	2.9	1.3
07/25/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	193	4.8	2.3	4.3	2.0	15.1	7.1	7.6	3.6
08/07/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	157	3.2	1.2	4.1	1.6	23.5	9.0	1.2	0.5
08/22/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	205	2.5	1.3	3.6	1.8	13.0	6.5	4.0	2.0
09/05/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	50	4.3	0.5	4.0	0.5	9.4	1.1	9.4	1.1
09/19/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	52	3.1	0.4	3.7	0.5	12.5	1.6	5.2	0.7
10/03/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	48	2.6	0.3	3.0	0.3	9.3	1.1	1.9	0.2
10/16/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	158	3.3	1.3	3.5	1.4	7.9	3.1	6.5	2.5
10/30/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	78	N/A	N/A	3.7	0.7	14.0	2.7	4.0	0.8
11/14/01	Salt Slough @Hwy 165	Salt Slough @Hwy 165 (USGS)	205	N/A	N/A	3.3	1.6	10.4	5.2	3.5	1.7
07/11/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	58	6.2	0.9	N/A	N/A	N/A	N/A	N/A	N/A
07/25/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	54	8.6	1.1	N/A	N/A	N/A	N/A	N/A	N/A
08/08/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	59	6.6	1.0	N/A	N/A	N/A	N/A	N/A	N/A
08/22/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	53	6.6	0.9	N/A	N/A	N/A	N/A	N/A	N/A
09/05/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	32	7.2	0.6	N/A	N/A	N/A	N/A	N/A	N/A
09/19/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	15	5.7	0.2	N/A	N/A	N/A	N/A	N/A	N/A
10/03/01	San Luis Drain @Kesterson	San Luis Drain (USGS)	9	6.5	0.1	N/A	N/A	N/A	N/A	N/A	N/A
03/20/00	San Luis Drain-Terminous	San Luis Drain (USGS)	45	N/A	N/A	4.1	0.5	13.4	1.5	7.8	0.9
03/31/00	San Luis Drain-Terminous	San Luis Drain (USGS)	40	N/A	N/A	5.0	0.5	30.0	2.9	3.9	0.4
04/16/00	San Luis Drain-Terminous	San Luis Drain (USGS)	41	N/A	N/A	5.8	0.6	31.3	3.1	9.2	0.9
04/29/00	San Luis Drain-Terminous	San Luis Drain (USGS)	39	N/A	N/A	6.7	0.6	33.8	3.2	14.0	1.3
05/13/00	San Luis Drain-Terminous	San Luis Drain (USGS)	47	N/A	N/A	4.7	0.5	21.8	2.5	6.9	0.8
05/26/00	San Luis Drain-Terminous	San Luis Drain (USGS)	50	N/A	N/A	3.7	0.4	14.2	1.7	3.9	0.5
06/09/00	San Luis Drain-Terminous	San Luis Drain (USGS)	67	N/A	N/A	5.2	0.8	21.7	3.5	10.1	1.7
06/23/00	San Luis Drain-Terminous	San Luis Drain (USGS)	61	N/A	N/A	6.4	1.0	45.5	6.8	4.8	0.7
07/12/00	San Luis Drain-Terminous	San Luis Drain (USGS)	67	N/A	N/A	4.9	0.8	31.0	5.1	2.7	0.4
07/26/00	San Luis Drain-Terminous	San Luis Drain (USGS)	57	N/A	N/A	3.8	0.5	20.8	2.9	1.2	0.2
08/09/00	San Luis Drain-Terminous	San Luis Drain (USGS)	55	N/A	N/A	7.0	0.9	53.9	7.2	4.0	0.5
08/23/00	San Luis Drain-Terminous	San Luis Drain (USGS)	56	N/A	N/A	6.5	0.9	30.9	4.2	14.6	2.0
09/06/00	San Luis Drain-Terminous	San Luis Drain (USGS)	47	N/A	N/A	9.2	1.1	75.5	8.7	7.2	0.8
09/20/00	San Luis Drain-Terminous	San Luis Drain (USGS)	21	N/A	N/A	3.3	0.2	12.4	0.6	2.5	0.1
10/04/00	San Luis Drain-Terminous	San Luis Drain (USGS)	19	N/A	N/A	4.0	0.2	20.7	1.0	2.6	0.1
10/18/00	San Luis Drain-Terminous	San Luis Drain (USGS)	20	N/A	N/A	3.5	0.2	14.0	0.7	3.0	0.1
11/01/00	San Luis Drain-Terminous	San Luis Drain (USGS)	21	N/A	N/A	2.9	0.1	8.1	0.4	1.8	0.1
11/15/00	San Luis Drain-Terminous	San Luis Drain (USGS)	17	N/A	N/A	5.1	0.2	31.5	1.3	3.7	0.2

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
11/23/00	San Luis Drain-Terminous	San Luis Drain (USGS)	22	N/A	N/A	3.0	0.2	8.2	0.4	3.1	0.2
12/13/00	San Luis Drain-Terminous	San Luis Drain (USGS)	24	N/A	N/A	3.8	0.2	13.4	0.8	5.2	0.3
12/29/00	San Luis Drain-Terminous	San Luis Drain (USGS)	22	N/A	N/A	2.6	0.1	6.3	0.3	0.9	0.0
01/09/01	San Luis Drain-Terminous	San Luis Drain (USGS)	27	N/A	N/A	3.5	0.2	14.7	1.0	2.2	0.1
01/23/01	San Luis Drain-Terminous	San Luis Drain (USGS)	30	N/A	N/A	3.5	0.3	17.5	1.3	1.0	0.1
02/06/01	San Luis Drain-Terminous	San Luis Drain (USGS)	53	N/A	N/A	7.4	1.0	40.3	5.2	15.1	2.0
02/21/01	San Luis Drain-Terminous	San Luis Drain (USGS)	58	N/A	N/A	3.9	0.5	15.8	2.2	4.3	0.6
03/07/01	San Luis Drain-Terminous	San Luis Drain (USGS)	79	N/A	N/A	3.6	0.7	16.4	3.2	2.2	0.4
03/21/01	San Luis Drain-Terminous	San Luis Drain (USGS)	55	N/A	N/A	11.1	1.5	69.6	9.4	24.2	3.3
04/04/01	San Luis Drain-Terminous	San Luis Drain (USGS)	38	N/A	N/A	8.6	0.8	57.5	5.3	13.4	1.2
04/18/01	San Luis Drain-Terminous	San Luis Drain (USGS)	34	N/A	N/A	9.6	0.8	75.6	6.3	10.1	0.8
05/02/01	San Luis Drain-Terminous	San Luis Drain (USGS)	30	N/A	N/A	5.1	0.4	29.2	2.1	5.4	0.4
05/16/01	San Luis Drain-Terminous	San Luis Drain (USGS)	40	N/A	N/A	4.7	0.5	23.8	2.3	5.8	0.6
05/30/01	San Luis Drain-Terminous	San Luis Drain (USGS)	46	N/A	N/A	4.4	0.5	19.0	2.1	6.0	0.7
06/13/01	San Luis Drain-Terminous	San Luis Drain (USGS)	59	N/A	N/A	8.0	1.2	62.2	9.0	6.7	1.0
06/27/01	San Luis Drain-Terminous	San Luis Drain (USGS)	50	N/A	N/A	8.3	1.0	55.1	6.7	12.7	1.6
07/11/01	San Luis Drain-Terminous	San Luis Drain (USGS)	58	N/A	N/A	5.6	0.8	24.5	3.5	11.5	1.6
07/25/01	San Luis Drain-Terminous	San Luis Drain (USGS)	54	N/A	N/A	6.6	0.9	47.9	6.3	5.0	0.7
08/07/01	San Luis Drain-Terminous	San Luis Drain (USGS)	61	N/A	N/A	6.9	1.0	57.1	8.5	1.7	0.3
08/22/01	San Luis Drain-Terminous	San Luis Drain (USGS)	53	N/A	N/A	5.4	0.7	32.8	4.3	5.2	0.7
09/05/01	San Luis Drain-Terminous	San Luis Drain (USGS)	32	N/A	N/A	4.1	0.3	16.8	1.3	5.2	0.4
09/19/01	San Luis Drain-Terminous	San Luis Drain (USGS)	15	N/A	N/A	3.6	0.1	10.8	0.4	5.2	0.2
10/03/01	San Luis Drain-Terminous	San Luis Drain (USGS)	9	N/A	N/A	4.0	0.1	17.8	0.4	4.3	0.1
10/16/01	San Luis Drain-Terminous	San Luis Drain (USGS)	19	N/A	N/A	4.3	0.2	21.6	1.0	4.3	0.2
10/30/01	San Luis Drain-Terminous	San Luis Drain (USGS)	17	N/A	N/A	N/A	N/A	75.6	3.1	N/A	N/A
11/14/01	San Luis Drain-Terminous	San Luis Drain (USGS)	37	N/A	N/A	N/A	N/A	67.0	6.1	N/A	N/A
10/12/99	SJR @Hwy 4	N/A	N/A	N/A	N/A	3.3	N/A	6.4	N/A	5.8	N/A
10/26/99	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.9	N/A	4.5	N/A	4.2	N/A
11/09/99	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.5	N/A	2.7	N/A	2.7	N/A
11/30/99	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.6	N/A	2.3	N/A	3.5	N/A
12/21/99	SJR @Hwy 4	N/A	N/A	N/A	N/A	3.0	N/A	6.1	N/A	4.0	N/A
01/08/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	3.9	N/A	7.7	N/A	9.6	N/A
01/22/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.3	N/A	1.7	N/A	1.5	N/A
02/05/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.6	N/A	3.7	N/A	2.2	N/A
02/21/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.6	N/A	3.0	N/A	3.1	N/A
03/03/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.3	N/A	2.1	N/A	1.5	N/A
03/20/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.3	N/A	1.5	N/A	1.8	N/A
03/31/00	SJR @Hwy 4	N/A	N/A	N/A	N/A	2.9	N/A	5.3	N/A	3.6	N/A
10/12/99	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	56	N/A	N/A	12.6	1.7	80.0	11.0	28.8	3.9
10/26/99	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	59	N/A	N/A	3.3	0.5	7.3	1.1	5.5	0.8
11/09/99	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	25	N/A	N/A	9.3	0.6	48.0	2.9	24.0	1.5
11/30/99	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	22	N/A	N/A	9.2	0.5	53.0	2.9	20.1	1.1

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
12/21/99	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	34	N/A	N/A	5.6	0.5	39.7	3.3	2.6	0.2
01/08/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	13	N/A	N/A	7.0	0.2	29.9	0.9	18.1	0.6
01/22/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	12	N/A	N/A	4.7	0.1	19.5	0.6	7.9	0.2
02/05/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	71	N/A	N/A	4.1	0.7	6.9	1.2	11.2	1.9
02/21/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	941	N/A	N/A	3.5	8.1	8.5	19.6	6.1	14.1
03/03/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	1,576	N/A	N/A	3.5	13.4	10.6	40.8	4.6	17.9
03/20/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	563	N/A	N/A	9.9	13.6	88.8	122.3	3.8	5.2
03/31/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	36	N/A	N/A	5.8	0.5	36.6	3.2	5.7	0.5
04/16/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	43	N/A	N/A	14.6	1.5	52.1	5.5	59.8	6.3
04/29/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	180	N/A	N/A	3.8	1.7	7.7	3.4	8.7	3.8
05/13/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	98	N/A	N/A	9.1	2.2	47.6	11.4	22.6	5.4
05/26/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	81	N/A	N/A	15.2	3.0	88.6	17.5	42.4	8.4
06/09/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	53	N/A	N/A	13.4	1.7	83.2	10.8	32.3	4.2
06/23/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	59	N/A	N/A	11.7	1.7	66.8	9.6	30.2	4.4
07/12/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	122	N/A	N/A	8.5	2.5	56.6	16.9	13.5	4.0
07/26/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	54	N/A	N/A	26.4	3.5	285.7	37.7	5.4	0.7
08/09/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	56	N/A	N/A	34.8	4.8	377.3	51.7	10.8	1.5
08/23/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	57	N/A	N/A	15.7	2.2	75.5	10.5	53.4	7.4
09/06/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	79	N/A	N/A	8.2	1.6	67.8	13.1	4.6	0.9
09/20/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	16	N/A	N/A	3.8	0.1	15.1	0.6	4.4	0.2
10/04/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	22	N/A	N/A	3.9	0.2	17.1	0.9	3.6	0.2
10/18/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	39	N/A	N/A	4.6	0.4	16.7	1.6	9.0	0.9
11/01/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	237	N/A	N/A	3.1	1.8	5.6	3.3	5.0	2.9
11/15/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	41	N/A	N/A	3.6	0.4	14.3	1.4	3.6	0.4
11/23/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	30	N/A	N/A	6.9	0.5	53.8	3.9	3.4	0.2
12/13/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	16	N/A	N/A	7.0	0.3	41.6	1.6	11.3	0.4
12/29/00	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	21	N/A	N/A	5.5	0.3	30.2	1.6	7.6	0.4
01/09/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	44	N/A	N/A	6.1	0.7	33.3	3.6	10.3	1.1
01/23/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	35	N/A	N/A	4.1	0.3	14.4	1.2	6.7	0.6
02/06/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	65	N/A	N/A	5.0	0.8	21.6	3.4	8.9	1.4
02/21/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	48	N/A	N/A	3.7	0.4	9.3	1.1	7.4	0.9
03/07/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	338	N/A	N/A	3.0	2.4	3.4	2.8	5.3	4.4
03/21/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	104	N/A	N/A	5.7	1.5	28.8	7.3	10.1	2.6
04/04/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	73	N/A	N/A	10.7	1.9	105.8	18.9	0.0	0.0
04/18/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	54	N/A	N/A	14.5	1.9	121.0	16.0	18.1	2.4
05/02/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	42	N/A	N/A	16.8	1.7	116.0	11.9	37.1	3.8
05/16/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	27	N/A	N/A	9.4	0.6	64.3	4.2	15.1	1.0
05/30/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	8	N/A	N/A	13.5	0.3	110.9	2.2	16.8	0.3
06/13/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	14	N/A	N/A	14.9	0.5	119.9	4.1	21.6	0.7
06/27/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	26	N/A	N/A	14.0	0.9	113.4	7.2	19.1	1.2
07/11/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	59	16.6	2.4	14.1	2.0	121.0	17.4	15.1	2.2
07/25/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	27	23.8	1.6	11.9	0.8	85.7	5.7	20.2	1.3

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
08/07/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	19	32.6	1.5	36.0	1.7	393.1	18.3	10.1	0.5
08/22/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	24	38.5	2.3	35.1	2.1	347.8	20.4	30.2	1.8
09/05/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	23	39.2	2.2	22.5	1.3	196.6	11.1	30.2	1.7
09/19/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	18	9.4	0.4	18.4	0.8	125.3	5.5	43.2	1.9
10/03/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	29	17.4	1.2	10.8	0.8	80.6	5.7	15.4	1.1
10/16/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	37	10.2	0.9	5.2	0.5	32.4	2.9	4.3	0.4
10/30/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	15	N/A	N/A	7.6	0.3	38.9	1.4	17.3	0.6
11/14/01	SJR @Lander-Hwy 165	SJR @Stevinson (CDEC)	21	N/A	N/A	8.2	0.4	58.0	3.0	10.1	0.5
10/12/99	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,820	N/A	N/A	4.6	20.4	14.7	65.5	10.2	45.6
10/26/99	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,920	N/A	N/A	3.6	17.1	6.6	30.8	8.3	39.1
11/09/99	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,770	N/A	N/A	2.6	11.3	3.1	13.2	3.1	13.2
11/30/99	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,360	N/A	N/A	3.3	11.0	8.1	26.9	5.0	16.7
12/21/99	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,170	N/A	N/A	2.4	7.0	2.4	6.9	2.1	6.1
01/08/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,150	N/A	N/A	2.8	7.8	4.9	13.9	3.1	8.6
01/22/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,750	N/A	N/A	2.6	10.9	3.4	14.5	2.4	10.2
02/05/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,860	N/A	N/A	2.9	13.2	3.2	14.6	5.0	22.7
02/21/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	9,690	N/A	N/A	2.4	57.2	2.1	49.6	2.2	51.2
03/03/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	11,100	N/A	N/A	2.3	63.5	2.1	55.7	1.7	45.4
03/20/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	9,160	N/A	N/A	3.2	72.6	5.6	124.9	6.0	134.6
03/31/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	4,440	N/A	N/A	2.8	30.6	5.2	56.6	3.2	34.7
04/16/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	5,120	N/A	N/A	2.6	32.6	4.3	53.6	2.2	28.0
04/29/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	4,290	N/A	N/A	2.8	29.2	4.8	50.1	3.2	33.9
05/13/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	4,120	N/A	N/A	2.9	28.8	4.9	49.4	3.7	37.4
05/26/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	2,290	N/A	N/A	3.5	19.3	10.8	60.4	4.4	24.9
06/09/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,740	N/A	N/A	4.0	16.8	11.3	48.0	7.7	32.8
06/23/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,170	N/A	N/A	6.3	18.1	36.3	103.8	9.9	28.3
07/12/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,360	N/A	N/A	6.9	22.9	41.3	137.4	10.8	35.8
07/26/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,390	N/A	N/A	6.1	20.7	37.6	127.8	7.3	24.7
08/09/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,340	N/A	N/A	5.1	16.8	36.7	120.1	1.1	3.5
08/23/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	2,250	N/A	N/A	3.5	19.3	15.0	82.6	2.3	12.7
09/06/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,850	N/A	N/A	3.9	17.5	17.5	79.2	3.5	15.7
09/20/00	SJR @Maze-Hwy 132	SJR @Maze (CDEC)	1,810	N/A	N/A	3.0	13.4	5.8	25.8	4.4	19.4
10/04/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,676	N/A	N/A	2.9	11.7	7.2	29.5	2.3	9.3
10/18/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,147	N/A	N/A	2.9	15.1	5.6	29.5	3.4	18.0
11/01/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,661	N/A	N/A	2.7	17.8	4.8	31.5	2.8	18.4
11/15/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,061	N/A	N/A	2.4	12.0	4.5	22.7	0.5	2.7
11/23/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,976	N/A	N/A	2.6	12.5	3.9	18.9	2.4	11.6
12/13/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,834	N/A	N/A	3.5	15.8	5.4	24.1	8.2	36.8
12/29/00	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,775	N/A	N/A	2.6	11.3	5.0	21.9	1.8	7.8
01/09/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,886	N/A	N/A	2.8	13.0	5.9	27.0	2.8	12.8
01/23/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,903	N/A	N/A	2.7	12.7	4.9	22.7	2.8	13.0
02/06/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,799	N/A	N/A	3.0	13.1	8.3	36.4	2.5	11.1

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
02/21/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,310	N/A	N/A	2.9	16.4	4.8	27.1	4.0	22.6
03/07/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	5,308	N/A	N/A	3.8	48.7	7.9	102.8	8.3	107.5
03/21/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,056	N/A	N/A	3.7	18.6	10.4	52.1	6.5	32.6
04/04/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,532	N/A	N/A	2.4	9.1	1.6	5.9	2.6	9.7
04/18/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,516	N/A	N/A	4.1	15.3	9.4	34.7	10.1	37.4
05/02/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,633	N/A	N/A	3.2	20.9	7.8	50.1	4.8	30.6
05/16/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,912	N/A	N/A	3.0	21.4	6.5	46.1	3.8	26.9
05/30/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,256	N/A	N/A	5.5	17.0	27.4	84.0	9.4	28.7
06/13/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	952	N/A	N/A	6.4	14.9	37.0	86.0	10.1	23.5
06/27/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	913	N/A	N/A	7.6	16.9	42.1	94.0	15.1	33.8
07/11/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	788	8.4	16.2	9.1	17.5	68.9	132.7	10.1	19.4
07/25/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	840	9.7	19.9	7.1	14.6	45.4	93.2	10.1	20.7
08/07/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	915	7.6	17.0	6.9	15.5	45.4	101.5	8.6	19.3
08/22/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	921	4.5	10.1	5.2	11.8	25.2	56.7	8.6	19.5
09/05/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	887	9.8	21.3	7.8	17.0	48.7	105.7	13.2	28.5
09/19/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	980	2.7	6.5	4.6	11.0	23.5	56.4	5.0	12.1
10/03/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	992	2.7	6.5	3.3	8.0	13.5	32.7	1.6	3.9
10/16/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,202	2.9	8.5	2.7	7.8	6.5	19.0	1.3	3.8
10/30/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	2,281	N/A	N/A	3.0	16.6	5.0	28.1	4.5	25.1
11/14/01	SJR @Maze-Hwy 132	SJR @Vern - Stan @Ripon (USGS)	1,840	N/A	N/A	3.1	14.0	7.7	34.6	3.8	17.3
04/16/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	5,900	N/A	N/A	2.8	40.1	5.2	75.2	2.9	42.1
04/29/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	5,730	N/A	N/A	2.7	38.2	4.7	66.5	2.8	39.6
05/13/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	5,640	N/A	N/A	2.7	37.3	5.4	74.3	2.3	31.9
05/26/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	4,000	N/A	N/A	3.6	35.1	12.1	118.8	4.6	45.2
06/09/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	3,360	N/A	N/A	3.2	26.3	7.2	59.5	4.8	39.2
06/23/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,010	N/A	N/A	6.2	30.3	39.3	193.0	6.9	34.1
07/12/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,840	N/A	N/A	8.0	36.2	51.7	232.8	12.9	58.2
07/26/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,850	N/A	N/A	7.0	31.6	44.3	200.3	9.7	43.9
08/09/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,760	N/A	N/A	5.5	23.9	40.4	174.0	1.8	7.7
08/23/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,610	N/A	N/A	4.1	26.4	16.7	106.9	5.8	37.2
09/06/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,330	N/A	N/A	5.0	28.6	35.3	201.1	1.1	6.2
09/20/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,290	N/A	N/A	3.1	17.3	8.1	45.3	3.5	19.4
10/04/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,080	N/A	N/A	3.0	15.1	8.1	41.3	2.6	13.4
10/18/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,730	N/A	N/A	2.9	19.3	5.5	36.9	3.6	23.7
11/01/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	3,140	N/A	N/A	2.4	18.6	2.8	21.8	1.8	13.5
11/15/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,460	N/A	N/A	2.5	15.3	4.1	24.4	2.0	11.8
11/23/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,380	N/A	N/A	2.4	14.2	2.6	15.3	2.0	11.8
12/13/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,240	N/A	N/A	3.5	19.3	5.4	29.4	8.2	45.0
12/29/00	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,150	N/A	N/A	2.4	12.8	3.8	19.9	1.4	7.1
01/09/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,280	N/A	N/A	2.7	15.3	6.5	36.1	1.9	10.8
01/23/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,260	N/A	N/A	2.7	14.8	5.6	31.2	2.0	11.0
02/06/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,150	N/A	N/A	2.8	14.5	6.8	35.7	1.9	9.7

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
02/21/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,700	N/A	N/A	2.8	18.3	4.7	30.9	3.2	21.4
03/07/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	5,900	N/A	N/A	6.7	96.9	18.7	270.0	23.0	332.4
03/21/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,450	N/A	N/A	3.6	21.7	10.8	64.7	5.6	33.6
04/04/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,040	N/A	N/A	2.9	14.7	3.9	19.4	4.9	24.4
04/18/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,130	N/A	N/A	3.8	20.0	18.4	95.6	2.7	14.1
05/02/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	4,180	N/A	N/A	3.1	31.5	6.5	66.2	4.3	44.2
05/16/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	4,510	N/A	N/A	2.9	32.0	4.8	52.4	4.1	45.3
05/30/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,980	N/A	N/A	8.1	39.1	57.0	275.7	10.0	48.4
06/13/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,530	N/A	N/A	6.7	24.9	28.6	106.8	16.8	62.8
06/27/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,480	N/A	N/A	8.5	30.8	70.6	255.3	5.0	18.2
07/11/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,350	13.0	42.9	9.8	32.3	60.5	199.6	20.2	66.5
07/25/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,300	7.0	22.2	8.2	26.1	54.2	172.2	12.6	40.0
08/07/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,350	6.0	19.8	8.4	27.8	55.4	183.0	13.4	44.4
08/22/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,340	5.2	17.0	5.1	16.7	25.4	83.2	7.6	24.8
09/05/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,280	6.9	21.6	8.9	27.9	47.0	147.2	21.8	68.4
09/19/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,330	5.0	16.3	4.5	14.7	25.2	81.9	3.6	11.7
10/03/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,330	3.6	11.7	4.1	13.2	15.8	51.5	5.8	18.7
10/16/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	1,510	4.5	16.6	2.6	9.7	6.9	25.5	0.9	3.2
10/30/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,800	N/A	N/A	2.6	17.5	3.9	26.6	2.2	14.8
11/14/01	SJR @Mossdale-Hwy 120	SJR @Vernalis (USGS)	2,220	N/A	N/A	3.1	16.6	9.1	49.2	2.6	14.1
04/16/00	SJR @Patterson	SJR @Patterson (CDEC)	1,084	N/A	N/A	3.6	9.5	10.8	28.6	5.3	14.1
04/29/00	SJR @Patterson	SJR @Patterson (CDEC)	2,203	N/A	N/A	2.8	15.1	4.9	26.2	3.3	17.8
05/13/00	SJR @Patterson	SJR @Patterson (CDEC)	1,939	N/A	N/A	3.4	15.9	8.6	40.7	5.1	24.0
05/26/00	SJR @Patterson	SJR @Patterson (CDEC)	1,101	N/A	N/A	4.4	11.7	17.5	47.0	6.9	18.7
06/09/00	SJR @Patterson	SJR @Patterson (CDEC)	919	N/A	N/A	4.4	9.8	13.9	31.1	9.2	20.8
06/23/00	SJR @Patterson	SJR @Patterson (CDEC)	767	N/A	N/A	9.2	17.2	61.1	114.6	15.6	29.2
07/12/00	SJR @Patterson	SJR @Patterson (CDEC)	863	N/A	N/A	8.6	18.1	56.1	118.3	14.3	30.2
07/26/00	SJR @Patterson	SJR @Patterson (CDEC)	830	N/A	N/A	8.3	16.8	61.9	125.6	8.7	17.7
08/09/00	SJR @Patterson	SJR @Patterson (CDEC)	800	N/A	N/A	5.8	11.3	38.5	75.3	4.7	9.2
08/23/00	SJR @Patterson	SJR @Patterson (CDEC)	780	N/A	N/A	5.4	10.3	35.4	67.4	3.6	6.9
09/06/00	SJR @Patterson	SJR @Patterson (CDEC)	884	N/A	N/A	4.7	10.2	25.0	54.1	5.0	10.8
09/20/00	SJR @Patterson	SJR @Patterson (CDEC)	657	N/A	N/A	3.5	5.6	11.6	18.6	4.3	6.9
10/04/00	SJR @Patterson	SJR @Patterson (CDEC)	660	N/A	N/A	3.0	4.8	8.5	13.7	2.5	4.0
10/18/00	SJR @Patterson	SJR @Patterson (CDEC)	1,442	N/A	N/A	2.9	10.2	5.1	18.1	3.9	13.6
11/01/00	SJR @Patterson	SJR @Patterson (CDEC)	1,599	N/A	N/A	2.9	11.2	4.5	17.6	3.9	15.2
11/15/00	SJR @Patterson	SJR @Patterson (CDEC)	1,183	N/A	N/A	2.4	7.0	3.6	10.3	1.5	4.2
11/23/00	SJR @Patterson	SJR @Patterson (CDEC)	1,088	N/A	N/A	2.4	6.5	2.8	7.4	2.0	5.3
12/13/00	SJR @Patterson	SJR @Patterson (CDEC)	973	N/A	N/A	2.6	6.2	5.3	12.7	1.7	4.1
12/29/00	SJR @Patterson	SJR @Patterson (CDEC)	893	N/A	N/A	2.5	5.5	4.4	9.7	1.7	3.7
01/09/01	SJR @Patterson	SJR @Patterson (CDEC)	885	N/A	N/A	2.7	5.8	6.2	13.4	1.5	3.3
01/23/01	SJR @Patterson	SJR @Patterson (CDEC)	990	N/A	N/A	2.7	6.5	6.1	14.8	1.8	4.4
02/06/01	SJR @Patterson	SJR @Patterson (CDEC)	995	N/A	N/A	3.1	7.5	9.1	22.2	2.9	7.0

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
02/21/01	SJR @Patterson	SJR @Patterson (CDEC)	1,055	N/A	N/A	3.1	7.9	8.1	20.9	3.2	8.4
03/07/01	SJR @Patterson	SJR @Patterson (CDEC)	2,484	N/A	N/A	2.1	12.6	1.1	6.6	0.3	1.8
03/21/01	SJR @Patterson	SJR @Patterson (CDEC)	1,199	N/A	N/A	3.8	11.1	11.3	33.2	6.5	19.0
04/04/01	SJR @Patterson	SJR @Patterson (CDEC)	909	N/A	N/A	3.1	7.0	8.6	19.2	3.5	7.7
04/18/01	SJR @Patterson	SJR @Patterson (CDEC)	1,184	N/A	N/A	4.3	12.4	20.9	60.4	4.3	12.5
05/02/01	SJR @Patterson	SJR @Patterson (CDEC)	1,192	N/A	N/A	3.6	10.4	10.1	29.4	5.8	16.8
05/16/01	SJR @Patterson	SJR @Patterson (CDEC)	1,766	N/A	N/A	3.2	13.8	7.0	30.3	4.9	21.0
05/30/01	SJR @Patterson	SJR @Patterson (CDEC)	832	N/A	N/A	2.7	5.5	6.3	12.9	1.7	3.5
06/13/01	SJR @Patterson	SJR @Patterson (CDEC)	805	N/A	N/A	5.7	11.3	29.2	57.4	9.7	19.1
06/27/01	SJR @Patterson	SJR @Patterson (CDEC)	647	N/A	N/A	6.1	9.7	37.8	59.8	7.6	12.0
07/11/01	SJR @Patterson	SJR @Patterson (CDEC)	691	7.9	13.3	7.3	12.4	53.8	90.8	6.7	11.4
07/25/01	SJR @Patterson	SJR @Patterson (CDEC)	730	7.7	13.7	8.1	14.4	57.1	102.0	10.1	18.0
08/07/01	SJR @Patterson	SJR @Patterson (CDEC)	680	9.0	15.0	6.1	10.1	36.2	60.3	8.1	13.4
08/22/01	SJR @Patterson	SJR @Patterson (CDEC)	741	6.1	11.1	5.0	9.1	28.8	52.2	5.0	9.1
09/05/01	SJR @Patterson	SJR @Patterson (CDEC)	518	7.4	9.4	5.2	6.6	24.5	31.0	8.6	10.9
09/19/01	SJR @Patterson	SJR @Patterson (CDEC)	361	4.1	3.6	3.5	3.1	14.3	12.6	2.6	2.3
10/03/01	SJR @Patterson	SJR @Patterson (CDEC)	362	5.7	5.0	3.8	3.3	14.8	13.1	4.3	3.8
10/16/01	SJR @Patterson	SJR @Patterson (CDEC)	487	4.3	5.1	2.8	3.4	8.1	9.6	1.6	1.9
10/30/01	SJR @Patterson	SJR @Patterson (CDEC)	966	N/A	N/A	2.8	6.7	5.8	13.6	2.9	6.8
11/14/01	SJR @Patterson	SJR @Patterson (CDEC)	936	N/A	N/A	2.9	6.7	9.4	21.4	1.4	3.3
07/11/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,350	5.9	19.5	5.6	18.5	25.9	85.6	10.8	35.6
07/25/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,300	5.5	17.5	6.5	20.6	39.3	125.0	9.1	28.8
08/07/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,350	5.6	18.5	7.4	24.5	60.5	199.6	3.4	11.1
08/22/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,340	3.2	10.5	5.0	16.5	21.6	70.8	9.4	30.7
09/05/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,280	7.2	22.5	7.0	21.8	50.4	157.7	6.0	18.9
09/19/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,330	2.9	9.4	3.7	12.1	15.1	49.2	3.8	12.3
10/03/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,330	2.1	6.8	3.1	10.0	10.8	35.1	1.7	5.6
10/16/01	SJR @Vernalis	SJR @Vernalis (USGS)	1,510	2.4	8.9	2.8	10.3	6.5	23.9	2.2	8.0
10/30/01	SJR @Vernalis	SJR @Vernalis (USGS)	2,800	N/A	N/A	3.3	22.7	8.6	59.1	4.7	32.0
11/14/01	SJR @Vernalis	SJR @Vernalis (USGS)	2,220	N/A	N/A	2.9	15.7	5.3	29.0	3.7	20.1
03/20/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,652	N/A	N/A	2.1	8.6	0.8	3.3	0.9	3.5
03/31/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	971	N/A	N/A	2.3	5.5	1.6	3.7	1.7	4.1
04/16/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,255	N/A	N/A	2.4	7.3	1.5	4.6	2.2	6.6
04/29/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,565	N/A	N/A	2.2	8.3	1.4	5.2	0.9	3.4
05/13/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,552	N/A	N/A	2.2	8.2	1.1	4.1	0.9	3.4
05/26/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,510	N/A	N/A	2.2	8.0	1.1	4.2	1.0	3.6
06/09/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,596	N/A	N/A	2.1	8.3	0.8	3.0	0.9	3.6
06/23/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	517	N/A	N/A	2.1	2.7	1.0	1.2	0.8	1.0
07/12/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	432	N/A	N/A	2.2	2.3	1.1	1.2	0.9	1.0
07/26/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	420	N/A	N/A	2.2	2.3	1.4	1.4	1.2	1.2
08/09/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	402	N/A	N/A	2.2	2.2	1.2	1.2	1.4	1.4
08/23/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	388	N/A	N/A	2.2	2.1	0.8	0.7	1.5	1.4

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
09/06/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	392	N/A	N/A	2.1	2.0	0.7	0.7	1.0	0.9
09/20/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	395	N/A	N/A	2.1	2.1	0.7	0.6	1.0	1.0
10/04/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	404	N/A	N/A	2.1	2.1	0.8	0.8	1.0	1.0
10/18/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	583	N/A	N/A	2.2	3.1	0.9	1.2	1.1	1.6
11/01/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	479	N/A	N/A	2.1	2.5	0.8	0.9	0.9	1.0
11/15/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	399	N/A	N/A	2.1	2.1	0.8	0.8	0.7	0.7
11/23/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	404	N/A	N/A	2.1	2.0	0.4	0.4	0.7	0.7
12/13/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	406	N/A	N/A	2.1	2.1	1.3	1.3	0.7	0.7
12/29/00	Stanislaus @Caswell Park	Stan @Ripon (USGS)	375	N/A	N/A	2.2	2.0	1.6	1.5	0.8	0.7
01/09/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	394	N/A	N/A	2.3	2.2	3.2	3.1	0.6	0.6
01/23/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	357	N/A	N/A	2.2	1.9	1.4	1.3	0.8	0.7
02/06/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	351	N/A	N/A	2.3	2.0	2.4	2.0	1.3	1.1
02/21/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	390	N/A	N/A	2.4	2.3	2.4	2.3	1.9	1.9
03/07/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	592	N/A	N/A	2.7	3.9	2.0	2.9	4.2	6.0
03/21/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	394	N/A	N/A	2.9	2.8	3.7	3.6	4.9	4.8
04/04/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	508	N/A	N/A	3.0	3.8	7.2	8.9	3.6	4.5
04/18/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	614	N/A	N/A	2.3	3.4	1.7	2.5	1.3	1.9
05/02/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,547	N/A	N/A	2.3	8.6	1.4	5.2	1.6	6.0
05/16/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	1,598	N/A	N/A	2.3	8.9	1.4	5.6	1.6	6.2
05/30/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	724	N/A	N/A	2.3	4.0	1.4	2.5	1.6	2.8
06/13/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	578	N/A	N/A	2.4	3.4	2.4	3.5	2.1	3.0
06/27/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	567	N/A	N/A	3.7	5.1	7.5	10.3	7.9	10.9
07/11/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	562	0.6	0.8	2.2	3.1	1.1	1.5	1.5	2.1
07/25/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	460	1.0	1.1	2.1	2.4	0.9	1.0	0.8	0.9
08/07/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	435	0.7	0.7	2.2	2.3	1.0	1.1	0.9	1.0
08/22/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	419	0.9	0.9	2.3	2.4	1.4	1.5	1.8	1.8
09/05/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	393	0.9	0.9	2.1	2.0	1.2	1.1	0.5	0.5
09/19/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	350	0.9	0.8	2.1	1.8	1.2	1.0	0.6	0.6
10/03/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	338	1.0	0.8	2.1	1.8	1.2	1.0	0.6	0.5
10/16/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	308	0.4	0.3	2.1	1.6	0.8	0.6	0.7	0.5
10/30/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	519	N/A	N/A	2.3	3.0	2.5	3.2	1.3	1.6
11/14/01	Stanislaus @Caswell Park	Stan @Ripon (USGS)	380	N/A	N/A	2.2	2.1	1.7	1.6	1.2	1.1
10/12/99	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	660	N/A	N/A	2.5	4.0	1.7	2.7	2.7	4.4
10/26/99	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	454	N/A	N/A	2.4	2.7	1.6	1.8	2.6	2.8
11/09/99	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	454	N/A	N/A	2.3	2.6	0.4	0.4	2.4	2.6
11/30/99	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	411	N/A	N/A	2.2	2.2	1.8	1.8	0.8	0.8
12/21/99	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	379	N/A	N/A	2.1	2.0	0.4	0.4	1.1	1.0
01/08/00	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	355	N/A	N/A	2.3	2.0	1.9	1.7	1.1	1.0
01/22/00	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	377	N/A	N/A	3.6	3.3	5.5	5.1	8.7	8.0
02/05/00	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	411	N/A	N/A	2.3	2.3	1.2	1.2	1.6	1.6
02/21/00	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	2,318	N/A	N/A	7.7	43.8	32.0	181.4	22.4	127.0
03/03/00	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	3,322	N/A	N/A	2.1	16.7	0.6	4.9	0.5	3.8

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
10/12/99	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	553	N/A	N/A	2.3	3.1	1.1	1.5	1.8	2.4
10/26/99	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	515	N/A	N/A	2.7	3.4	2.6	3.2	3.8	4.8
11/09/99	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	506	N/A	N/A	2.2	2.7	1.1	1.3	1.1	1.3
11/30/99	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	424	N/A	N/A	2.7	2.8	4.2	4.4	3.1	3.2
12/21/99	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	417	N/A	N/A	2.4	2.4	2.2	2.2	1.8	1.8
01/08/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	416	N/A	N/A	2.2	2.2	1.6	1.6	0.9	0.9
01/22/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	503	N/A	N/A	2.5	3.1	3.0	3.7	2.5	3.1
02/05/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	362	N/A	N/A	2.2	1.9	0.8	0.7	1.2	1.0
02/21/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	3,930	N/A	N/A	4.3	41.3	10.3	98.6	10.8	103.8
03/03/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	4,245	N/A	N/A	2.1	21.5	0.6	6.4	0.6	6.2
03/20/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	5,290	N/A	N/A	2.4	30.8	1.9	24.7	2.1	26.6
03/31/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	2,769	N/A	N/A	2.2	14.6	1.0	7.0	1.0	6.7
04/16/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	4,481	N/A	N/A	2.2	24.1	1.2	13.0	1.2	13.2
04/29/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	2,027	N/A	N/A	2.2	11.0	1.5	7.5	1.1	5.4
05/13/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	2,025	N/A	N/A	2.1	10.6	1.1	5.7	0.8	4.1
05/26/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	881	N/A	N/A	2.2	4.8	2.1	4.5	0.9	2.0
06/09/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	617	N/A	N/A	2.3	3.5	1.7	2.6	1.5	2.3
06/23/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	762	N/A	N/A	2.3	4.2	2.0	3.7	1.1	2.0
07/12/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	627	N/A	N/A	2.2	3.4	1.1	1.7	1.6	2.4
07/26/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	692	N/A	N/A	2.1	3.6	0.7	1.2	0.8	1.4
08/09/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	478	N/A	N/A	2.1	2.4	0.5	0.6	0.7	0.9
08/23/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,629	N/A	N/A	2.1	8.5	0.9	3.4	1.0	3.8
09/06/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	825	N/A	N/A	2.1	4.3	0.8	1.5	0.9	1.8
09/20/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,093	N/A	N/A	2.2	5.8	0.8	2.2	1.2	3.2
10/04/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	928	N/A	N/A	2.1	4.9	1.0	2.3	0.9	2.1
10/18/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	588	N/A	N/A	2.2	3.2	1.0	1.5	1.4	2.0
11/01/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	652	N/A	N/A	2.0	3.2	0.4	0.7	0.4	0.6
11/15/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	487	N/A	N/A	2.1	2.5	0.7	0.9	0.5	0.6
11/23/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	497	N/A	N/A	2.0	2.5	0.3	0.4	0.4	0.5
12/13/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	455	N/A	N/A	2.1	2.3	0.6	0.7	0.5	0.6
12/29/00	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	442	N/A	N/A	2.1	2.3	1.4	1.6	0.5	0.6
01/09/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	510	N/A	N/A	2.2	2.7	1.7	2.2	0.9	1.1
01/23/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	456	N/A	N/A	2.2	2.4	1.6	1.8	0.9	1.0
02/06/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	442	N/A	N/A	2.2	2.4	1.6	1.7	1.0	1.1
02/21/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,271	N/A	N/A	2.2	7.0	1.2	3.8	1.4	4.5
03/07/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,850	N/A	N/A	2.5	11.1	1.9	8.5	2.6	11.7
03/21/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	607	N/A	N/A	2.2	3.3	1.8	2.7	0.9	1.3
04/04/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	605	N/A	N/A	2.3	3.4	1.9	2.8	1.4	2.1
04/18/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	566	N/A	N/A	2.4	3.3	3.2	4.4	1.1	1.6
05/02/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,507	N/A	N/A	2.2	8.1	1.2	4.5	1.2	4.5
05/16/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	1,078	N/A	N/A	2.3	6.0	1.5	4.0	1.4	3.8
05/30/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	433	N/A	N/A	2.3	2.4	2.7	2.8	1.0	1.1

Appendix A. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
06/13/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	336	N/A	N/A	2.6	2.1	2.4	2.0	3.0	2.5
06/27/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	340	N/A	N/A	2.8	2.4	4.3	3.6	3.8	3.2
07/11/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	215	1.0	0.5	2.2	1.2	2.4	1.3	0.5	0.3
07/25/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	315	1.2	0.9	2.3	1.8	3.3	2.6	0.6	0.4
08/07/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	303	1.4	1.0	2.5	1.8	3.2	2.4	1.9	1.4
08/22/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	327	1.5	1.2	2.6	2.1	3.7	2.9	2.4	1.9
09/05/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	327	1.0	0.8	2.3	1.8	2.1	1.7	1.0	0.8
09/19/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	336	1.3	1.1	2.3	1.9	2.5	2.1	1.4	1.2
10/03/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	327	1.0	0.8	2.3	1.9	3.2	2.5	0.9	0.7
10/16/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	328	0.7	0.6	2.4	1.9	2.9	2.3	1.7	1.4
10/30/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	289	N/A	N/A	2.5	1.8	3.6	2.5	1.9	1.4
11/14/01	Tuolomne @Shiloh Rd	Tuol @Modesto (USGS)	269	N/A	N/A	2.2	1.5	1.9	1.2	1.0	0.7

Appendix B. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed in the nutrient special study. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
08/22/01	Bear Crk @Bert Crane Rd	N/A	N/A	2.6	N/A		N/A	4.3	N/A	2.4	N/A
09/06/01	Bear Crk @Bert Crane Rd	N/A	N/A	2.3	N/A		N/A	3.1	N/A	1.1	N/A
09/19/01	Bear Crk @Bert Crane Rd	N/A	N/A	1.7	N/A		N/A	4.2	N/A	1.1	N/A
08/22/01	DMC @J2 (Tracy)	N/A	N/A	1.0	N/A		N/A	3.9	N/A	2.8	N/A
09/06/01	DMC @J2 (Tracy)	N/A	N/A	1.2	N/A		N/A	3.0	N/A	1.4	N/A
09/19/01	DMC @J2 (Tracy)	N/A	N/A	1.0	N/A		N/A	3.2	N/A	0.9	N/A
08/22/01	DMC @Lammers	N/A	N/A	1.0	N/A		N/A		N/A		N/A
09/06/01	DMC @Lammers	N/A	N/A	1.2	N/A		N/A		N/A		N/A
09/19/01	DMC @Lammers	N/A	N/A	1.0	N/A		N/A		N/A		N/A
08/22/01	DMC @Volta Rd	N/A	N/A	0.9	N/A		N/A	3.2	N/A	1.6	N/A
09/06/01	DMC @Volta Rd	N/A	N/A	1.2	N/A		N/A	2.8	N/A	0.6	N/A
09/19/01	DMC @Volta Rd	N/A	N/A	0.9	N/A		N/A	2.9	N/A	0.7	N/A
08/22/01	Merced @Livingston	N/A	N/A	0.7	N/A		N/A	0.6	N/A	0.3	N/A
09/06/01	Merced @Livingston	N/A	N/A	1.1	N/A		N/A	0.6	N/A	0.1	N/A
09/19/01	Merced @Livingston	N/A	N/A	0.5	N/A		N/A	0.6	N/A	0.2	N/A
08/22/01	Merced @Snelling Rd	Merced @Snelling (CDEC)	166	0.6	0.2		0.0	0.7	0.3	0.1	0.0
09/06/01	Merced @Snelling Rd	Merced @Snelling (CDEC)	169	1.0	0.4		0.0	0.9	0.4	0.2	0.1
09/19/01	Merced @Snelling Rd	Merced @Snelling (CDEC)	179	0.5	0.2		0.0	0.7	0.3	0.1	0.0
08/22/01	Mud Slough @Gun Club Rd	N/A	N/A	11.4	N/A		N/A	14.8	N/A	8.6	N/A
09/06/01	Mud Slough @Gun Club Rd	N/A	N/A	12.4	N/A		N/A	8.6	N/A	4.8	N/A
09/19/01	Mud Slough @Gun Club Rd	N/A	N/A	5.8	N/A		N/A	9.6	N/A	2.9	N/A
08/22/01	Mud Slough @Hwy 140	N/A	N/A	8.7	N/A		N/A	16.7	N/A	5.4	N/A
09/06/01	Mud Slough @Hwy 140	N/A	N/A	7.8	N/A		N/A	19.1	N/A	7.4	N/A
09/19/01	Mud Slough @Hwy 140	N/A	N/A	4.8	N/A		N/A	9.1	N/A	6.9	N/A
08/22/01	Old River @Tracy Blvd (J2)	N/A	N/A	7.5	N/A		N/A	20.9	N/A	9.4	N/A
09/06/01	Old River @Tracy Blvd (J2)	N/A	N/A	10.2	N/A		N/A	46.2	N/A	5.6	N/A
09/19/01	Old River @Tracy Blvd (J2)	N/A	N/A	11.2	N/A		N/A	53.3	N/A	24.5	N/A
08/22/01	Outside Cn @Mendota	N/A	N/A	0.9	N/A		N/A	4.0	N/A	1.7	N/A
09/06/01	Outside Cn @Mendota	N/A	N/A	1.6	N/A		N/A	3.7	N/A	0.5	N/A
09/19/01	Outside Cn @Mendota	N/A	N/A	1.0	N/A		N/A	4.0	N/A	0.6	N/A
08/22/01	Salt Slough @Hereford Rd	N/A	N/A	3.3	N/A		N/A	5.8	N/A	2.9	N/A
09/06/01	Salt Slough @Hereford Rd	N/A	N/A	9.1	N/A		N/A	7.2	N/A	3.5	N/A
09/19/01	Salt Slough @Hereford Rd	N/A	N/A	10.4	N/A		N/A	2.1	N/A	0.5	N/A
08/22/01	Salt Slough @Wolfsen	N/A	N/A	3.7	N/A		N/A	8.6	N/A	4.0	N/A
09/06/01	Salt Slough @Wolfsen	N/A	N/A	4.6	N/A		N/A	8.4	N/A	1.2	N/A
09/19/01	Salt Slough @Wolfsen	N/A	N/A	3.7	N/A		N/A	7.9	N/A	2.9	N/A
08/22/01	San Luis Spillway @Santa Fe	N/A	N/A	4.2	N/A		N/A	12.2	N/A	5.4	N/A
09/06/01	San Luis Spillway @Santa Fe	N/A	N/A	2.9	N/A		N/A	6.5	N/A	2.9	N/A
09/19/01	San Luis Spillway @Santa Fe	N/A	N/A	1.7	N/A		N/A	6.0	N/A	2.1	N/A
08/22/01	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	419	0.7	0.7		0.0	0.6	0.6	0.4	0.4
09/06/01	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	374	1.0	0.9		0.0	0.7	0.6	0.2	0.1
09/19/01	Stanislaus @J6 - Escalon Rd	Stan @Ripon (USGS)	350	0.5	0.4		0.0	1.0	0.8	0.2	0.2

Appendix B. Flow, BOD, chlorophyll and pheophytin concentrations and loads in the San Joaquin River watershed in the nutrient special study. Data from UC Davis.

Date	Sampling Site	Flow Site	Flow	BOD_{10}		Apparent BOD_{10}		Chorophyll a		Pheophytin	
				(conc)	(load)	(conc)	(load)	(conc)	(load)	(conc)	(load)
			cfs	mg/L	kg	mg/L	kg	ug/L	kg	ug/L	kg
08/22/01	Stanislaus @Orange Blossom	Stan @Orange Blossom (CDEC)	354	0.4	0.3		0.0	0.5	0.4	0.1	0.1
09/06/01	Stanislaus @Orange Blossom	Stan @Orange Blossom (CDEC)	331	0.9	0.7		0.0	0.8	0.6	0.1	0.1
09/19/01	Stanislaus @Orange Blossom	Stan @Orange Blossom (CDEC)	292	0.4	0.3		0.0	0.5	0.3	0.2	0.1
08/22/01	Tuolumne @LaGrange	Tuol @LaGrange (CDEC)	142	0.3	0.1		0.0	0.5	0.2	0.1	0.0
09/06/01	Tuolumne @LaGrange	Tuol @LaGrange (CDEC)	125	0.8	0.2		0.0	0.7	0.2	0.1	0.0
09/19/01	Tuolumne @LaGrange	Tuol @LaGrange (CDEC)	122	0.2	0.1		0.0	0.2	0.1	0.1	0.0
08/22/01	Tuolumne @Modesto	Tuol @Modesto (USGS)	327	1.4	1.1		0.0	1.4	1.2	1.7	1.4
09/06/01	Tuolumne @Modesto	Tuol @Modesto (USGS)	335	1.8	1.5		0.0	1.7	1.4	0.4	0.3
09/19/01	Tuolumne @Modesto	Tuol @Modesto (USGS)	336	0.9	0.7		0.0	1.8	1.5	1.0	0.8