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CCoWS

Chualar Creek Pilot Project
Water Quality Monitoring
March 2001 – December 2002
Final Report

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Preface

A major issue facing the Monterey Bay National Marine Sanctuary is the protection of its waters and the control of nonpoint source pollution. The Coalition of Central Coast County Farm Bureaus has joined the Monterey Bay National Marine Sanctuary, the Central Coast Regional Water Quality Control Board, and other local agencies in addressing water quality issues and implementing the Water Quality Protection Program Action Plan for Agriculture and Rural Lands. This program involves the development of watershed working groups, water quality monitoring plans within those groups, and implementation of agricultural management practices to protect and improve water quality.

This document is the final report on the data results and analysis of water quality monitoring for Chualar Creek from March 2001 to December 2002 that was conducted by the Chualar Creek watershed working group and the Watershed Institute at California State University Monterey Bay. The project was commissioned by the Central Coast Regional Water Quality Control Board and serves as a pilot to the much larger agricultural watershed management program taking place along the Central Coast of California.

Cover Photo: Chualar Creek watershed working group meeting on 22 Oct 02. This meeting of Chualar growers, ranchers, university researchers, and various representatives from technical assistance agencies was held to discuss the results of the water quality monitoring summarized in this report, to address any questions and concerns, and to discuss future steps and group activities. Watershed working group meetings such as this are held regularly and demonstrate the dedication of participating growers and ranchers toward working collaboratively with the scientific community to protect and improve water quality in the Chualar Creek Watershed.

Acknowledgements

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- Coalition of Central Coast County Farm Bureaus
  - Kelly Huff

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1 Introduction

1.1 Background

The Coalition of Central Coast County Farm Bureaus recently developed an agricultural watershed management program for six counties throughout the Central Coast region of California. The Coalition was organized to increase agricultural participation in addressing water quality issues and to assist the Monterey Bay National Marine Sanctuary in the implementation of the Water Quality Protection Program Action Plan for Agriculture and Rural Lands (MBNMS 1999). A major component of each county's program includes the formation of voluntary networks of landowners, growers, and ranchers, known as 'watershed working groups'. Participants in the program work with technical assistance organizations to monitor water quality, improve management practices, and develop watershed plans to address nonpoint source pollution.

The Chualar Creek Watershed Working Group was formed in 2000 as a pilot project for the Coalition's program. The watershed working group plan involves a 3 level monitoring and tracking program:

- Level 1: Watershed Scale Water Quality Monitoring
- Level 2: Farm/Field Scale Monitoring
- Level 3: Management Practice Tracking

This study involved the watershed scale level of the monitoring and tracking program. The Monterey County Farm Bureau hired a water quality technician to collect samples at several sites throughout the Chualar watershed. Sampling commenced in March 2001 and continued approximately monthly through December 2002. Monitoring parameters included:

- nitrate
- ammonia
- orthophosphate
- suspended sediment
- turbidity
- transparency
- pH
- conductivity
- total coliform
- fecal coliform
- *E. coli*

The Watershed Institute at California State University Monterey Bay provided technical assistance to the Central Coast Regional Water Quality Control Board by handling the laboratory analysis for various water quality constituents and by further reporting and analyzing the results. This report presents the final results of the monitoring period from March 2001 to December 2002.

1.2 Objectives

The specific objective of the coalition monitoring and tracking program was: "To establish baseline water quality information for the pilot project areas and baseline management practice information, develop goals and timetables for future management practice implementation, and develop reporting formats for growers and watershed coordinators. Ultimately be able to link changes in management practices to improvements in water quality and perhaps other indicators such as increases in riparian habitat, reductions in pesticide and fertilizer use, improved irrigation efficiency, amount of sediment retained, reduction in tail water, etc."

The aim of the watershed scale monitoring was to address at least some of the following questions:

- Are nutrients, sediments or pesticides moving off farmlands in the watershed/pilot area?
- When are the most materials moving or are concentrations the highest?
- Are concentration levels changing over time?
- What is the total loading of pollutants over time?
- Are there impacts to beneficial uses of the downstream water body (from ammonia, DO, pH, others)?
- What management practices are being implemented?
- Is the level of management practice implementation be linked to improvements in water quality?

The major goal of this study was to analyze and report the results of water quality monitoring in the Chualar Creek Pilot Project area, and to make recommendations for the development of future monitoring plans.

2 Study Area

The Chualar Creek watershed is located in Monterey County and occupies an area of approximately 91 km^2 (22,486 acres) (Fig. 2.1) . The drainage originates in the Gabilan Range, continues through the small town of Chualar, and then ultimately flows into the Salinas River. The headwaters of the creek are predominantly non-perennial with a relatively steep gradient. The geology of the upper watershed is Mesozoic granitic rocks, producing a channel substrate that ranges from cobble to sand. The primary land use in the headwaters of the creek include natural lands/grazing with scattered vineyards and residential areas.

Chualar Creek then flows to the Salinas Valley floor comprised of Quaternary alluvium. The creek is channelized with uniform flow as it runs through row-crop agricultural lands, the small residential area of the Chualar, and finally enters the Salinas River approximately one mile downstream of the Chualar USGS station on the Salinas River. These lower reaches of the creek lack riparian vegetation and are predominantly perennial as they receive summer tail water input from local agricultural production. The channel substrate is typically sand and silt.

Three on-stream reservoirs, all with capacities less than 50 acre-feet, were constructed in Chualar Canyon. The farthest upstream reservoir was built prior to 1906, and the lower two were built in the early to mid 1900s. They were originally constructed for irrigation and drainage management by the Johnson family who owned much of the land in the Chualar Creek watershed. Today, the reservoirs are maintained by current landowners to provide flood protection, groundwater recharge, and sediment retention.

Approximately 70 km^2 (17,300 acres) of irrigated agricultural operations exist in the Chualar Creek Pilot project area.

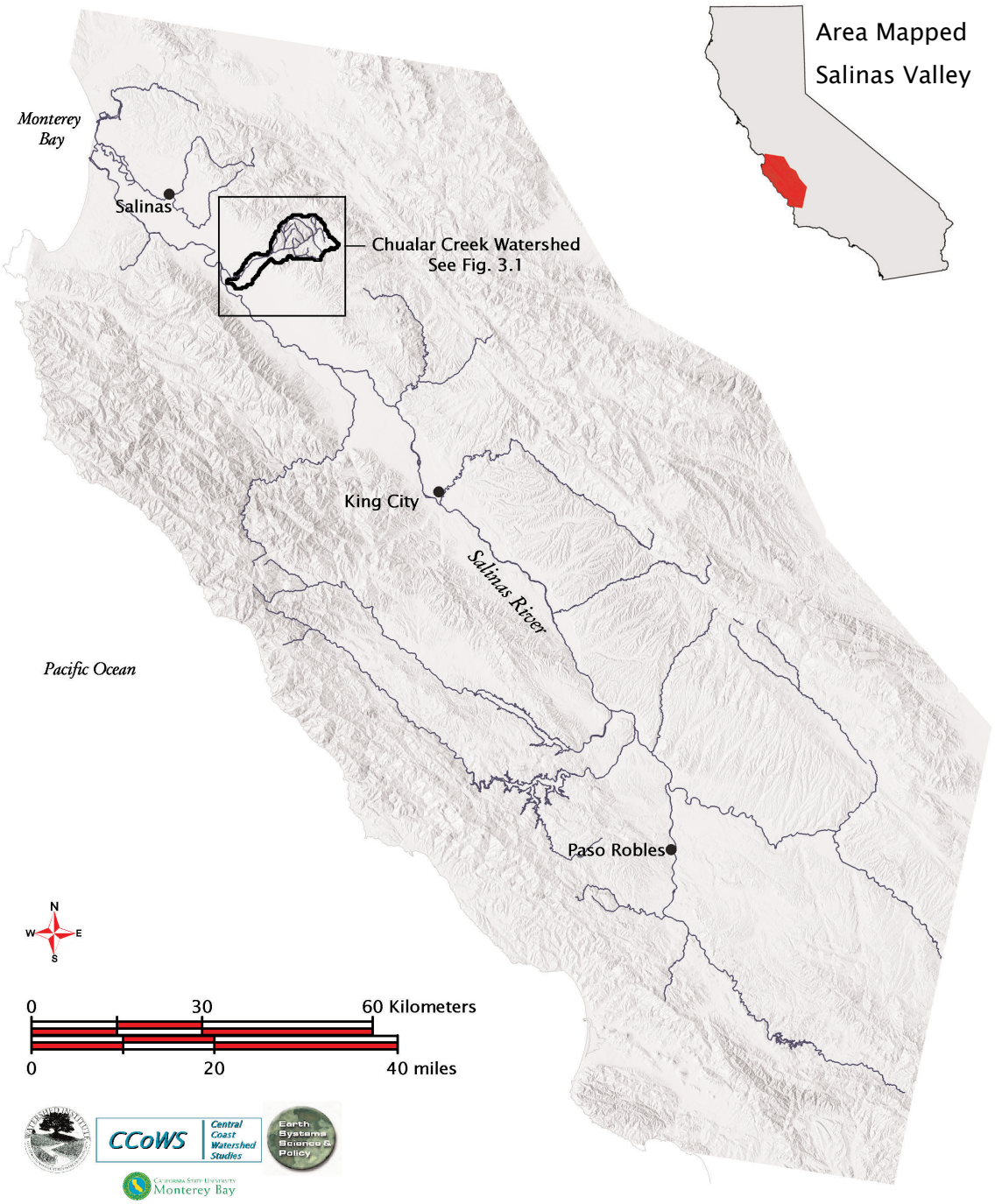


Figure 2.1 Map of Salinas Valley showing the location of the Chualar Creek Watershed.

3 Methods

3.1 Sampling Locations

A total of 7 monitoring sites, all at publicly accessible locations, were selected for this study (Fig. 3.1). The monitoring plan included sampling at two main sites, therefore two locations were chosen as the primary monitoring sites: one immediately upstream of the project area and one immediately downstream of the area. These primary "above" and "below" sites for the project were CHU-CCR (above) and CHU-CRR (below). However, it should be noted that CHU-CCR is predominantly non-perennial, and that CHU-OSR was selected as an alternate site to be monitored when CHU-CCR was not flowing. Additional sites that were monitored less frequently included: CHU-FOL, CH1-RWY, ESZ-HWY, and ESZ-OSR.

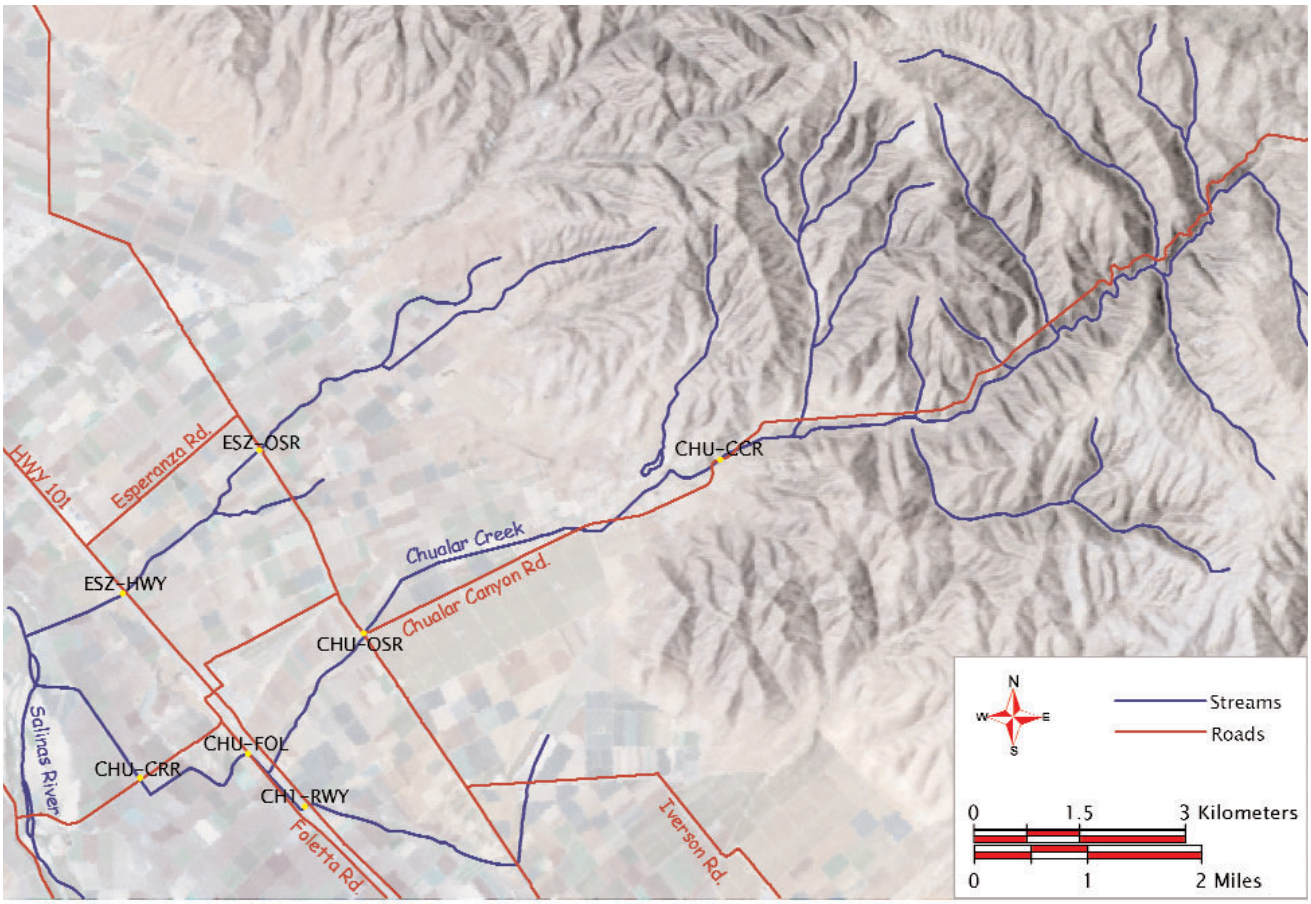


Figure 3.1 Chualar Creek Pilot Project Area and Monitoring Sites.

CHU-CCR

The section of Chualar Creek near site CHU-CCR (Fig. 3.2-3.3) is predominantly dry all year, except in high rainfall years. This site was chosen as the "above" site for the project area because it is located in the upper watershed above the irrigated agricultural lands. The primary land use above this site is natural lands/grazing with some scattered vineyards and residential areas. Site CHU-CCR collects runoff from all land uses above the row-crop areas. The primary substrate is sand with some gravel and cobble.

Figure 3.2 Site CHU- CCR: downstream of bridge (photo: Julie Hager Mar 02).

Figure 3.3 Site CHU-CCR: upstream of bridge (photo: Julie Hager Mar 02).

CHU-CRR

Site CHU-CRR (Fig. 3.4-3.5) is located on Chualar River Road immediately downstream of the road crossing. This was the "below" site for the project area. This site collects almost all runoff from the Chualar Creek watershed, as it is located approximately one mile from the confluence with the Salinas River.

Figure 3.4 Site CHU-CRR: Upstream of River Road crossing (photo: Fred Watson).

Figure 3.5 Site CHU-CRR: Downstream of River Road crossing; staff plate visible on right bank side of road crossing (photo: Fred Watson).

CHU-FOL

Site CHU-FOL (Figure 3.6-3.7) is located on the west side Foletta Road (west of Highway101) and upstream of site CHU-CRR. A tributary drainage that flows south of Chualar joins Chualar Creek immediately upstream of this site.

Figure 3.6 Site CHU-FOL: Upstream of Foletta Road (photo: Fred Watson).

Figure 3.7 Site CHU-FOL: Downstream of Foletta Road (photo: Fred Watson).

CHU-OSR

Site CHU-OSR (Fig. 3.8-3.9) is located at Old Stage Road near the bottom of Chualar Canyon. Towards the end of the monitoring period, this site became the secondary "above" site for the project, as a result of the lack of flow at CHU-CCR. The primary land uses above this site include natural/grazing lands, small residential, and a few scattered vineyards. However, due to the dry nature of the headwaters, flow from these land uses rarely reaches site CHU-OSR. Much of the row-crop agricultural land is downstream of this location, with the exception of a couple of farms near the bottom of the canyon.

Figure 3.8. Site CHU-OSR: Downstream of Old Stage Road (photo: Fred Watson).

Figure 3.9 Site CHU-OSR: Upstream of Old Stage Road (photo: Julie Hager).

CH1-RWY

Site CH1-RWY (Fig. 3.10-3.11) is located on the drainage that flows south of Chualar Creek. It too is a channelized ditch with the majority of its flow resulting from agricultural tail water. This monitoring site was located on Foletta Road just before the confluence with Chualar creek.

Figure 3.10 Site CH1-RWY: Downstream of sampling site (photo: Fred Watson).

Figure 3.11 Site CH1-RWY: Culvert and sampling location (photo: Fred Watson).

ESZ-HWY

Site ESZ-HWY (Fig. 3.12-3.13) is located on a drainage ditch that flows north of Chualar Creek. This site is located at the bottom of the drainage system, less than one mile before the confluence with the Salinas river. The primary land uses of this catchment area include row crop agriculture and greenhouses.

Figure 3.12 Site ESZ-HWY: Culvert and monitoring location (photo: Fred Watson).

Figure 3.13 Site ESZ-HWY: Downstream of monitoring location (photo: Fred Watson).

ESZ-OSR

Site ESZ-OSR (Fig. 3.14-3.15) is on the same drainage ditch north of Chualar Creek and upstream of site ESZ-HWY. The primary land use above this site is row-crop agriculture and greenhouses.

Figure 3.14 Site ESZ-OSR: Downstream of Old Stage Road (photo: Fred Watson).

Figure 3.15 Site ESZ-OSR: Upstream of Old Stage Road (photo: Fred Watson).

3.2 Monitoring

3.2.1 Field Sampling Plan

Field sampling was completed approximately monthly, and was conducted by technicians from the Monterey County Farm Bureau and the CCoWS team at the Watershed Institute. Regional board staff also assisted in field monitoring throughout the course of the project.

The original monitoring plan involved monitoring two sites (one upstream of the pilot project area and one downstream of the project area). Each site was to be monitored bimonthly and during two winter storm events. At each sampling location, single samples were to be collected and analyzed for nitrate, ammonia, ortho-phosphate, coliform, pH, turbidity, dissolved oxygen, and benthic macro-invertebrates.

After a brief initial sampling period, changes were made to the design of the monitoring plan. Due to the lack of sufficient funding and the need for replicated samples in order to detect various sources of variability, the sampling plan was altered. The new monitoring agreement called for approximately monthly monitoring, the addition of alternate sites if needed, periodic replicates for each analyte, the elimination of dissolved oxygen measurements and benthic macro-invertebrate sampling, and the addition of discharge measurements when available. The new plan called for the following parameters to be measured:

- nitrate
- ammonia
- orthophosphate
- suspended sediment
- turbidity
- transparency
- pH
- conductivity
- total coliform
- fecal coliform
- *E. coli*
- water depth
- water temperature
- stream discharge

Table 3.1 summarizes the equipment necessary for this type of field sampling.

Table 3.1 Field Equipment List

Field Equipment	
flow probe (current meter)	boots or waders
bucket	latex gloves
measuring tape	anitbacterial hand wash
stopwatch	waterproof field book
clean sample bottles	pencil/pen
DH-48	cooler
Oakton pH probe	ice
Oakton conductivity probe	thermometer

3.2.2 Field Sampling Protocols

A full description of the sampling and analytical protocols used by the CCoWS team is given in Watson et al. (2002). This section reviews key passages from that document and repeats the description of field-monitoring protocols for collecting suspended sediment samples, nutrient samples, and stream discharge measurements in the field. Depending on a number of factors such as, stream conditions, safety, equipment availability, and time, the methods for collecting water quality samples in a stream may have varied.

Suspended Sediment Sample Collection

Depending on the magnitude of stream flow, the concentration of suspended sediment can range from a well mixed to a vertically and horizontally stratified solution. To ensure that an accurate representation of the water column was collected, a DH-48 suspended sediment sampler was used when possible. When using a DH-48 sampler, a vertically integrated sample should be taken from several stations along a transect. However, due to the typical low water depths of Chualar Creek, a direct water sample or "grab" was sometimes collected. Grab samples were taken by simply reaching out from the bank and inserting the bottle into the channel with a quick downward motion in order to try to collect an integrated sample. Each sample was taken immediately following the stream height, or stage reading in locations where staff plates had been installed.

Nutrient Sample Collection

At each sampling visit to a single site, a single nutrient sample was collected. Some visits involved collecting replicate samples for quality control, during which 3 samples were taken within an approximate five minute period, from slightly different locations at the site. This provided information on variation in the data at very short temporal and spatial scales, combined with variation in storage and analytical effects. In order to prevent contamination, clean sample bottles were provided by the laboratory, and each bottle was additionally rinsed three times using the stream water. Wearing latex gloves, the technician collected a grab sample from the stream by dipping the bottle into the stream. The samples were immediately placed on ice and transported to the laboratory.

Measuring Stream Discharge
When possible, discharge measurements were taken in one of two ways. The preferred method involved measuring velocity along a cross-sectional area of the creek. Average velocity measurements were taken at regular intervals along a transect at 6/10 water depth using an impeller-type flow meter. One of the models used during this study was the *Global Water Flow Probe* (Global Water 2002). Several other impeller-type models used in the field were constructed by CCoWS using the *Global Water Flow Probe* as a model (Cole 2001).

The alternate method involved collecting stream flow into a bucket for a given amount of time. With a known volume of water and time, the stream discharge could then be calculated. At some sites, this method was ideal because stream flow was directed through culverts. The exit of water from these culverts was the most appropriate location to measure stream discharge.

3.3 Laboratory Analysis

3.3.1 Location
Analyses were performed both in house at the Watershed Institute at California State University Monterey Bay and by external laboratories as follows:

- Suspended Sediment Concentration - CCoWS
- Turbidity - BC Laboratories and CCoWS
- Transparency - CCoWS
- pH-CCoWS (in field)
- Conductivity - CCoWS (in field)
- Nutrients - BC Laboratories,Monterey County Laboratories, and CCoWS
- Total coliform - BC Laboratories, Monterey County Laboratories, and Creek Environmental Laboratories
- Fecal Coliform - BC Laboratories, Monterey County Laboratories, and Creek Environmental Laboratories
- *Escherichia coli* - Monterey County Laboratories

3.3.2 Laboratory analytical protocols
Detailed methods for laboratory analysis can be found in American Public Health Association's Standard Methods (1998), USEPA (1997), and ASTM (2002). Methods for laboratory analysis used in this study are as follows:

- SSC - comparable to ASTM D3977
- Turbidity - EPA 180.1, SM 2130B
- pH - SM 4500B
- Conductivity - SM 2510
- Nitrate - EPA 300
- Ammonia - EPA 350.1, EPA 350.3

- Orthophosphate – EPA 365.1, EPA 365.2
- Total coliform – SM 9221B, SM 9221C, SM 9223
- Fecal Coliform – SM 9221E
- *Escherichia coli* – SM 9221E, SM 9223

3.4 Quality Assurance Quality Control

In addition to a full description of the CCoWS sampling and analytical protocols, Watson et. al (2002) also details quality assurance procedures. CCoWS maintains chain of custody files for samples sent to external laboratories, data reports from external laboratories, maintenance and calibration records for CCoWS field and lab equipment, and all original field books and notes. All data are compiled into a *Microsoft Access* database.

All external laboratories used during this project are USEPA certified laboratories whose methods have been previously noted in this section. To further assure the quality of work, replicate samples were collected to test for laboratory precision and/or environmental variability. Additionally, duplicates for certain constituents, such as coliform, were sent to separate laboratories for comparison.

3.5 CCAMP Data Analysis

To serve as a comparison to the data collected on Chualar Creek, selected preliminary data results from the Central Coast Ambient Monitoring Project (CCAMP) were analyzed. Preliminary data from 16 CCAMP sites throughout the Salinas Valley (Fig. 3.16) were retrieved from the CCAMP database and then statistical analyses were performed. Site codes and locations are presented in Table 3.2. The data used for this analysis was collected from 1999 to 2000 according to protocol and methods approved by CCAMP (2002). Although the CCAMP preliminary data provides information on general levels and trends of pollutants in the Salinas Valley, direct comparison cannot be made with complete confidence due to differences in the frequency of sampling and in rainfall patterns between the two years.

Table 3.2 CCAMP Monitoring Sites

Site Code	Site Location
306CAR	Carneros Creek in Los Lomas @ Blohm Road
309ALD	Salinas Reclamation Canal @ Boronda Road
309ALU	Salinas Reclamation Canal @ Airport Road
309SAC	Salinas River @ Chualar Bridge on River Road
309TEM	Tembladero Slough @ Preston Road
309GAB	Gabilan Creek @ Independence Road and East Boronda Road
309QUA	Quail Creek @ Potter Road
309SET	Arroyo Seco River @ Thorne Road
309SEC	Arroyo Seco River @ Elm Street
309LOR	San Lorenzo Creek @ Bitterwater Road east of King City
309UAL	Salinas Reclamation Canal @ Old Stage Road
309ATS	Atascadero Creek @ Highway 41
309NAC	Nacimiento River @ Highway 101
309SAN	San Antonio River @ Highway 101
309SAT	Salinas River @ Highway 41 bridge
317CHO	Cholame Creek @ Bitterwater Road
317EST	Estrella River @ Airport Road

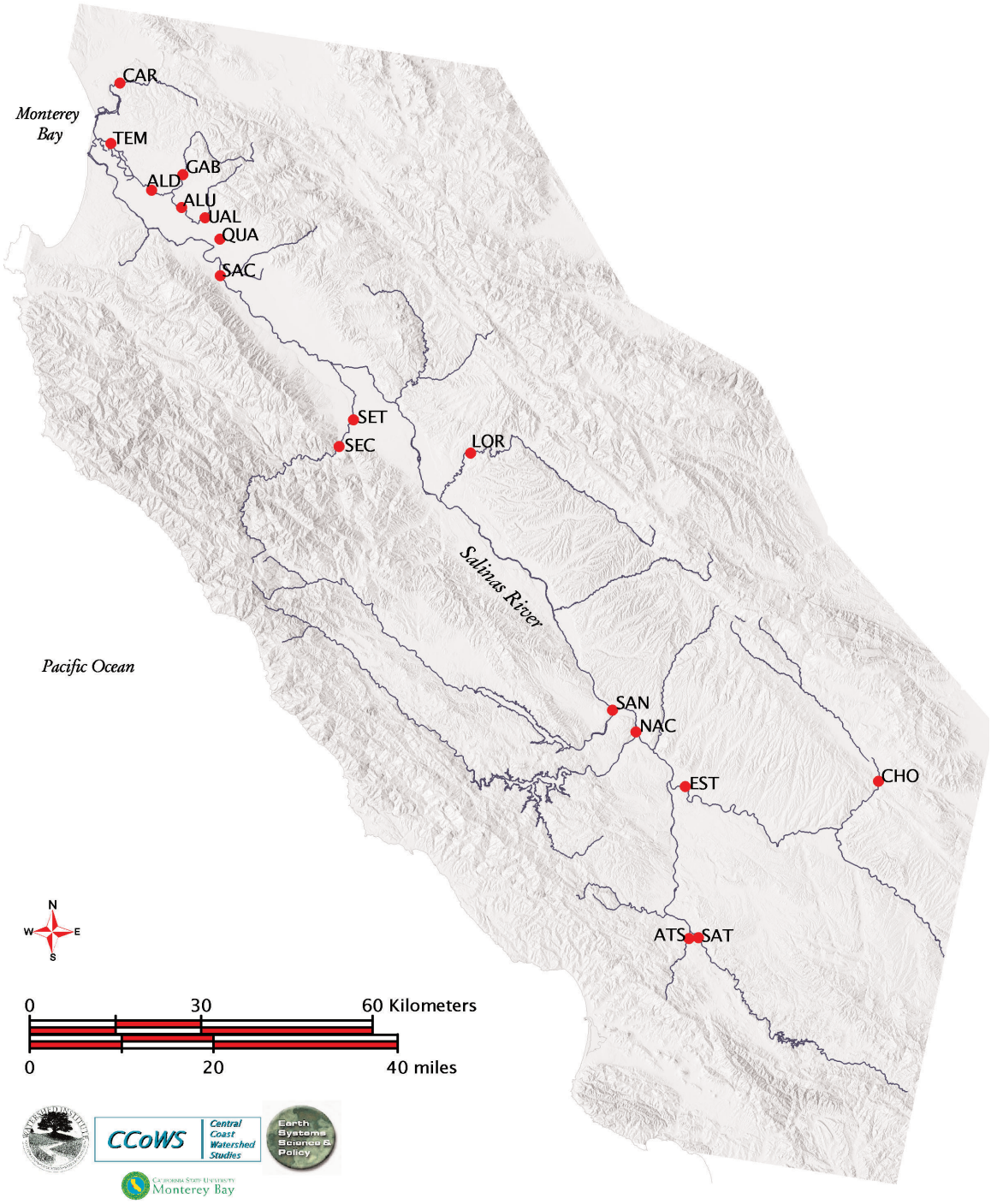


Figure 3.16 Map of Salinas Valley showing locations of selected CCAMP monitoring sites.

4 Results & Discussion

4.1 Climate & Flow

This section presents climate and flow patterns for the project time-frame. The frequency of visits to each site is also summarized (Table 4.1).

The total precipitation for the 2000 water year, during which most of the CCAMP monitoring took place, was approximately 37 cm (14.5 inches). Figure 4.1 presents a precipitation summary for the Salinas area for the time period of the Chualar monitoring. Maximum and minimum daily air temperature values for the same area are shown in Figure 4.2. These data were retrieved from the California Irrigation Management Information System South Salinas Station #89 (CIMIS 2002). It should be noted that error in precipitation measurements is not uncommon at this site due to its close proximity to an irrigated agricultural field. Intermittent rainfall occurred from March 2001 until June 2001 and was then followed by a dry period from July 2001 to October 2001. Rain commenced again in November 2001 and periodically fell through April 2002. The same rainfall patterns occurred in 2002 with intermittent rainfall from March to June, a dry period from July to October, and winter rains from November through the end of the monitoring period. Based on 62 years of rain data for the Salinas area, the average water year (October to September) precipitation is approximately 33 cm (13 inches). The total 2001 water year precipitation for south Salinas was approximately 41 cm (16 inches). Most monitoring of Chualar Creek occurred during the 2002 water year, during which the total precipitation was approximately 28 cm (11 inches). Monitoring also continued into the 2003 water year. As of December 31, 2002 the approximate total precipitation for the 2003 water year was 7 cm (2.7 inches) The warmest air temperatures occurred in May 2001, and July/August 2002, while the lowest temperatures were recorded in January 2002. This pattern of precipitation and air temperature is typical for the mediterranean climate that characterizes the Central Coast region of California.

The dates of Chualar sampling visits are also shown in Figures 4.1 and 4.2. Sampling typically occurred monthly, however some sites were monitored bimonthly during the summer months. A goal of this project was to capture at least two significant storm events. Sampling was conducted during a small rainfall event on 17 Mar 02 and a moderate storm event from 13 Dec 02 to 23 Dec 02. With the exception of these two events, the storms throughout the monitoring period were not significantly intense, did not generate a large amount runoff or streamflow in the Chualar area, and were therefore not monitored.

Table 4.2 presents the results of discharge measurements taken at various sites. Due to time restrictions, discharge measurements were not taken on every visit, and therefore stage-discharge curves could not be constructed (except for at site CHU-CRR). With continued flow monitoring in the future, this may be possible. In which case, discharges for the present sampling period could be estimated retrospectively. Discharges on Chualar Creek, measured at sites CHU-CRR, CHU-FOL, CHU-OSR, CHU-CCR, and CH1-RWY ranged from 0.7 to 2,065 L/s

(0.03 to 73 cfs). The highest flow, 2,065 L/s (73 cfs), was recorded during the December 2002 storm event. Sites CHU-CRR , CHU-FOL, and CH1-RWY flowed throughout the entire year (with a few exceptions immediately following storm flow recessions and when nearby agricultural fields were not being irrigated) and site CHU-OSR flowed intermittently. Flow at site CHU-CCR, located near the headwaters, was only observed two times (March 2001 and December 2002) throughout the entire monitoring period. Therefore, with the exception of these March 2001 and December 2002 discharges, the headwaters did not supply flow to the downstream reaches of Chualar Creek. With the exception of residential runoff from the small town of Chualar, it can be concluded that the majority of flow in Chualar Creek, especially in the summer months, is the result of agricultural tail water and would otherwise not exist except for in high rainfall years.

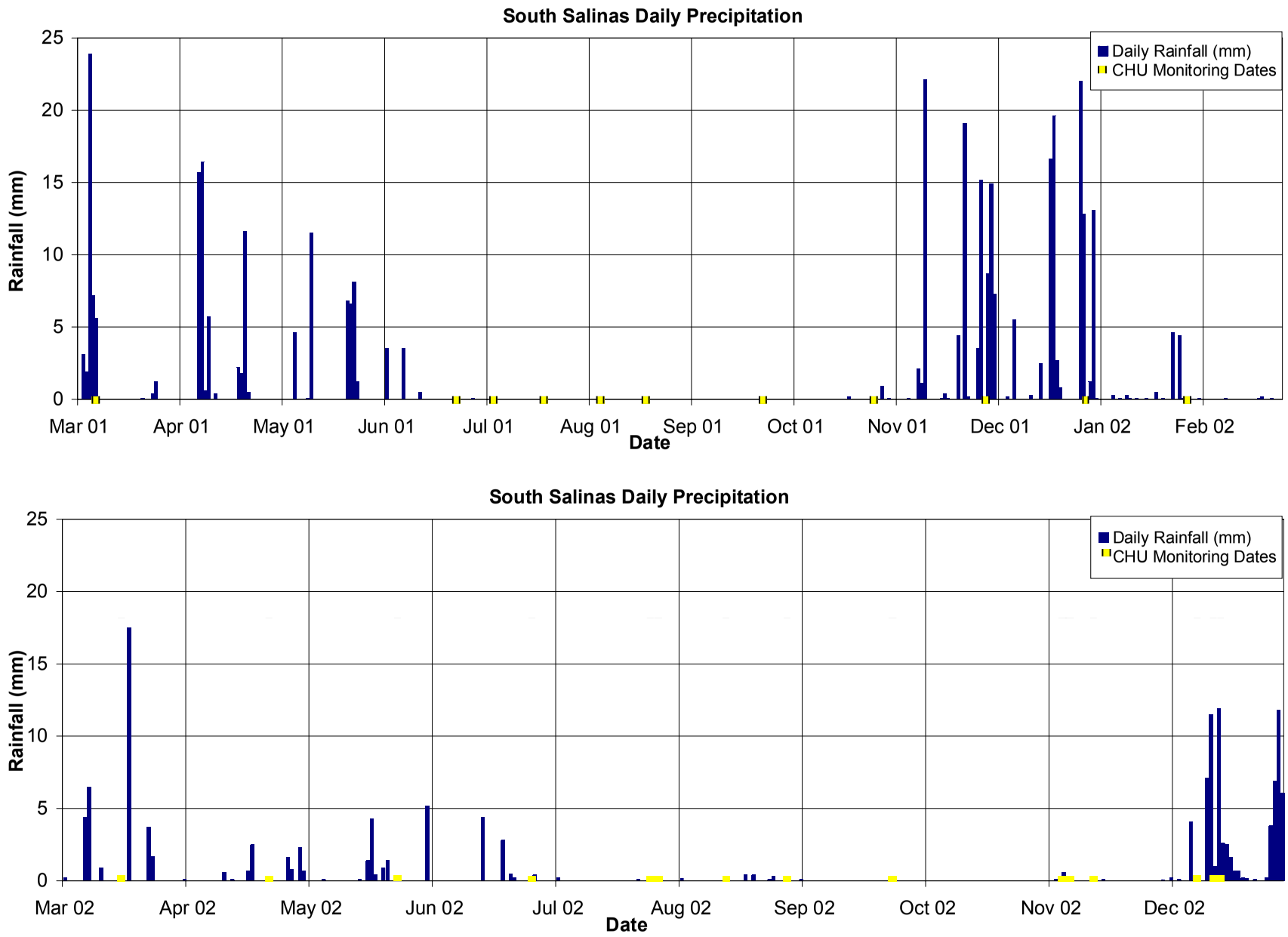
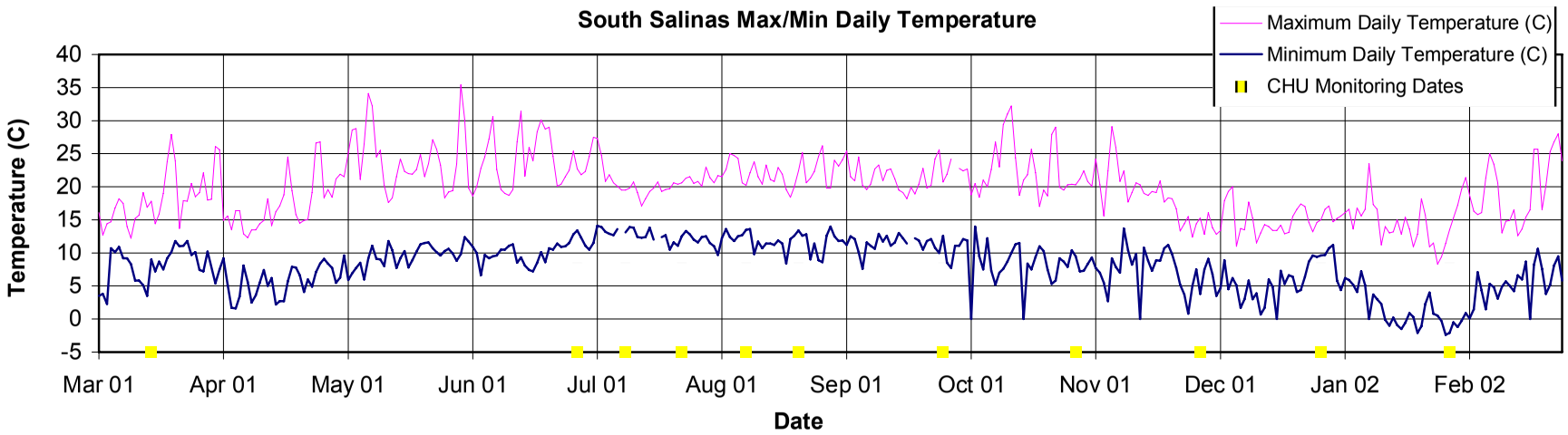


Figure 4.1 Daily Precipitation Data for CIMIS South Salinas Station.



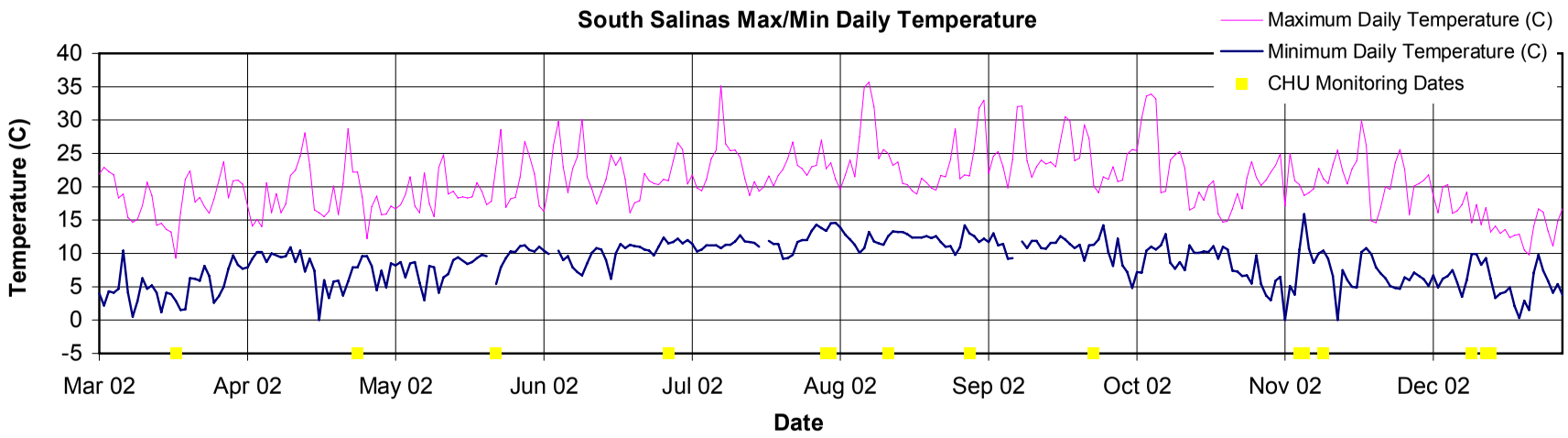


Figure 4.2 Maximum and Minimum Temperature Data for CIMIS South Salinas Station.

Table 4.1 Site Sampling Frequency

Site Code	# of visits
CHU-CRR	29
CHU-FOL	11
CHU-OSR	16
CHU-CCR	10
CH1-RWY	13
ESZ-HWY	5
ESZ-OSR	3

Table 4.2 Chualar Creek Discharge Data

Site Code	Date	Discharge (m^3/s)	Discharge (cfs)
CHU-CRR	17-Mar-02	0.097	3.44
CHU-CRR	24-Apr-02	0.039	1.38
CHU-CRR	23-May-02	0.021	0.74
CHU-CRR	28-Jun-02	0.048	1.70
CHU-CRR	31-Jul-02	0.060	2.13
CHU-CRR	30-Aug-02	0.038	1.34
CHU-CRR	25-Sep-02	0.005	0.17
CHU-CRR	07-Nov-02	0.003	0.11
CHU-CRR	08-Nov-02	0.578	20.41
CHU-CRR	16-Dec-02	1.548	54.67
CHU-CRR	17-Dec-02	2.065	72.92
CHU-FOL	30-Oct-01	0.001	0.03
CHU-FOL	30-Nov-01	0.001	0.03
CHU-FOL	30-Dec-01	0.001	0.03
CHU-OSR	17-Mar-02	0.016	0.57
CHU-OSR	31-Jul-02	0.004	0.15
CHU-OSR	08-Nov-02	0.132	4.66
CHU-OSR	16-Dec-02	1.246	44.00
CHU-OSR	17-Dec-02	0.380	13.42
CHU-CCR	14-Mar-01	0.009	0.33
CHU-CCR	16-Dec-02	0.220	7.77
CHU-CCR	17-Dec-02	0.078	2.75
CH1-RWY	27-Sep-01	0.030	1.06
CH1-RWY	31-Jan-02	0.022	0.77

4.2 Suspended Sediment

Time series for total suspended sediment, turbidity, and inverse transparency data collected at the Chualar monitoring sites: CHU-CRR, CHU-FOL, CH1-RWY, and CHU-OSR are presented in Figures 4.3 to 4.7. Figures 4.3 to 4.5 present sediment data results for the first year of monitoring at sites CHU-CRR, CHU-FOL, and CH1-RWY. These sites were chosen due to more frequent and consistent site visits to them. During the second year of monitoring, only two sites were monitored regularly. Sediment data from these sites, CHU-CRR and CHU-OSR, are presented in Figures 4.6 to 4.7. Time series based on preliminary data for total suspended sediment and turbidity at CCAMP sites: QUA and ALU are presented in Figures 4.8 to 4.9. These sites were selected because the land uses above these sites are similar to those in the Chualar project area.

Figure 4.10 is a schematic of a whisker plot. This whisker plot format will be used throughout the rest of the results section to illustrate data distribution. Figures 4.11 to 4.12 show whisker plots of suspended sediment and turbidity values at selected CCAMP and Chualar monitoring sites.

Numeric criteria for suspended sediment are not outlined in the Basin Plan (CCR-WQCB 1994) for the Central Coast of California, however, it is stated that: "The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner to cause nuisance or adversely affect beneficial uses."

Turbidity is the scattering of light due to suspended particles, both organic and inorganic. Figures 4.3 to 4.7 illustrate a strong correspondence between the values for SSC and turbidity. For comparison to the turbidity levels observed at the Chualar sites, the USEPA (2000) recommended water quality criteria for the Central Coast region is 1.84 NTU.

4.2.1 Suspended Sediment

Suspended sediment (SSC) measurements at the four main Chualar sites ranged from 0 to 17,311 mg/L. The highest SSC concentration was measured at CHU-OSR during the December 2002 rain event, and the lowest concentration occurred at site CHU-CRR in May 2002. In 2001, at sites CHU-CRR and CHU-FOL, the highest SSC levels generally occurred during the summer months (Fig. 4.3 to Fig. 4.4). Likewise, CH1-RWY had elevated levels of SSC during the summer, but levels were also elevated in January 2002 (Fig. 4.5). During the 2002 monitoring period, an opposite trend was observed. At CHU-CRR, SSC concentrations were lowest in the summer and were higher from late fall to early spring (Fig. 4.6). This change in the trend for SSC could be attributed to the timing of sampling during several winter storm events that occurred in 2002. Similarly, at CHU-OSR, SSC concentrations, from November to March, were >1,000 mg/L. With the exception of July 2002, no flow was observed at CHU-OSR from April to early November.

All suspended sediment samples collected by CCoWS were processed using a

method comparable to ASTM D3977 (2002). This method, in which the entire sample is analyzed for sediment, is referred to as suspended sediment concentration (SSC). Another commonly used method, total suspended solids (TSS), involves analysis of only an aliquot of the entire water sample. Although results from the two different techniques may be used for general comparisons, it should be noted that the TSS method tends to underestimate the total suspended sediment concentration, whereas the SSC method produces a closer estimate of the actual suspended sediment concentration (Gray et al., 2000).

The preliminary suspended sediment data from CCAMP were determined using the TSS method. At CCAMP site QUA (Fig. 4.8), TSS values were highest in July and during monitoring that coincided with rain events in February 1999 and 2001, and lowest in November. However, not enough sampling in other months was conducted to ensure this trend. As for ALU, TSS concentrations were highest in May and during monitoring that coincided with or followed rain events in February 1999 and January, February 2000 (Fig. 4.9). When the Chualar data were compared to the data from CCAMP (Fig. 4.11), the average SSC values at Chualar were higher than most other sites in the region, with the exception of Quail and Gabilan Creek.

4.2.2 Turbidity

Turbidity measurements ranged from 5 to >30,000 NTU at the four main Chualar sites (Fig. 4.3 to 4.7). The reading, >30,000 NTU, occurred during the December 2002 rain event. During 2001, samples were not analyzed for turbidity from October to December (due to a laboratory transition period), however it is expected that trends would be similar to those seen for SSC, with the highest turbidity levels occurring in the summer months. An exception to that trend occurred at CH1-RWY on the January 2002 sampling visit (Fig. 4.5). As was for SSC, the trend for turbidity was reversed in 2002, with lower values measured from May to early November (Fig. 4.6).

When compared to other sites throughout the Salinas Valley (Fig. 4.12), turbidity values at the Chualar sites were among the highest measured, as were the values for Quail and Gabilan Creek. In general, streams in the northeastern portion of the valley had higher turbidity levels than streams to the south and those originating on the western slopes.

4.2.3 Transparency

Transparency of the water was measured using a 60 cm transparency tube. Figure 4.3 to 4.7 display the inverse of transparency, which has been shown to be proportional to suspended sediment and turbidity (Watson et al., 2002). This is useful information as it is much easier and more cost effective to use this technique as opposed to SSC and/or turbidity. For instance, growers or ranchers could perform this test in less than 5 minutes with only one necessary piece of equipment - an inexpensive transparency tube.

Values for inverse transparency at the Chualar sites ranged from 0.03 to 9.9 cm. Just as the 2001 trends for SSC and turbidity, transparency values were general-

ly highest in the summer, with the exception of January 2002 at site CH1-RWY (Fig. 4.5). The trend was reversed in 2002 (most likely the result of sampling during rain events), with smaller transparency readings occurring from May to early November and high values in late November through March. CCAMP transparency data were not analyzed for this report.

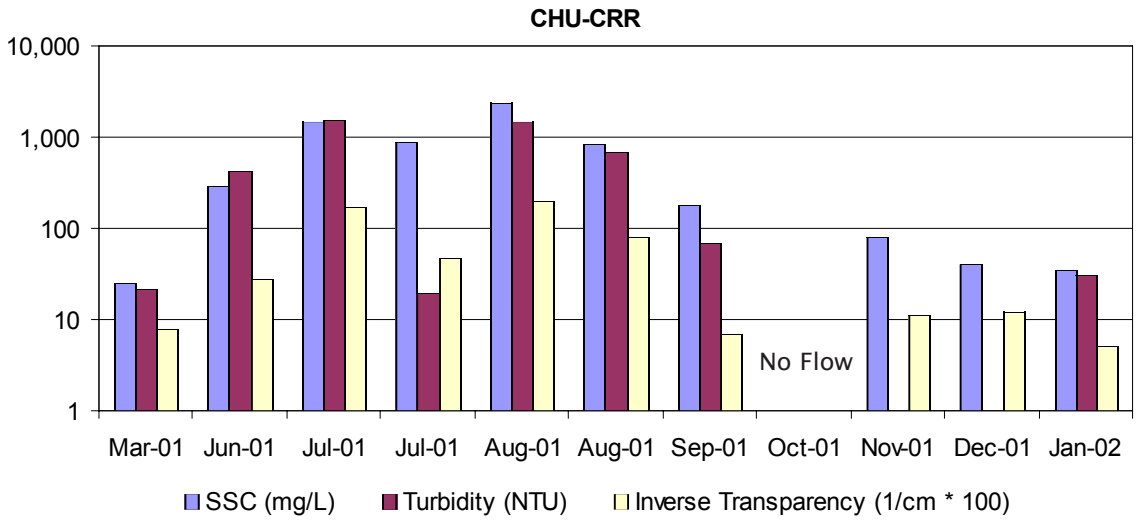


Figure 4.3 Suspended sediment and turbidity time series for CHU-CRR.

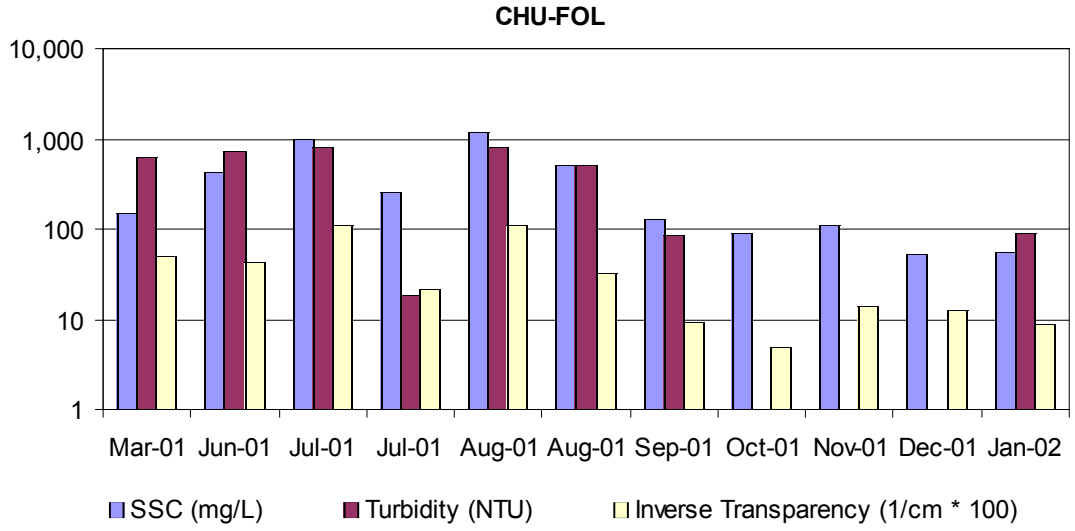


Figure 4.4 Suspended sediment and turbidity time series for CHU-FOL.

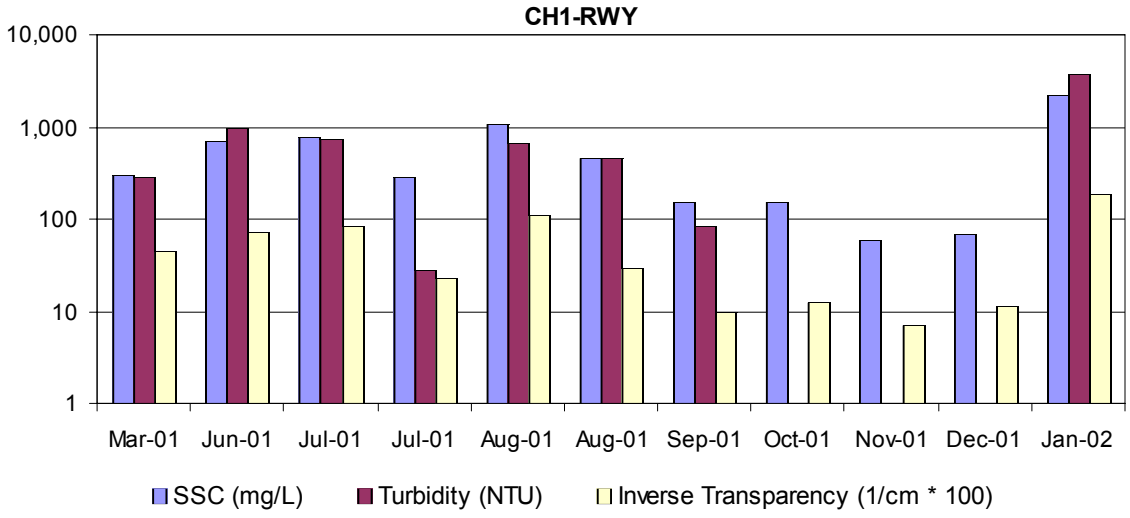


Figure 4.5 Suspended sediment and turbidity time series for CH1-RWY.

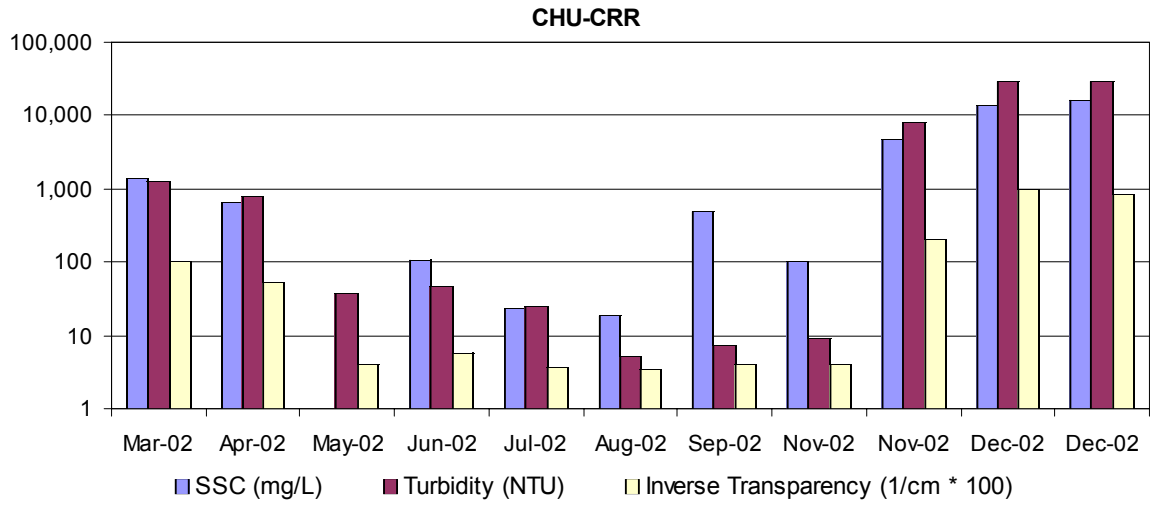


Figure 4.6 Suspended sediment and turbidity time series for CHU-CRR.

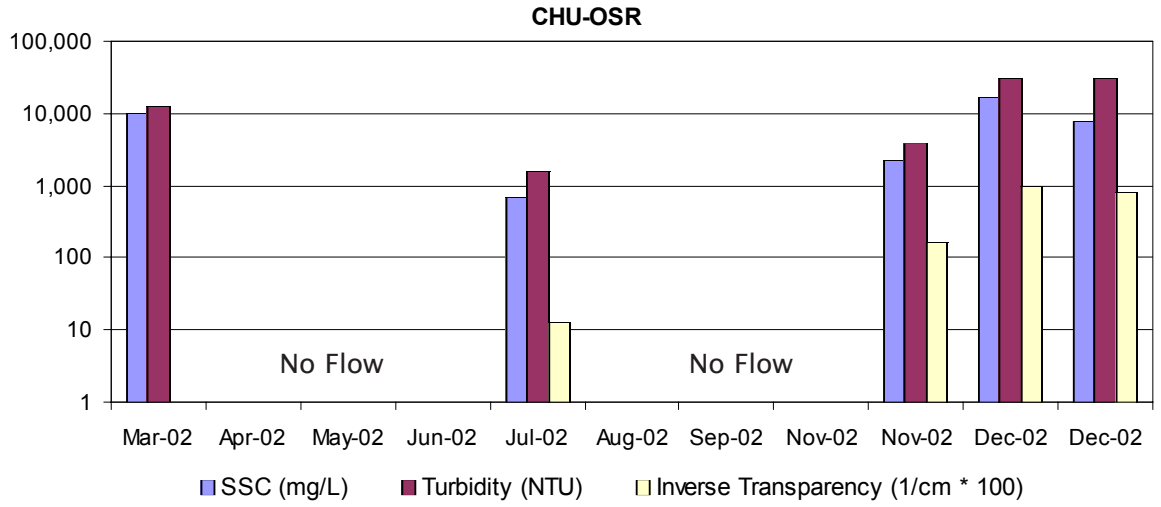


Figure 4.7 Suspended sediment and turbidity time series for CHU-OSR.

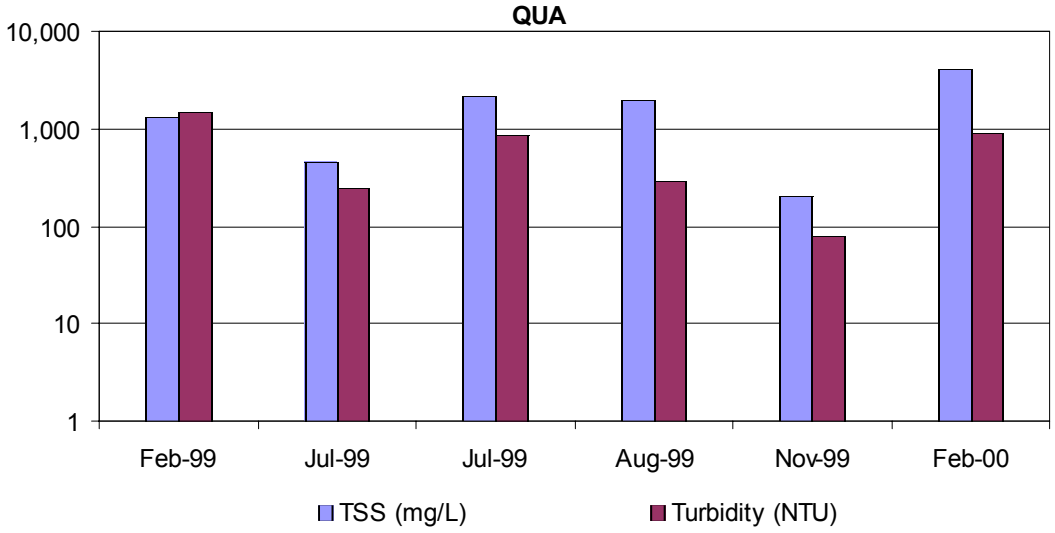


Figure 4.8 Suspended sediment and turbidity time series for QUA.

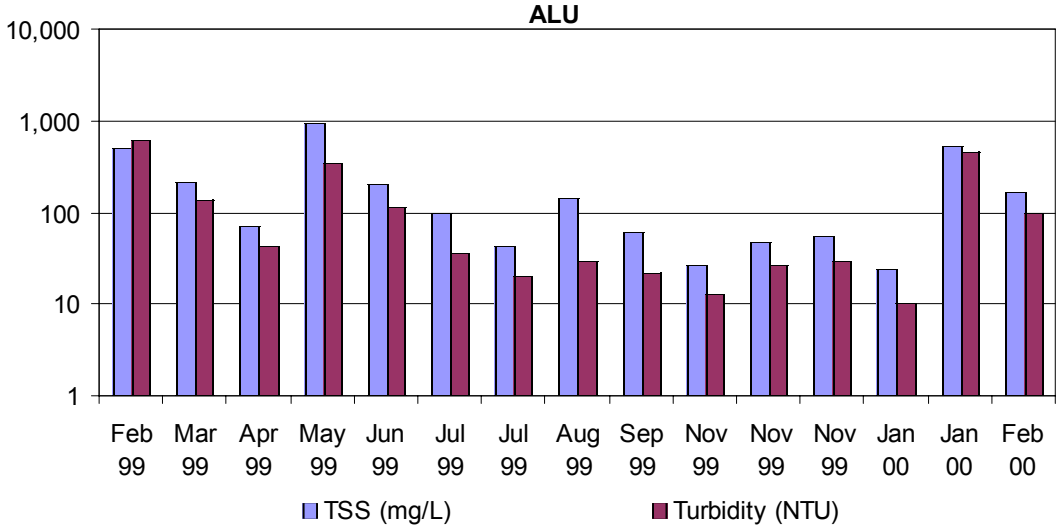


Figure 4.9 Suspended sediment and turbidity time series for ALU.

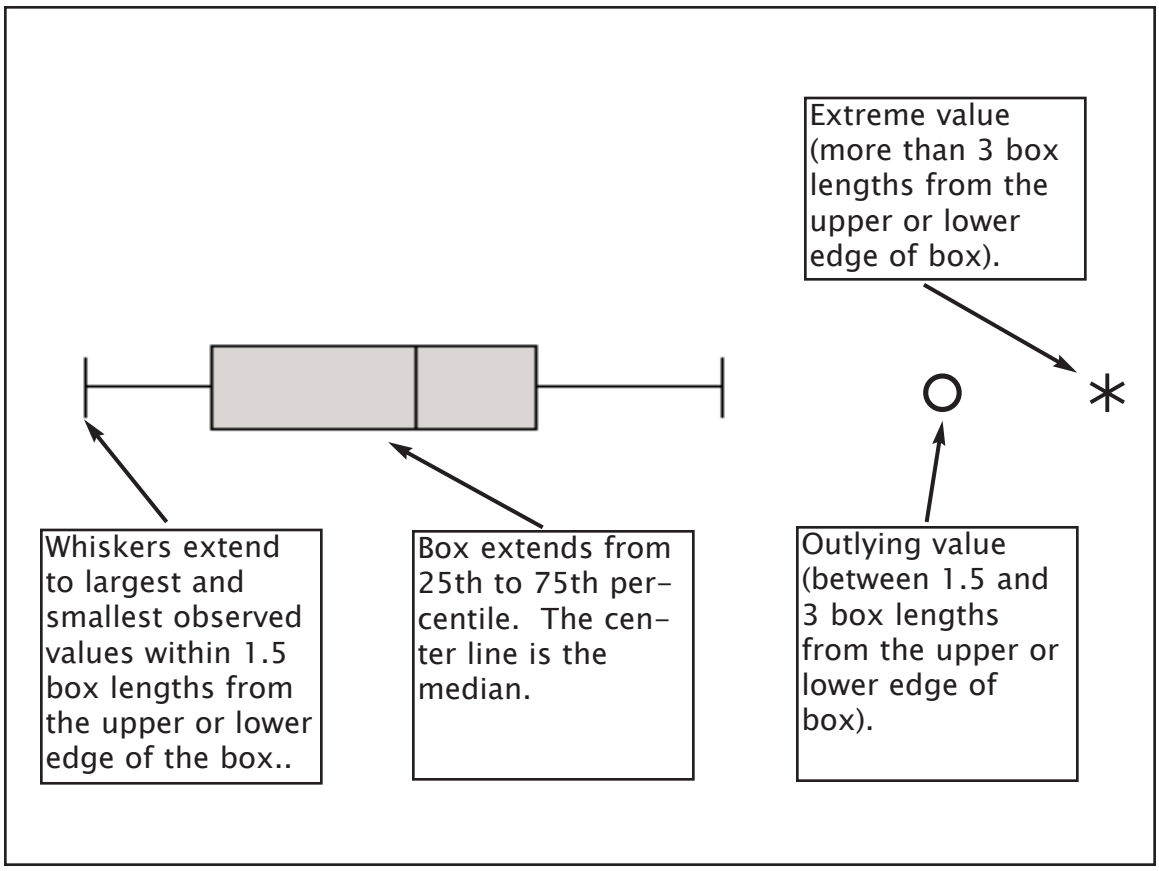


Figure 4.10 Whisker plot schematic. All whisker plots are made using SPSS 11.0.

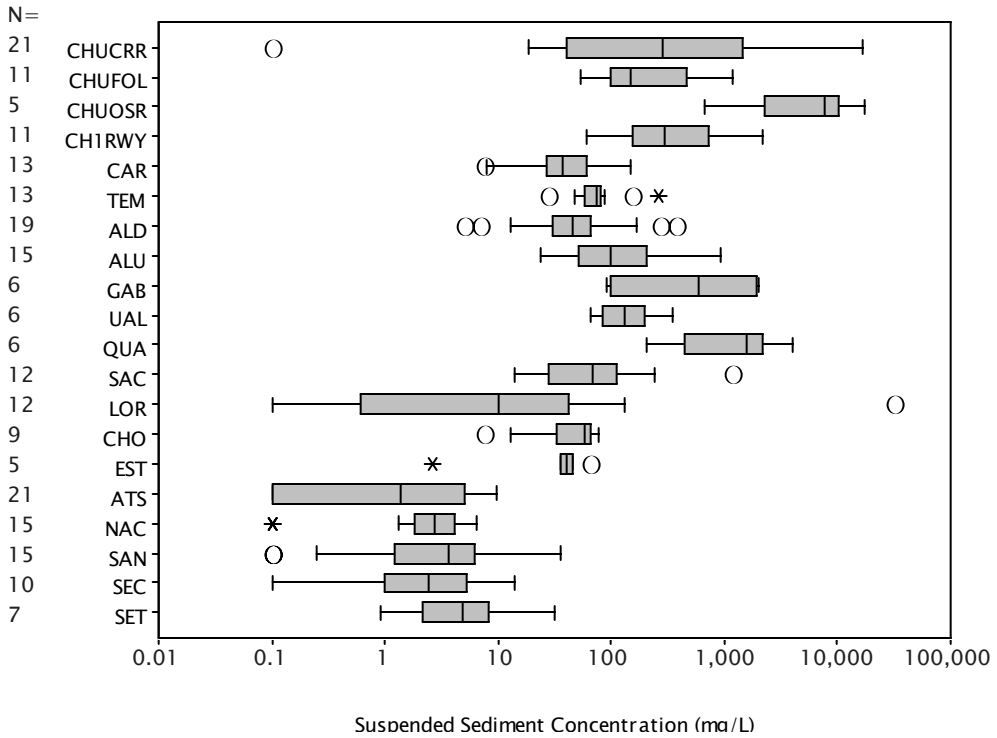


Figure 4.11 Suspended sediment data for selected CCAMP and Chualar sites. Note: Chualar samples were analyzed using SSC, and CCAMP samples were analyzed using TSS.

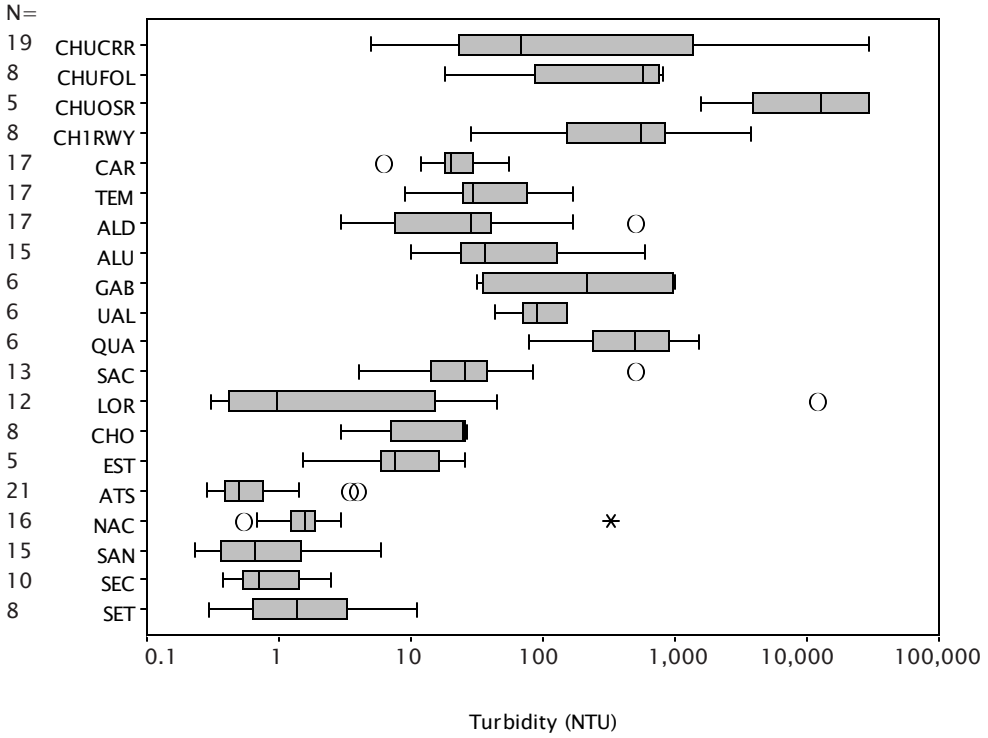


Figure 4.12 Turbidity data for selected CCAMP and Chualar sites.

4.3 Conductivity & pH

Figure 4.13 presents time series data from 2001 for conductivity at sites: CHU-CRR, CHU-FOL, and CH1-RWY. Conductivity data from 2002 for sites CHU-CRR and CHU-OSR are presented in Figure 4.14. Time series were not constructed for pH as data was relatively constant throughout the monitoring period. Time series for CCAMP sites: QUA and ALU are presented in Figures 4.15 to 4.16. These sites were selected because land use above these sites are similar to land use in the Chualar Creek watershed. Whisker plots for both conductivity and pH are presented in Figures 4.17 to 4.18 for selected CCAMP and Chualar sites.

Although conductivity of water in a given area is highly influenced by the local geology, changes or significant increases can often be the result of increases in inorganic dissolved solids, such as nitrate, phosphate, and various salts. Numeric water quality criteria for water conductivity are not given in the Basin Plan. For contact recreational use, pH values should range between 6.5 and 8.3 (CCRWQCB 1994), although contact recreation may be an unlikely beneficial use of Chualar Creek.

4.3.1 Conductivity

Conductivity ranged from 164 to 2,340 uS/cm (~82 to 1170 ppm) at the four Chualar sites (Fig. 4.13 to 4.14). The lowest value occurred at CHU-OSR during the December 2002 rain event and the highest value occurred at CHU-CRR during June 2002. Conductivity levels were generally lowest during the winter months, which is most likely the result of dilution from rainfall.

At CCAMP site QUA (Fig. 4.15), the lowest conductivity reading was measured in November 1999 and the highest in February 2000. More monitoring is needed at this site during the winter and spring to detect yearly trends. At ALU (Fig. 4.16), which had more frequent monitoring, conductivity levels were highest from late spring to early fall, and lowest during the winter months. When the Chualar values are compared to preliminary CCAMP data (Fig. 4.17), conductivity for the Chualar sites was in a similar range with most other sites throughout the Salinas Valley. The highest values in the region occurred at CCAMP sites CHO and LOR.

4.3.2 pH

As would be expected, pH did not vary as much as the other water constituents throughout the course of the monitoring. Values ranged from 7.4 to 8.8 (slightly higher than Basin Plan objective) at CHU-CRR, CHU-OSR, CHU-FOL, and CH1-RWY. When compared to preliminary data from selected CCAMP sites throughout the region (Fig. 4.18), pH data for Chualar were within the normal range of the values obtained at the other sites.

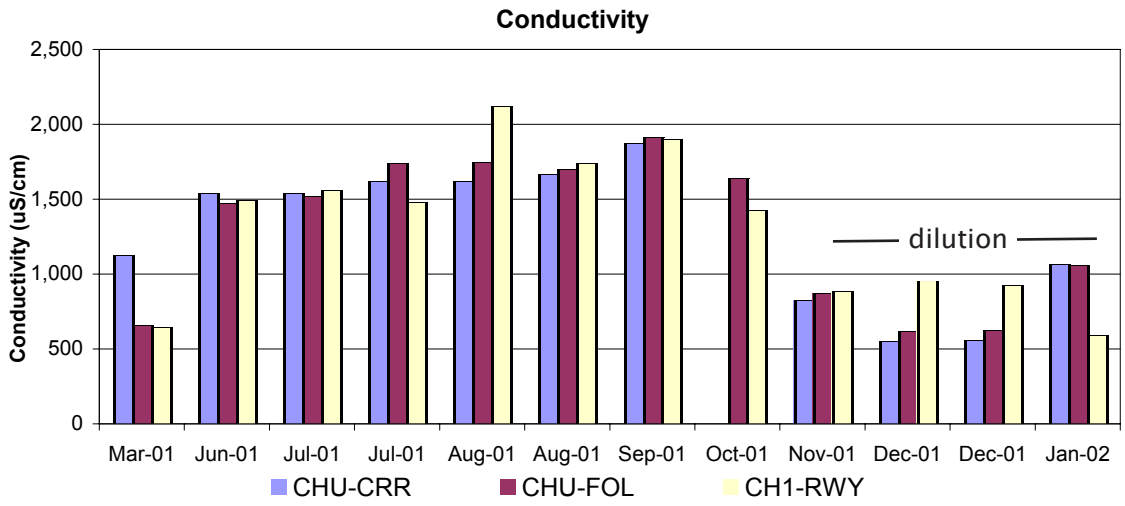


Figure 4.13 Conductivity time series for CHU-CRR, CHU-FOL, and CH1-RWY.

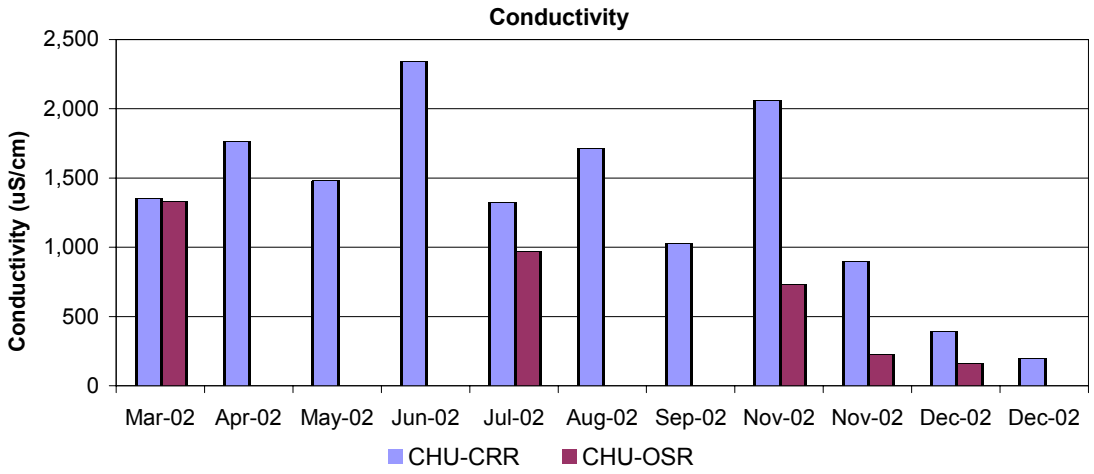


Figure 4.14 Conductivity time series for CHU-CRR, and CHU-OSR

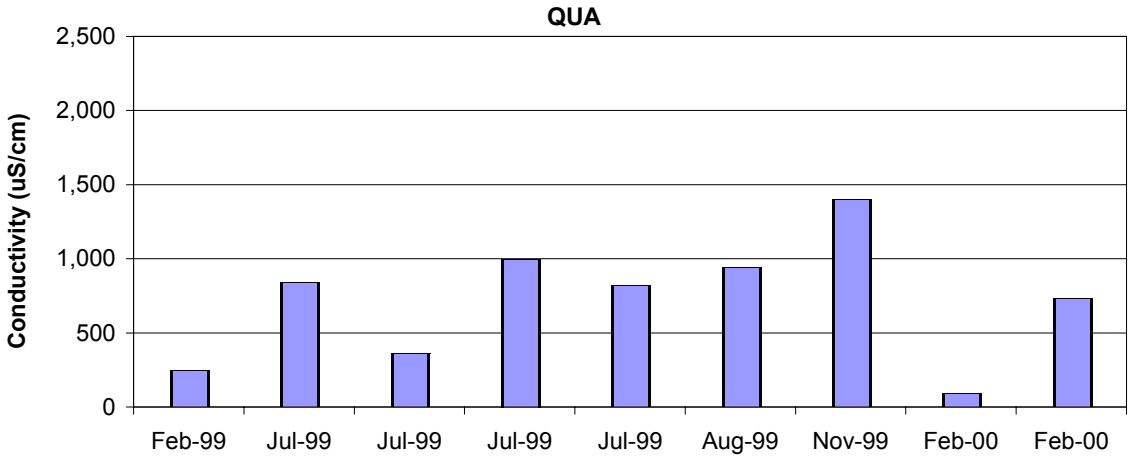


Figure 4.15 Conductivity time series for QUA.

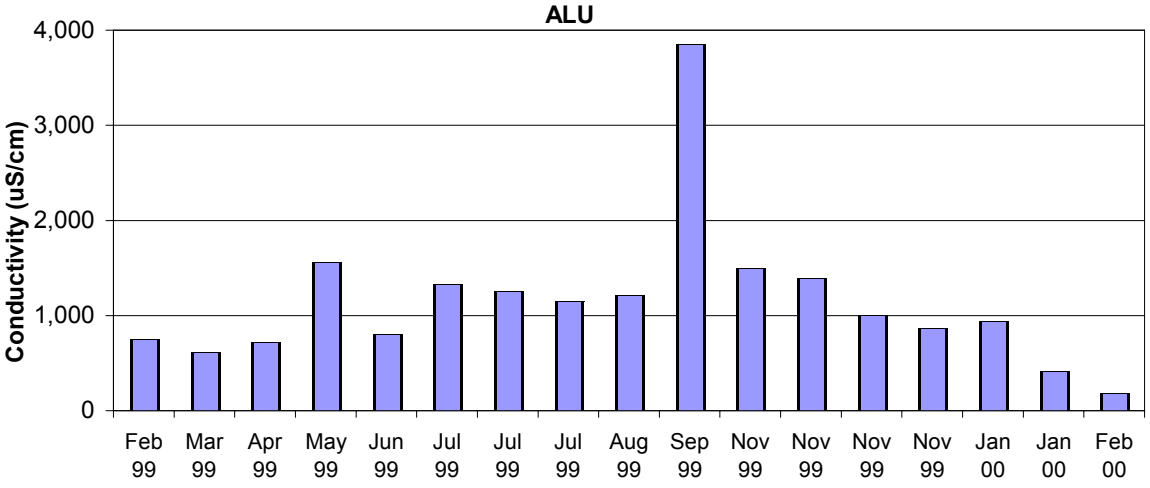


Figure 4.16 Conductivity time series for ALU.

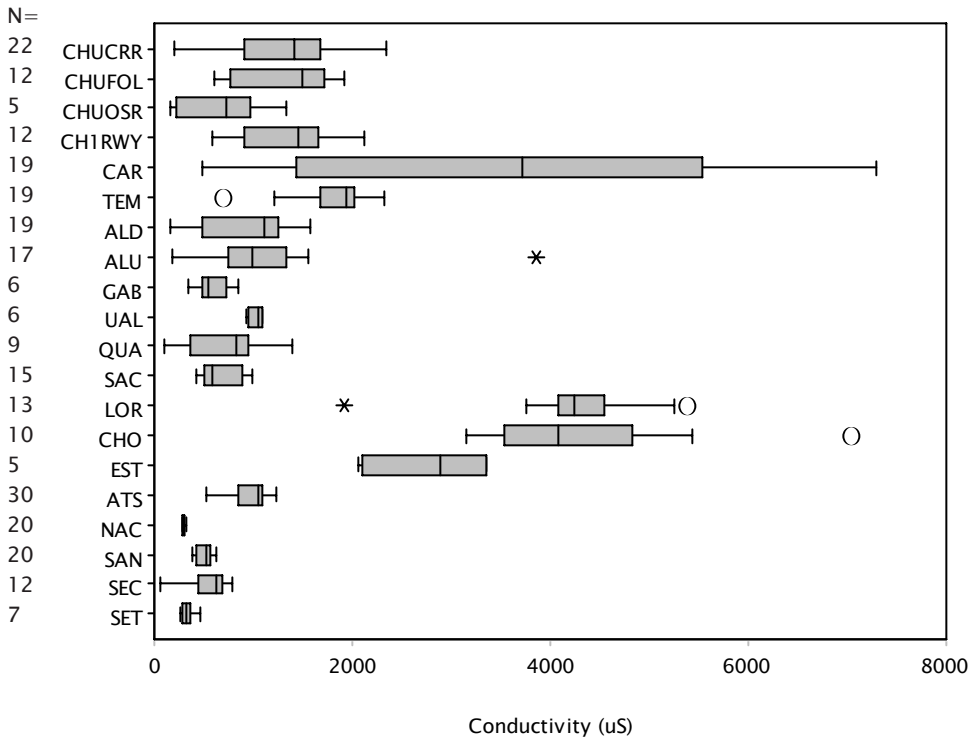


Figure 4.17 Conductivity data for selected CCAMP and Chualar sites.

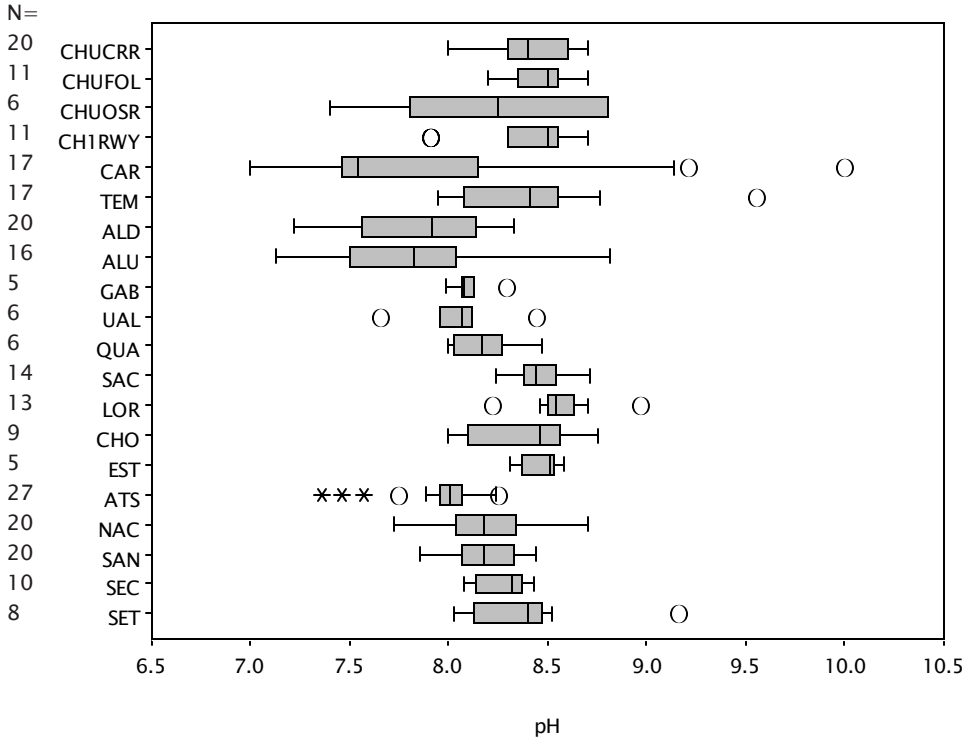


Figure 4.18 pH data for selected CCAMP and Chualar sites.

4.4 Nutrients

Time series for nutrient concentrations at sites CHU-CRR, CHU-OSR, CHU-FOL, and CH1-RWY are presented in Figure 4.19 to 4.23. Time series for selected CCAMP sites are illustrated in Figure 4.24 to 4.25. Whisker plots of the nutrient data at CCAMP and Chualar sites are shown in Figure 4.26 to 4.28. Analysis of preliminary data from these CCAMP sites allows for a generalized comparison of the Chualar nutrients values to those in other regions throughout the Salinas Valley.

In order to test for method precision and environmental variability, replicate nutrient samples (3) were collected for each site visit from March 2001 to January 2002. Due to a consistent low variance in the data, it was concluded that the sampling and laboratory methods were precise and that variability for a given site within a small temporal scale was not significant. Therefore, replicate sampling was discontinued after January 2002.

Numeric water quality objectives for nutrients in surface water are not listed in the Basin Plan. The USEPA (2000) water quality recommendations to the state for the Central Coast region are: total phosphorus - 0.022 mg/L and total nitrogen 0.377 mg/L.

4.4.1 Nitrate

Chualar nitrate-N concentrations ranged from 0.41mg/L in March 2001 to 74 mg/L during the March 2002 rain event, with even the lower range being higher than the USEPA recommended level for total nitrogen. In 2001, nitrate-N values varied throughout the year, with the most concentrated sample (42 mg/L) occurring in August 2001 at CH1-RWY. In 2002, nitrate-N values also varied throughout the year. Nitrate-N concentrations >40 mg/L occurred in March (CHU-OSR), June (CHU-CRR), and November (CHU-OSR) 2002.

At CCAMP site QUA (Figure 4.24), nitrate-N values were highest in July and August, with an even more concentrated spike occurring in November. At ALU (Figure 4.25), nitrate-N levels were highest in June and July with an even higher concentrated spike occurring in September. When Chualar nitrate-N results are compared to preliminary nitrate-N data collected by CCAMP (Fig. 4.26), the average concentrations found at the Chualar sites were some of the highest in the Salinas Valley. However, elevated levels were also found at CCAMP sites: TEM, UAL, and QUA.

4.4.2 Ammonia

The concentrations of ammonia-N measured at the Chualar sites ranged from non-detect in March 2001 to 14 mg/L in August 2002. In 2001, ammonia values varied year round, with a 6.4 mg/L spike at CHU-CRR in July 2001 and a 4.8 spike at CHU-FOL in October 2001. Likewise, in 2002 ammonia values also varied throughout the year. Ammonia-N concentrations >5 mg/L occurred March (CHU-OSR), April (CHU-CRR), June (CHU-CRR), July (CHU-OSR), and August (CHU-CRR) 2002.

At QUA, ammonia-N levels were highest in July and August (Fig. 4.24) . Elevated ammonia-N levels were recorded in May and June at site ALU (Fig. 4.25). Additionally, a large spike (>5 mg/L) occurred during the February 2000 monitoring, which coincided with a rain event. Likewise to the trends for nitrate-N, the average concentrations of ammonia-N were higher at the Chualar sites than at other sites in the region (Fig. 4.27). Elevated levels did however occur at CCAMP sites: ALU, ALD, and QUA.

4.4.3 Orthophosphate

Orthophosphate-P concentrations ranged from 0.02 mg/L in March 2001 to 25.8 mg/L during the December 2002 rain event. In 2001, concentrations were variable throughout the year. In 2002, orthophosphate-P concentration varied throughout the year, and the highest values (>5 mg/L) occurred in March, November, and December.

At CCAMP sites QUA and ALU (Fig. 4.24 to 4.25), orthophosphate-P values were also variable throughout the year. The orthophosphate-P concentrations for Chualar (with the exception of CHU-OSR) were similar in range to nearby streams

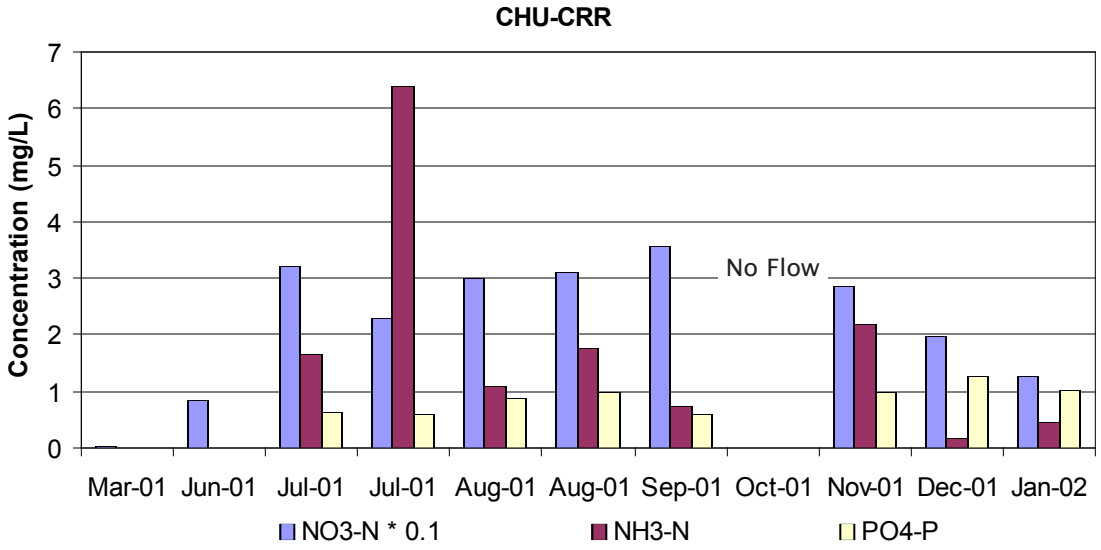


Figure 4.19 Nutrient time series for CHU-CRR.

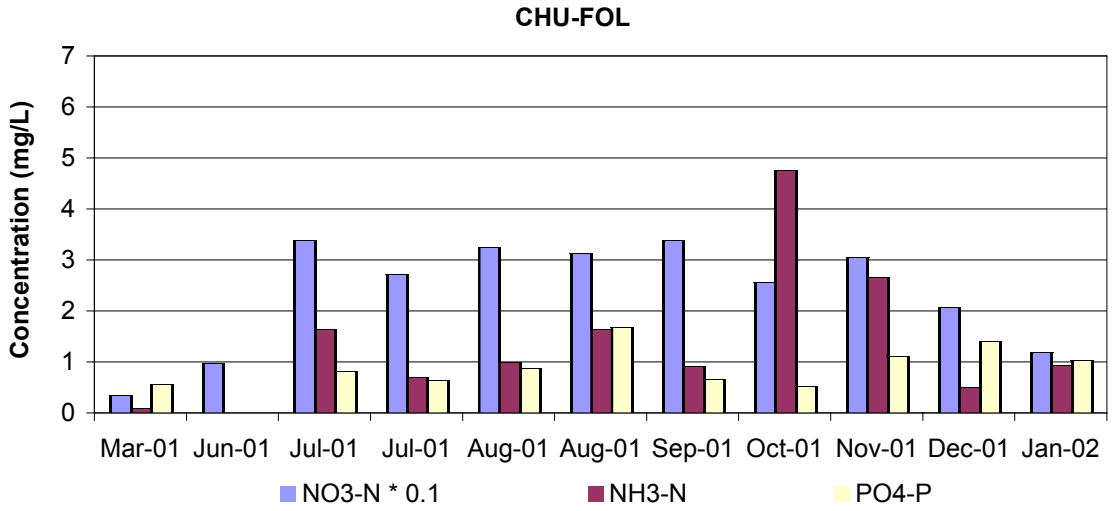


Figure 4.20 Nutrient time series for CHU-FOL.

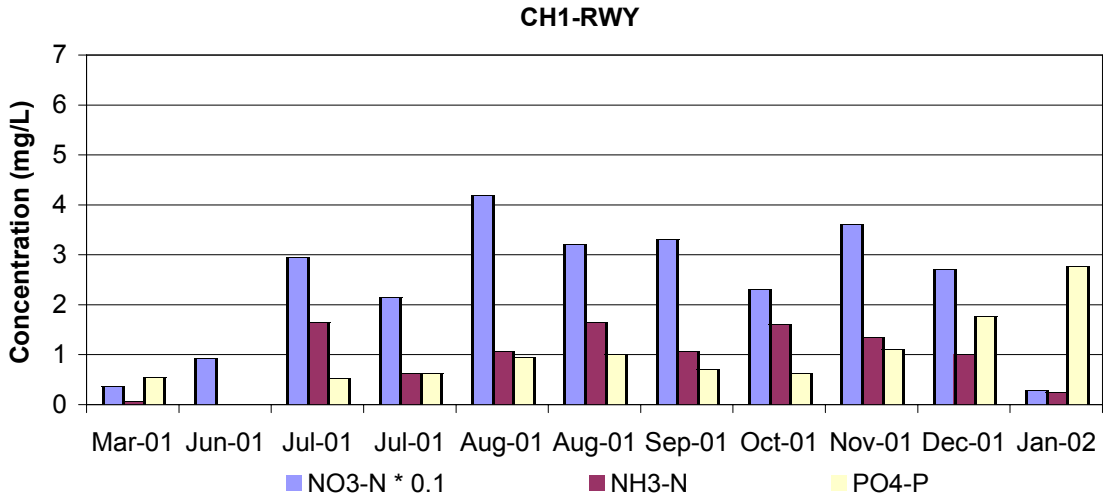


Figure 4.21 Nutrient time series for CH1-RWY.

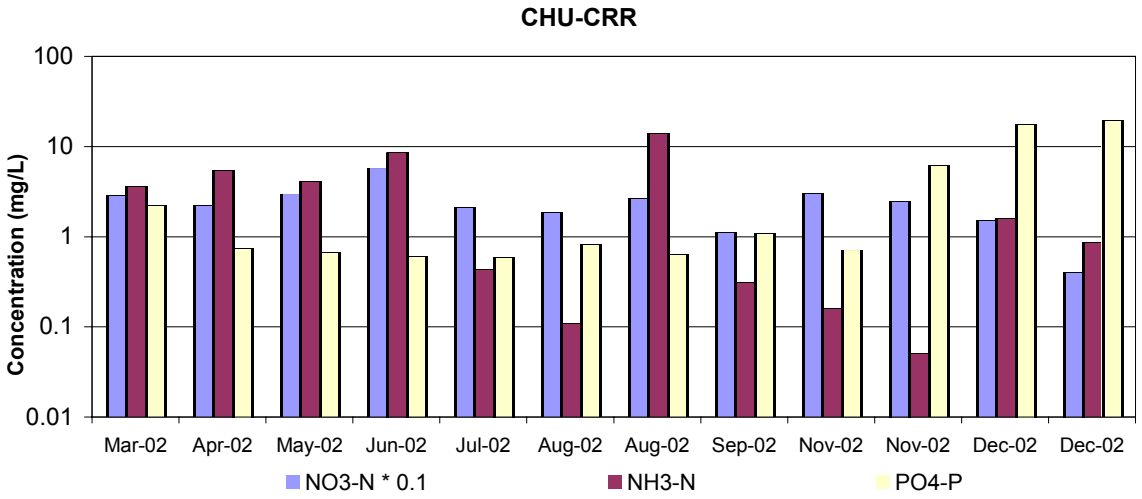


Figure 4.22 Nutrient time series for CHU-CRR.

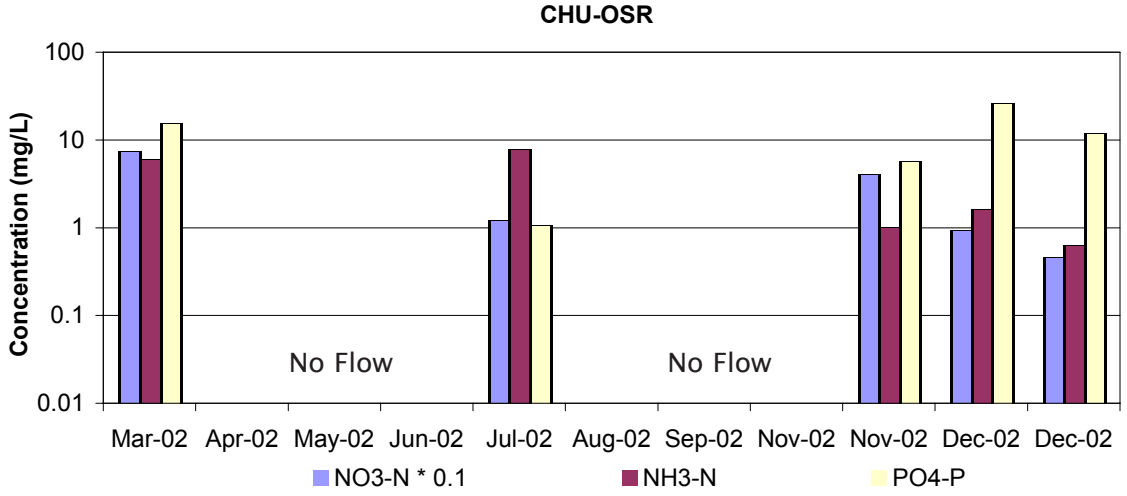


Figure 4.23 Nutrient time series for CHU-OSR.

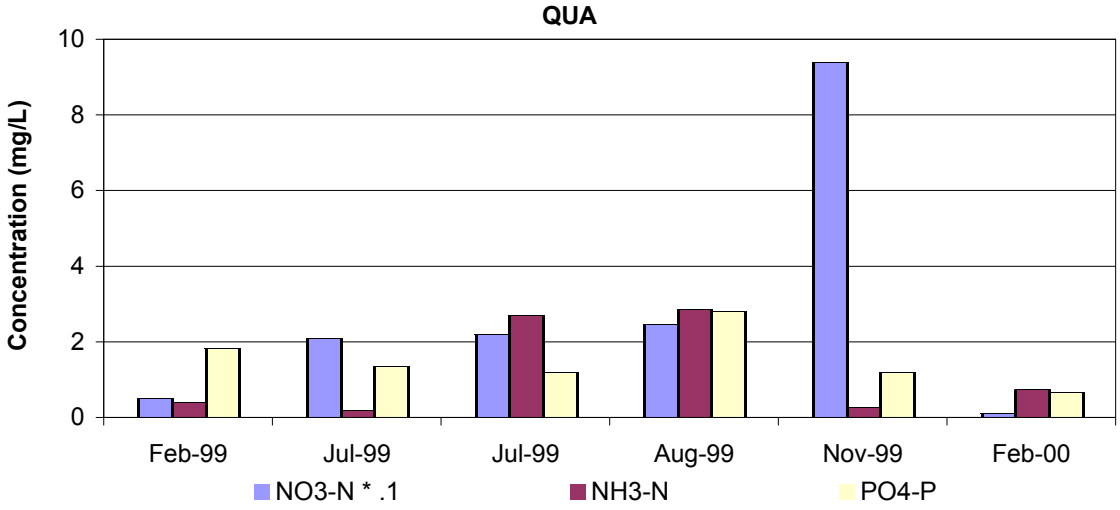


Figure 4.24 Nutrient time series for CCAMP site QUA.

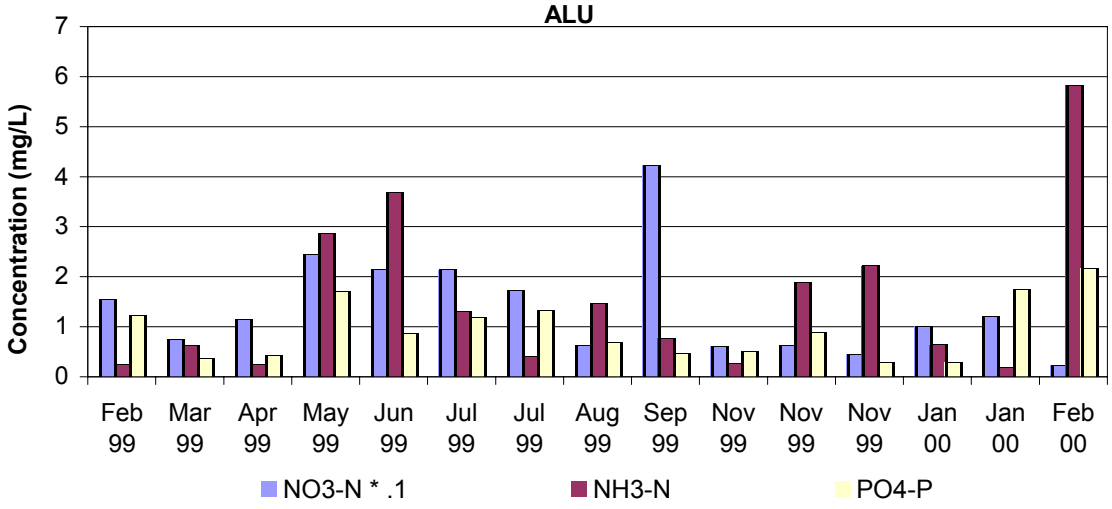


Figure 4.25 Nutrient times series for CCAMP site ALU.

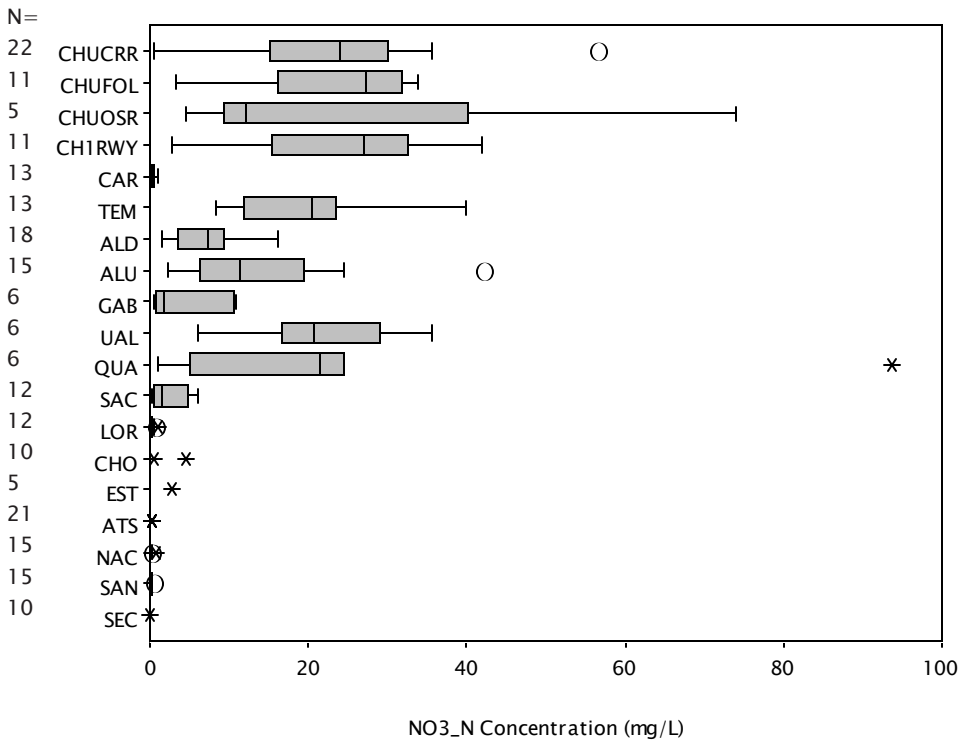


Figure 4.26 Nitrate-N data for selected CCAMP and Chualar sites.

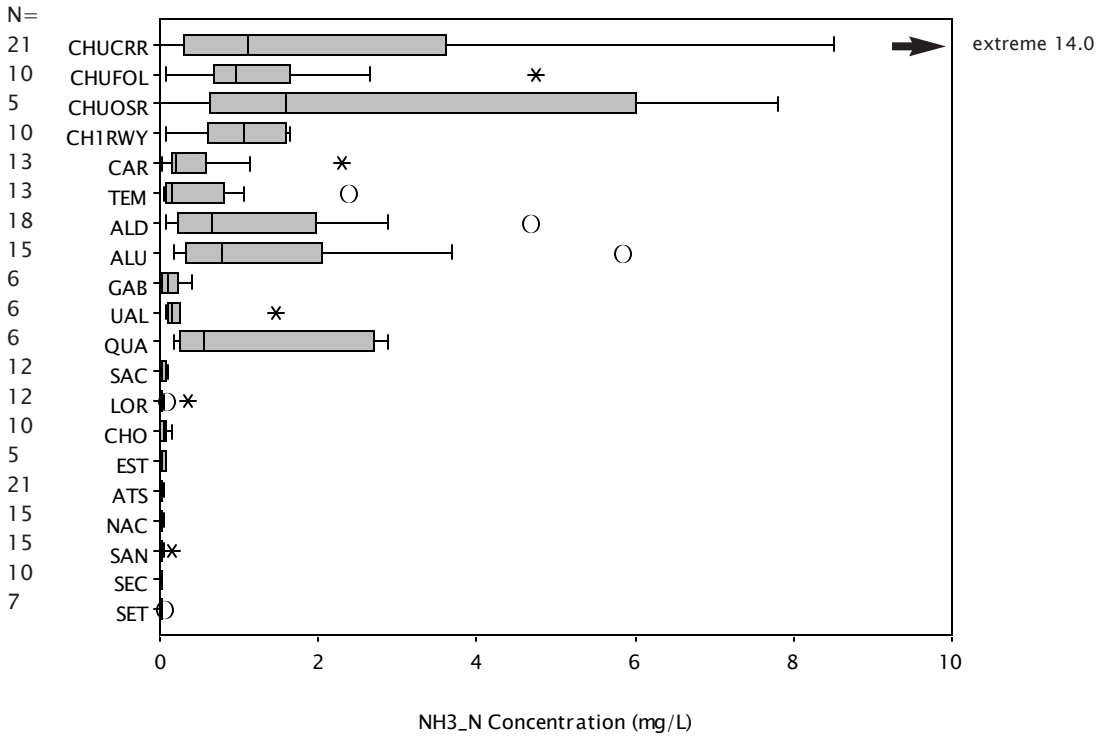


Figure 4.27 Ammonia-N data for selected CCAMP and Chualar sites.

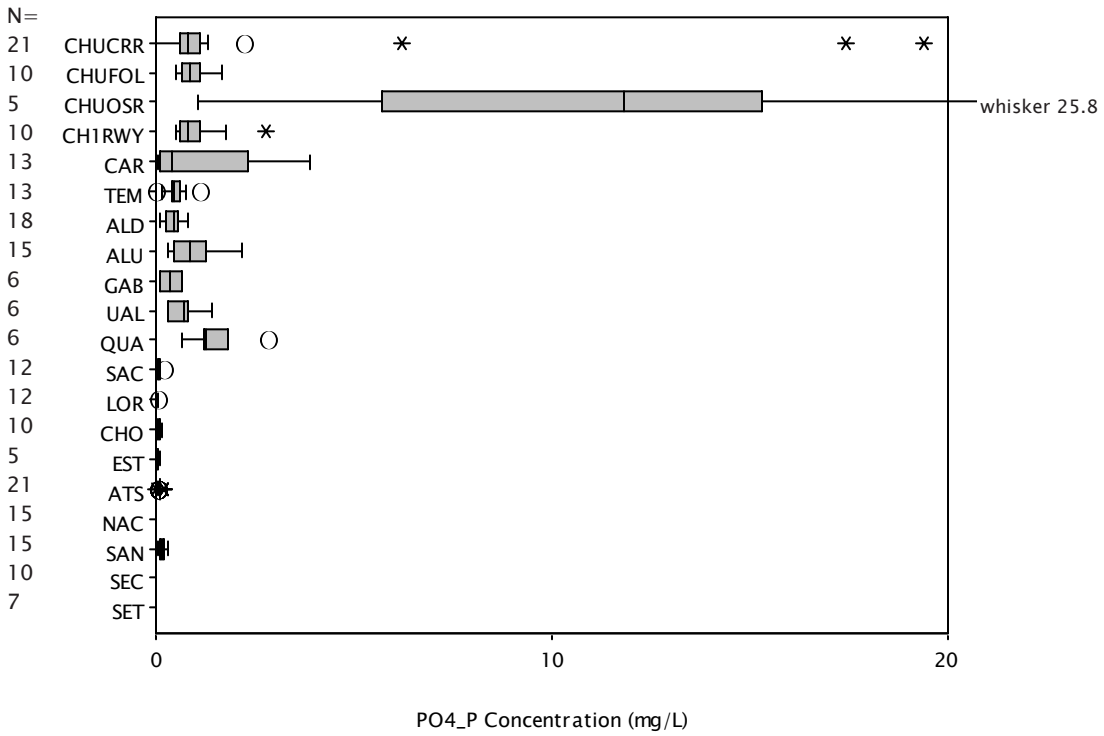


Figure 4.28 Orthophosphate-P data for selected CCAMP and Chualar sites.

4.5 Coliform

Samples were collected and analyzed for total coliform, fecal coliform, and E. coli at six sites throughout the Chualar pilot project area during the 2001/2002 monitoring period. The results of this monitoring are not included in this report because the coliform data are inconclusive at this time. Several reasons for this are:

> 1) In situ growth may occur in the waterway if an adequate source of carbon and nutrients are available. If so, high coliform values may be attributed to bacterial growth within the waterway rather than to an abundant source elsewhere entering the waterway.
> 2) There were no obvious signs of fecal contamination within the watershed. Sources of the coliform bacteria detected in Chualar Creek are unknown at this time.
> 3) There may be some members of the fecal coliform group that are not of fecal origin but can be detected by the analytical method.
> 4) There was high variation among and within sample sites.
> 5) There were inconsistencies when the results from different testing methods, such as membrane filtration and multiple tube fermentation, were compared.

The fecal coliform group and specifically E. coli are often used as indicators for waterborne pathogen presence and fecal contamination in waterways. Coliform bacteria are defined as aerobic and facultatively anaerobic, rod shaped, gram-negative, non-spore forming bacteria that produce gas upon lactose fermentation within 48 hours at 35o C (Maier et al. 2000). Some members of the coliform and fecal coliform groups are of fecal origin, while others are not. Coliform bacteria have many adaptations allowing them to persist in harsh environmental conditions, and these survival mechanisms may also enable in situ growth of coliform bacteria in aquatic environments. The rate of in situ survival (and potentially growth) in freshwater environments can be affected by a number of factors such as light, temperature, turbidity, nutrients, pH, and predation by organisms such as protozoa and other bacteria. The complex interactions of these environmental factors, the various life cycle stages of coliform bacteria, and the wide variety of environments in which they can live make it difficult to accurately measure fecal coliform levels using conventional methods. However, measuring levels of fecal coliform bacteria, which are often not pathogenic themselves, still remains one of the primary ways of indicating potential presence of actual pathogenic bacteria and viruses in waterways.

It is a distinct possibility that in situ bacterial growth may be occurring in Chualar Creek. If so, the issue may not solely be about bacterial sources, but rather about controlling conditions that promote growth. With an adequate source of carbon and nutrients, coliform growth growth can occur in waterways. Thus, the detection of elevated coliform levels in surface waters does not necessarily imply abundant sources. Much more work is needed before conclusions can accurate-

ly be made upon the coliform data that was collected as part of this study.

Coliform levels detected throughout the watershed were high enough to warrant further investigation and resulted in many unresolved issues and questions. Future studies should involve an intensive literature review to better understand the factors promoting bacterial growth in aquatic environments. Studies should be conducted to determine whether or not in situ growth is occurring in Chualar Creek. Future work should also identify potential sources and address them within the collaborative effort that is currently ongoing in this watershed. Continued monitoring with the possible addition of genetic ribotyping and/or polymerase chain reaction (PCR) analysis would allow for specific identification of the genetic source of coliform bacteria present in Chualar Creek.

4.6 Loads

Instantaneous loads for nitrate-N, ammonia-N, orthophosphate-P, and SSC were calculated for all sampling visits during which discharge measurements were made. Table 4.3 presents discharges and instantaneous loads for measured pollutants at the Chualar sites. Figure 4.29 shows the daily mean discharge for the Salinas River at the USGS Chualar station (USGS 2002), as well as the dates of the Chualar Creek monitoring. Although flow for Chualar Creek was generally low in comparison to major streams such as the Salinas River, significant loads of suspended sediment and nutrients were transported by Chualar Creek, particularly during the two storm events that were monitored.

4.6.1 March 2002 Event

The March 2002 rain event was brief, lasting only one day, and was not as intense as the December event. Based on precipitation data from the CIMIS Salinas South station, the total rainfall on 17 Mar 02 was approximately 17.5 mm (0.7 inches). A discharge of 96.3 L/s (3.4 cfs), was measured at site CHU-CCR during this rain event. This discharge transported some of the largest nutrient and sediment loads occurring during the monitoring period for Chualar Creek, with the exception of November and December 2002. For instance, the SSC load was 139 g/s, nitrate-N load was 2.8 g/s, ammonia-N load was 0.4 g/s, and orthophosphate-P load was 0.2 g/s. Site CHU-OSR was also monitored during this event. Although the discharge at CHU-OSR 16 L/s (0.6 cfs), was significantly less than at CHU-CRR, loads for SSC and orthophosphate-P were larger due to elevated concentrations. If the discharge and concentrations at CHU-CCR on March 2002 were hypothetically extended for a 24 hour period (a typical duration period for a moderate rain event), Chualar Creek could have transported as much as 12 tonnes of suspended sediment, 241 kg of nitrate-N, 30 kg of ammonia-N, and 19 kg orthophosphate-P.

Although sediment and nutrient loading provides a better understanding of the quality of water for Chualar Creek, it is also important to understand the effects that this loading may have on receiving waters. Figure 4.29 shows the daily mean discharge for the Salinas River at the USGS Chualar station (USGS 2002), as well as the dates of the Chualar Creek monitoring. Generally, the Chualar monitoring days coincided with low flows [less than 3,000 L/s (~100 cfs)] on the Salinas River, with the exception of a few storm events. For instance, during the March 2002 rain event, the Salinas River had a flow of less than 3,000 L/s (~100 cfs).

If Salinas River sediment and nutrient concentrations are low, and the river is at low flow, input from Chualar Creek may significantly impact pollutant concentrations in the Salinas River. For example, when 3 g/s of nitrate-N from Chualar Creek is mixed with a flow of 3,000 L/s (~100 cfs) from the Salinas River, then the nitrate-N concentration in the river increases by 1 mg/L. When one considers the number of creeks similar to Chualar Creek that drain into the Salinas River, the cumulative increase may be significant.

4.6.2 December 2002 Event

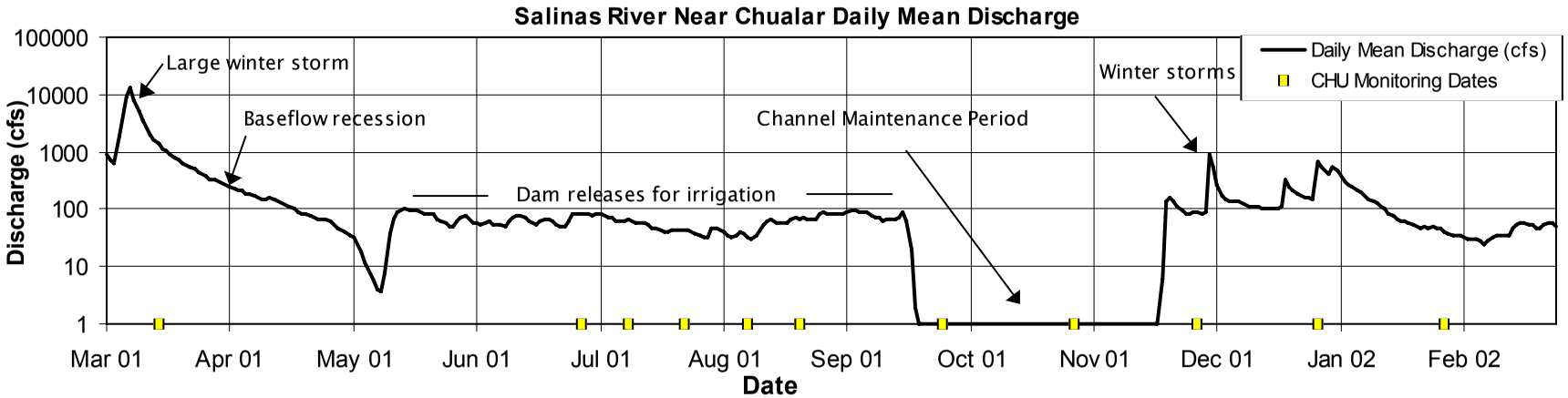
Larger discharges and instantaneous loads were measured during the December 2002 event. The rainfall total from December 13th to the 23rd was approximately 1.6 inches (40.6 mm) or greater. Data was retrieved from the CIMIS Salinas South Station and was flagged due to missing hourly data. Approximately 0.5 inches (12.7 mm) of rainfall was received on the 16th. At CHU-CRR discharge was 1.5 m^3/s (55 cfs) on December 16th and 2 m^3/s (73 cfs) on December 17th. Figure 4.32 shows measured and computed discharges for CHU-CRR (based on a stage vs. discharge curve constructed by CCoWS; see Figure 4.33), as well as hydrographs for the Reclamation Ditch and San Lorenzo Creek, the most similar USGS gaged creeks in the region. The instantaneous loads for suspended sediment and nutrients are presented in Table 4.3. The maximum estimated SSC load was 34,275 g/s, the nitrate-N load was 23.4 g/s, the ammonia-N load was 2.5 g/s, and orthophosphate-P load was 40 g/s. Figure 4.30 and 4.31 show sediment laden flow at CHU-CRR and CHU-CCR.

For comparison, daily mean discharge for the Salinas River at Chualar during the rain event ranged from 0.03 m^3/s (1 cfs) on December 16th to 31 m^3/s (1,100 cfs) on December 17th. Although sediment and nutrient loads for the the Salinas River were not measured during this particular event, loads can be estimated based on known flow (Figure 4.29) for the event and historical load data for that flow. Figures 4.34 to 4.37 show instantaneous loads that have been measured by CCoWS at sampling sites along the Salinas River. Thus, at a discharge between 10-20 m^3/s (350-700 cfs) for the Salinas River near Chualar, the expected range of NO3-N load is approximately 3 to 20 g/s, NH3-N load is approximately 0.3 to 2 g/s, PO4-P load is approximately 0.2 to 2 g/s, and suspended sediment load is approximately 400 to 100,000 g/s. With the exception of PO4-P, these ranges are of a similar order of magnitude to the instantaneous loads measured at CHU-CRR.

Discharges at CHU-CRR ranged from 1.5-2 m^3/s (50-70 cfs) during the December 2002 rain event . Figures 4.34 to 4.37, show that Chualar Creek was discharging loads of suspended sediment, nitrate-N, and ammonia-N equivalent to loads estimated for the Salinas River. Loads of orthophosphate-P from Chualar Creek were ten times the amount estimated to have been transported by the Salinas River. It can be inferred that during large storm events, such as this, sediment and nutrient loads from Chualar Creek may significantly increase and at times may double the sediment and nutrient load being transported by the Salinas River. This is despite the fact that the Chualar Creek watershed is approximately 1% of the area of the Salinas River watershed and that the discharge for Chualar Creek during this event was only 10% of the discharge for the Salinas River.

Table 4.3 Suspended Sediment and Nutrient Instantaneous Loads for Chualar Monitoring Sites.

Site Code	Date	Discharge (m^3/s)	Discharge (cfs)	SSC (g/s)	NO3-N (g/s)	NH3-N (g/s)	PO4-P (g/s)
CHU-CRR	17-Mar-02	0.0974	3.44	138.78	2.7943	0.3506	0.2143
CHU-CRR	24-Apr-02	0.039	1.38	26.07	0.8569	0.2126	0.0292
CHU-CRR	23-May-02	0.021	0.74	0.00	0.6179	0.0861	0.0140
CHU-CRR	28-Jun-02	0.048	1.7	5.29	2.7108	0.4080	0.0288
CHU-CRR	31-Jul-02	0.0603	2.13	1.41	1.2706	0.0259	0.0350
CHU-CRR	30-Aug-02	0.0379	1.34	0.70	1.0017	0.5306	0.0239
CHU-CRR	25-Sep-02	0.0047	0.17	2.29	0.0520	0.0015	0.0051
CHU-CRR	07-Nov-02	0.0032	0.11	0.32	0.0969	0.0005	0.0023
CHU-CRR	08-Nov-02	0.578	20.41	2795.17	14.3625	0.0289	3.5894
CHU-CRR	16-Dec-02	1.548	54.67	21635.78	23.4291	2.4768	26.9352
CHU-CRR	17-Dec-02	2.065	72.92	34275.07	8.3966	1.7966	40.0610
CHU-OSR	17-Mar-02	0.0162	0.57	163.63	1.2003	0.0972	0.2479
CHU-OSR	31-Jul-02	0.0043	0.15	2.89	0.0522	0.0335	0.0046
CHU-OSR	08-Nov-02	0.132	4.66	301.17	5.3077	0.0000	0.7564
CHU-OSR	16-Dec-02	1.246	44	21570.04	11.5402	1.9936	32.1468
CHU-OSR	17-Dec-02	0.38	13.42	2959.22	1.7168	0.2394	4.4840
CHU-CCR	14-Mar-01	0.0093	0.33	1.15	0.1092	0.0002	0.0060
CHU-CCR	16-Dec-02	0.22	7.77	2953.63	0.2982	0.1672	1.6368
CHU-CCR	17-Dec-02	0.078	2.75	122.57	0.0352	0.0156	0.1529
CHU-FOL	30-Oct-01	0.00074	0.03	0.07	0.0189	0.0035	0.0004
CHU-FOL	30-Nov-01	0.0009	0.03	0.10	0.0274	0.0024	0.0010
CHU-FOL	30-Dec-01	0.00078	0.03	0.04	0.0161	0.0004	0.0011
CH1-RWY	27-Sep-01	0.0301	1.06	4.53	0.9961	0.0322	0.0216
CH1-RWY	31-Jan-02	0.0218	0.77	47.52	0.0616	0.0053	0.0602



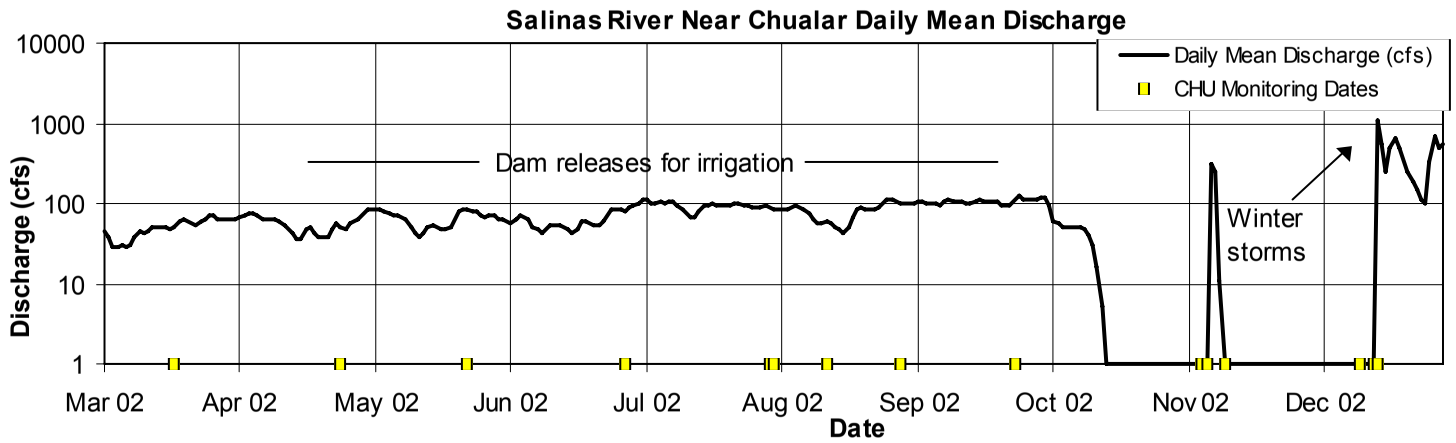


Figure 4.29 Daily mean discharge data for Salinas River near Chualar (USGS 2002).

Figure 4.30 Flow during December 2002 rain event at CHU-CRR (photo: Julie Hager 17 Dec 02).

Figure 4.31 Flow during December 2002 rain event at CHU-CCR (photo: Julie Hager 17 Dec 02).

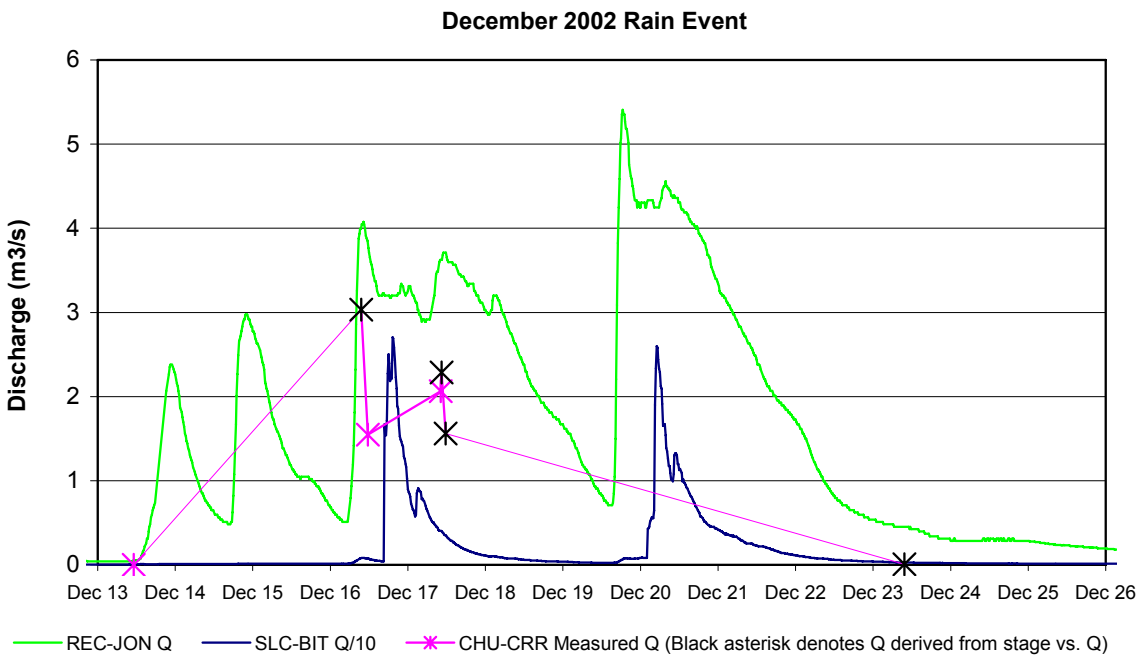


Figure 4.32 Hydrographs for December 2002 rain event. CHU-CRR (pink line) shows measured discharges as well as those estimated using a stage-discharge curve constructed by CCoWS. Hydrographs for the Reclamation Ditch at San Jon Road (REC-JON) and San Lorenzo Creek at Bitterwater Road (SLC-BIT) are based on hourly flow data from USGS (2002). Hydrographs for REC-JON and SLC-BIT, the two gaged sites in the region that are most similar to Chualar Creek, are displayed in order to give a rough estimate of the hydrograph shape at CHU-CRR.

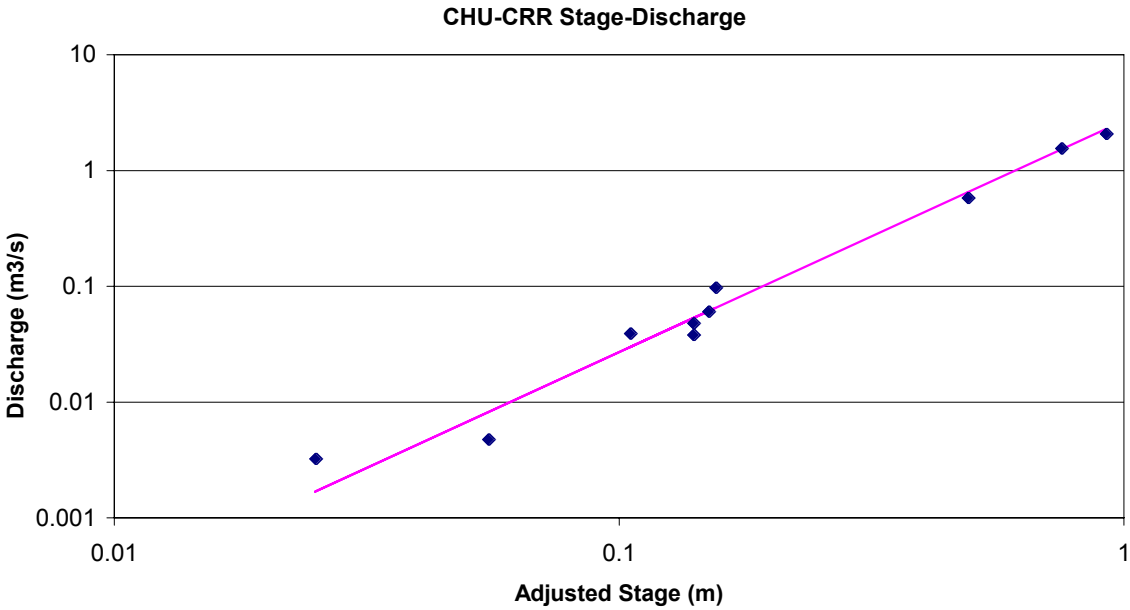


Figure 4.33 Stage-Discharge curve for CHU-CRR. Adjusted stage is measured stage minus the measured stage at which flow is zero.

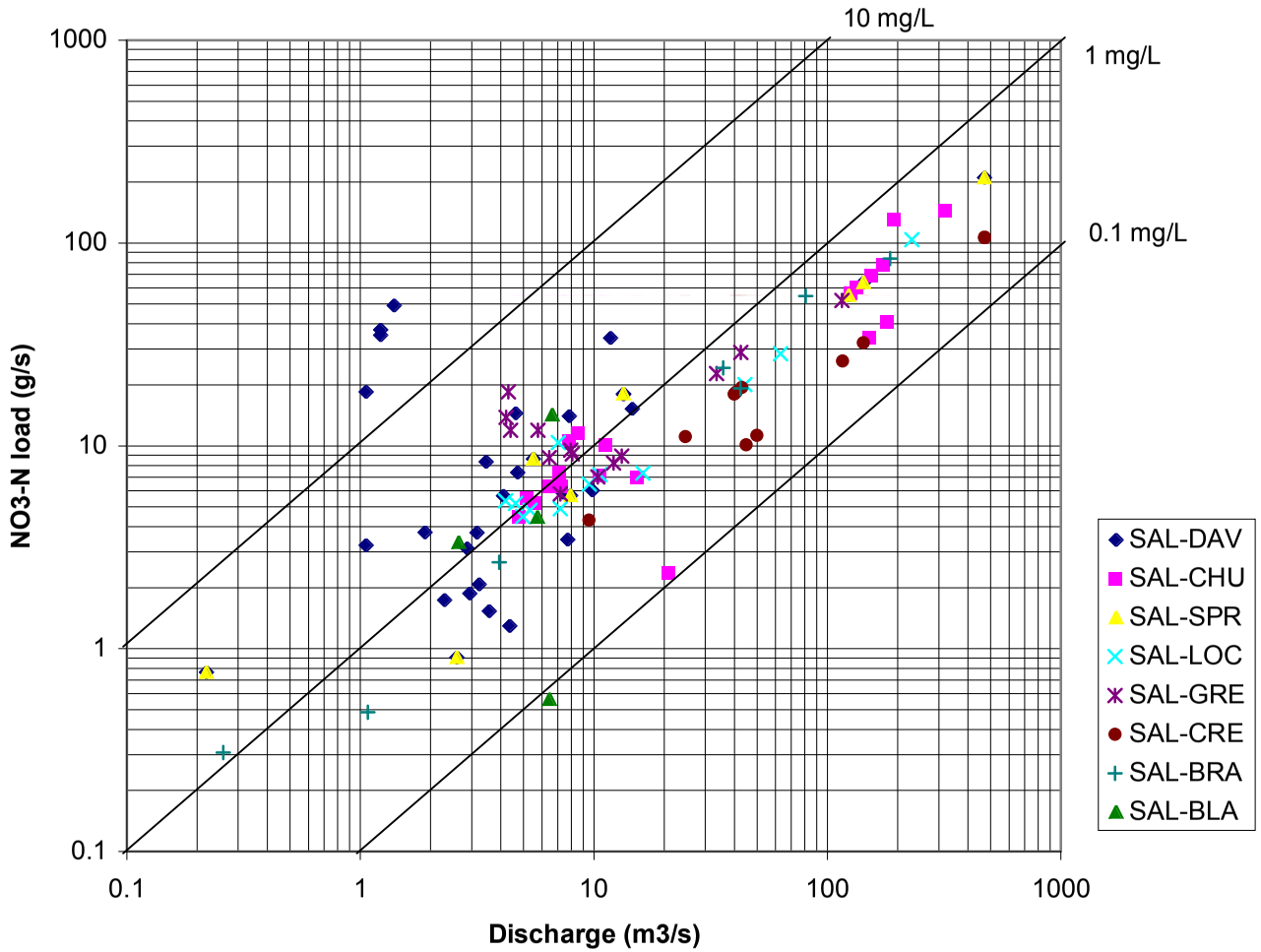


Figure 4.34 Nitrate-N instantaneous loads for selected CCoWS sampling sites along the Salinas River. Discharges were derived from stage vs. discharge curves constructed by CCoWS and based on a combination of CCoWS and USGS flow measurements. The black circles indicates the range of estimated instantaneous nitrate-N loads that occurred at Chualar site CHU-CRR during the December 2002 rain event. The pink circle indicates the estimated range of instantaneous nitrate-N loads for the Salinas River near Chualar at a flow range similar to the magnitude of flow that occurred on the Salinas River during the December 2002 event.

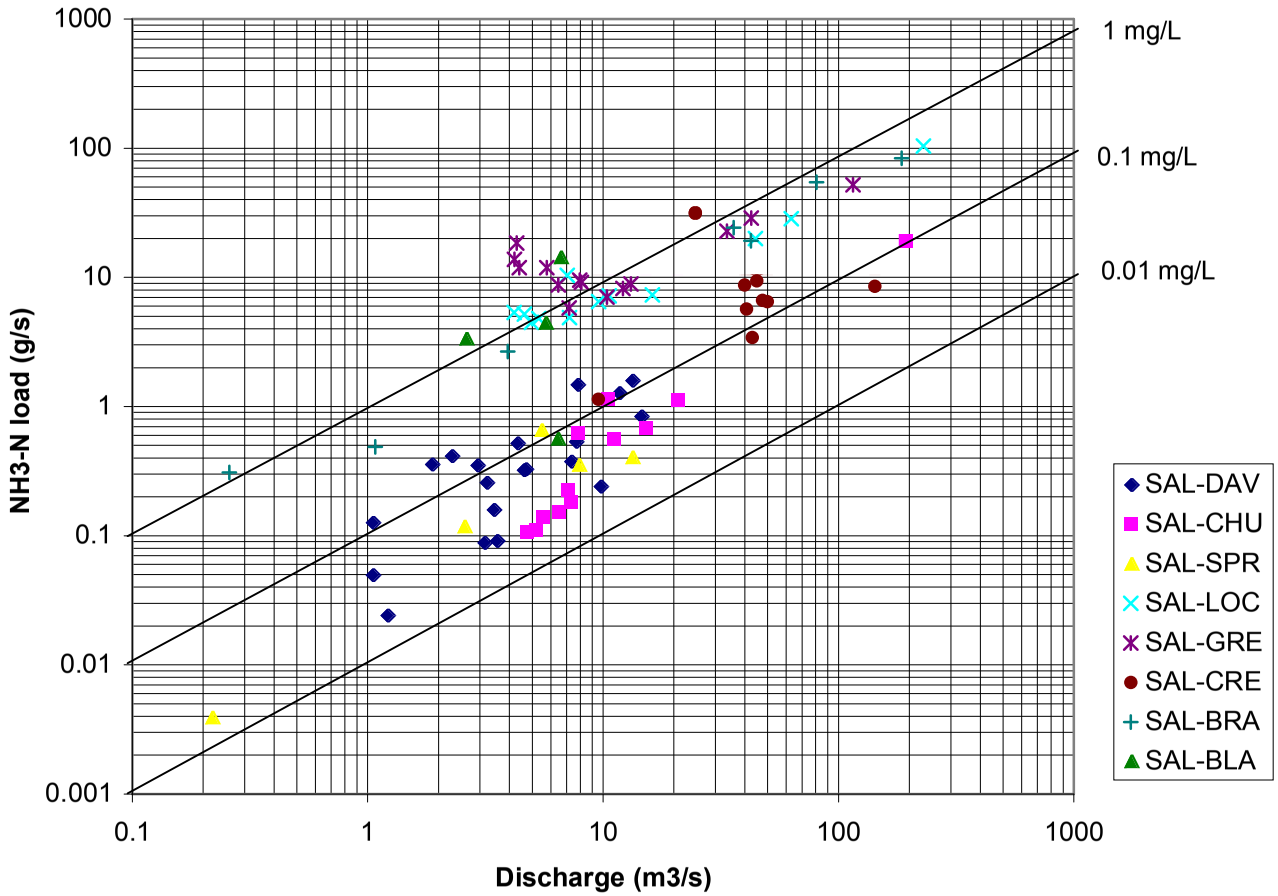


Figure 4.35 Ammonia-N instantaneous loads for selected CCoWS sampling sites along the Salinas River. Discharges were derived from stage vs. discharge curves constructed by CCoWS and based on a combination of CCoWS and USGS flow measurements. The black circles indicates the range of estimated instantaneous ammonia-N loads that occurred at Chualar site CHU-CRR during the December 2002 rain event. The pink circle indicates the estimated range of instantaneous ammonia-N loads for the Salinas River near Chualar at a flow range similar to the magnitude of flow that occurred on the Salinas River during the December 2002 event.

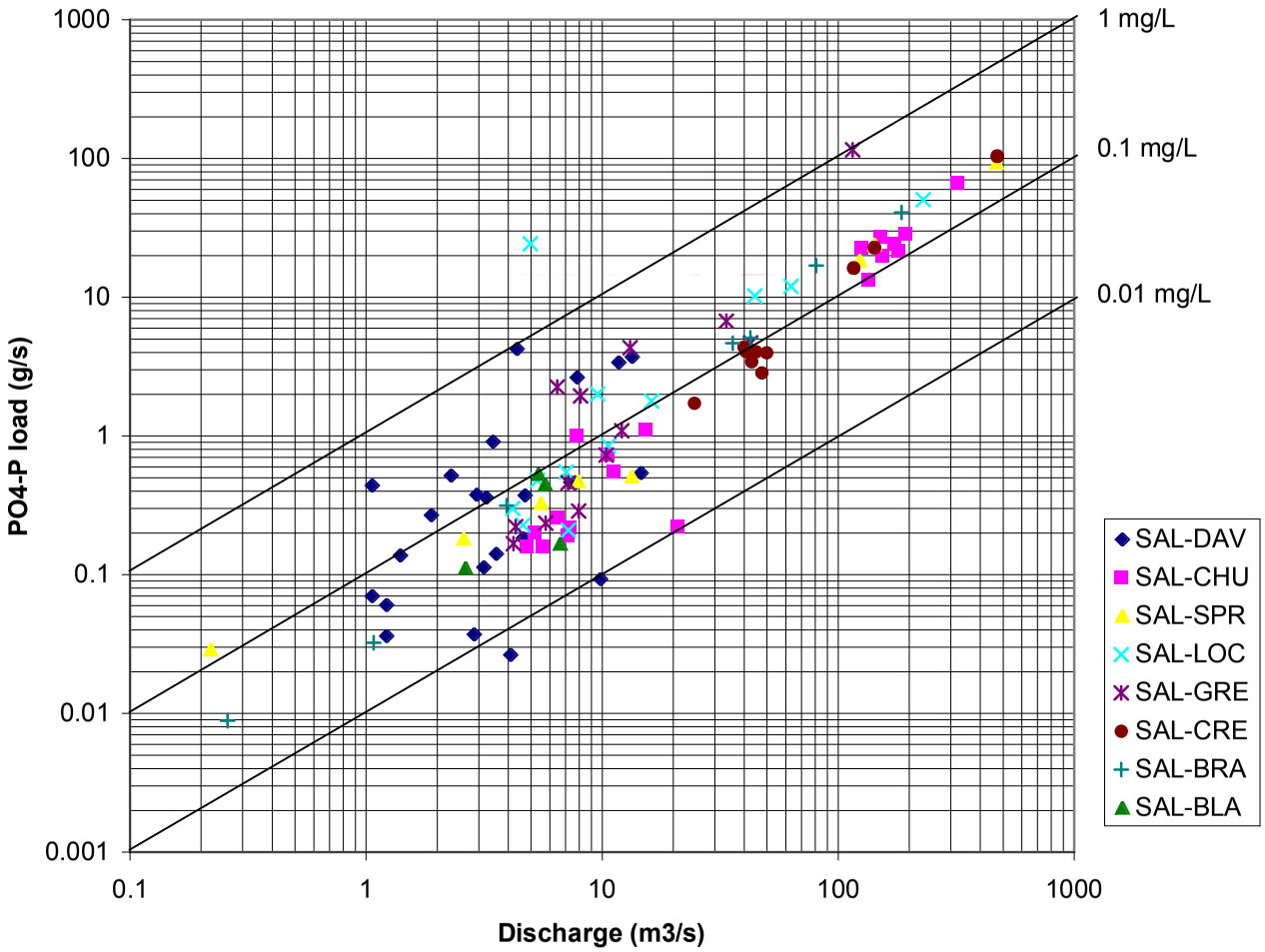


Figure 4.36 Orthophosphate-P instantaneous loads for selected CCoWS sampling sites along the Salinas River. Discharges were derived from stage vs. discharge curves constructed by CCoWS and based on a combination of CCoWS and USGS flow measurements. The black circles indicates the range of estimated instantaneous Orthophosphate-P loads that occurred at Chualar site CHU-CRR during the December 2002 rain event. The pink circle indicates the estimated range of instantaneous Orthophosphate-P loads for the Salinas River near Chualar at a flow range similar to the magnitude of flow that occurred on the Salinas River during the December 2002 event.

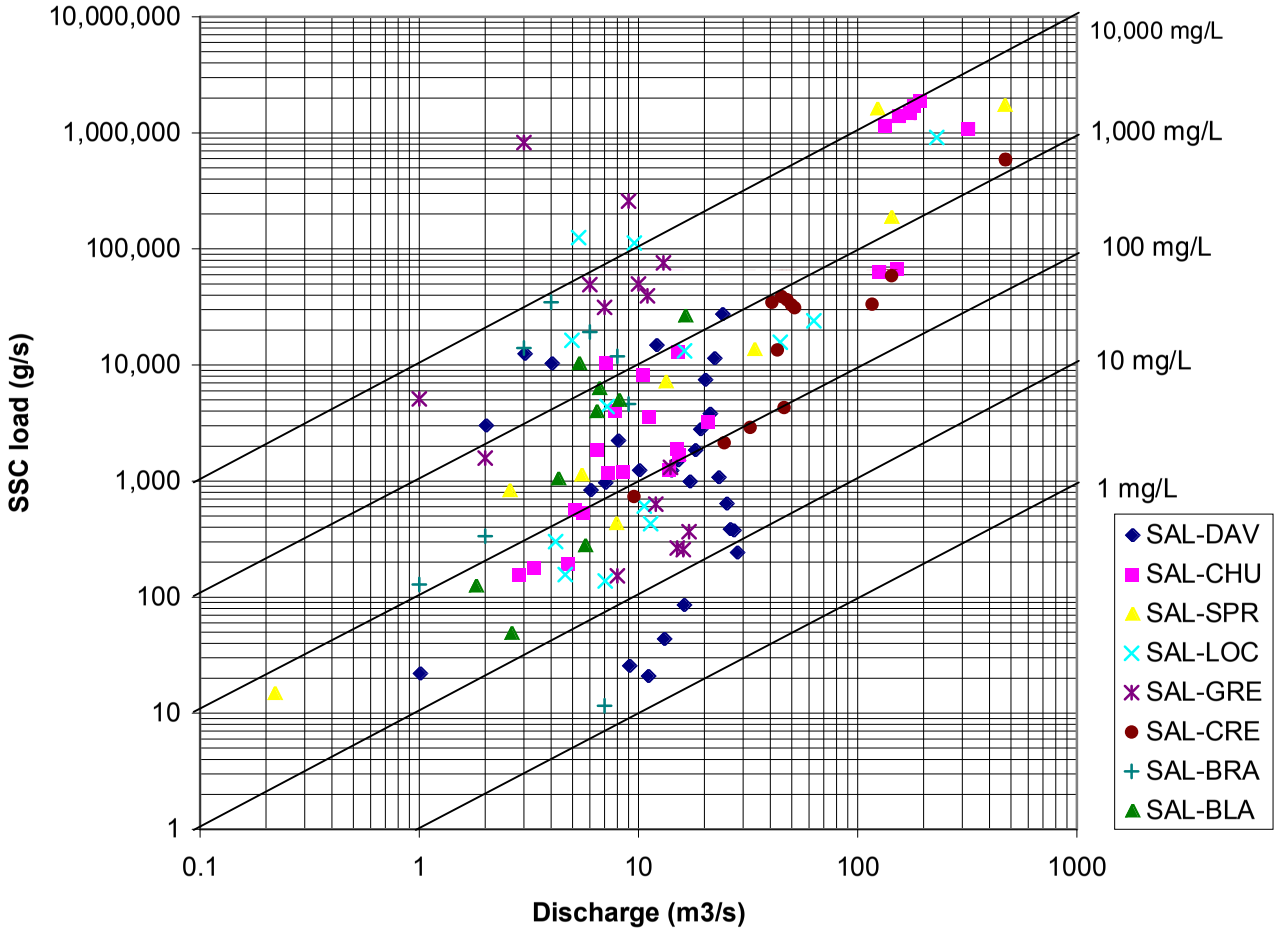


Figure 4.37 SSC instantaneous loads for selected CCoWS sampling sites along the Salinas River. Discharges were derived from stage vs. discharge curves constructed by CCoWS and based on a combination of CCoWS and USGS flow measurements. The black circles indicates the range of estimated instantaneous SSC loads that occurred at Chualar site CHU-CRR during the December 2002 rain event. The pink circle indicates the estimated range of instantaneous SSC loads for the Salinas River near Chualar at a flow range similar to the magnitude of flow that occurred on the Salinas River during the December 2002 event.

5 Conclusions

Specific beneficial uses for Chualar Creek have not been identified in the Basin Plan for the Central Coast region of California. The primary beneficial use for Chualar Creek, especially the lower reaches, is agriculture, and the creek would not be considered as an ideal place for for other uses such as recreation, fishing, or aesthetic enjoyment. However, it does drain into the Salinas River, which has a wide range of beneficial uses such as recreation and aquatic habitat.

The headwaters of Chualar Creek rarely flow, however downstream reaches generally flow the entire year due to agricultural tail water input, except after rain events when irrigation is not occurring. After a full year of monitoring the water quality of Chualar Creek, high levels of suspended sediment, nutrients, and coliform have been detected. Levels for these pollutants were above, often far above, the objectives and criteria recommended by the USEPA and the State Water Resources Control Board. The results of the monitoring thus far, suggest that water quality in Chualar Creek is highly degraded. However, when compared to CCAMP data for the region, the high values measured at Chualar Creek are comparable to other sites in the Salinas Valley, especially sites in the northeastern part of the valley. The CCAMP sites with the highest values were generally creeks that had been previously converted to channelized agricultural drainages. Chualar Creek is thus a typical agricultural drainages of this region, characterized by degraded water quality, a lack of riparian vegetation, and a loss of any potential for beneficial uses other than agricultural production.

The results of the monthly monitoring did not reveal any significant trends. Concentrations of the various water quality constituents seem to vary throughout the year, with elevated levels occurring both in the summer and winter months. Continued intense and consistent monitoring is needed in order to detect any trends and/or improvements in the water quality for Chualar Creek.

The results of sampling during two storm events demonstrated that Chualar Creek can contribute a significant load of nutrients and sediment to the Salinas River. During the December 2002 event, Chualar Creek discharged pollutants loads similar in capacity to estimated loads simultaneously being transported by the Salinas River. However, with increased implementation of agricultural practices to improve water quality and manage runoff, these loads can be significantly reduced.

Many agricultural practices are currently in place and increasing within the Chualar Creek Pilot Project area that may significantly improve the water quality of Chualar Creek. The watershed working group will help to facilitate the conversion to these practices and also track management practice implementation within the Chualar Creek watershed. With the continued participation of growers and ranchers in the program, it is very likely that within 10 years, improvements in the water quality of Chualar Creek and remediation of many of the problems addressed in this document will be observed. Chualar Creek farmers are a major part of this process, and it is important that they receive information

on which practices to implement as well as agency and community support for implementation.

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