



SWAMP Annual Work Plan for the Central Coast Region 2006-07

## Central Coast Ambient Monitoring Program Work Plan for the 2007 Santa Maria Watershed Rotation Area

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## Table of Contents

<b>FIVE YEAR PLAN.....</b>	<b>2</b>
INTRODUCTION .....	2
CCAMP MISSION AND GOALS .....	3
CCAMP MONITORING QUESTIONS AND OBJECTIVES .....	3
GENERAL CHARACTERIZATION OF THE CENTRAL COAST REGION .....	6
CCAMP MONITORING APPROACHES .....	7
<i>Evaluation of existing sources of data</i> .....	8
<i>General monitoring design</i> .....	8
MONITORING METHODS .....	9
<i>Conventional Water Quality</i> .....	9
<i>Sediment Chemistry</i> .....	11
<i>Toxicity Sampling</i> .....	11
<i>Beneficial use assessment</i> .....	13
CCAMP MONITORING SITES .....	13
DELIVERABLES .....	18
<b>ANNUAL PLAN.....</b>	<b>19</b>
MONITORING APPROACH .....	20
SITE-SPECIFIC MONITORING ACTIVITIES .....	21
MONITORING METHODS .....	25
<i>Conventional Water Quality</i> .....	25
<i>Sediment Chemistry</i> .....	26
<i>Toxicity Sampling</i> .....	27
WATERSHED CHARACTERIZATIONS .....	28
<b>Soda Lake Hydrologic Unit 311.00</b> .....	28
<b>Santa Maria Hydrologic Unit 312.00</b> .....	28
BUDGET .....	30
<b>BIBLIOGRAPHIC REFERENCES.....</b>	<b>36</b>
<b>APPENDIX A. SUMMARY OF CENTRAL COAST WATERSHED CHARACTERISTICS AND CONDITIONS .....</b>	<b>41</b>
<b>Big Basin Hydrologic Area 304</b> .....	41
<b>Aptos Creek – Hydrologic SubArea 304.13</b> .....	42
<b>Soquel Creek – Hydrologic SubArea 304.13</b> .....	42
<b>San Lorenzo River Watershed – Hydrologic Subarea 304.12</b> .....	43
<b>Pajaro River Hydrologic Unit 305</b> .....	46
<b>Soda Lake Hydrologic Unit 311</b> .....	60
<b>Santa Maria Hydrologic Unit 312</b> .....	61

## **Five Year Plan**

### **Introduction**

Fiscal Year (FY) 2006-07 will mark the fifth year of the coordinated implementation of the Surface Water Ambient Monitoring Program (SWAMP). The Central Coast Ambient Monitoring Program (CCAMP) conducts SWAMP monitoring for the Central Coast Water Board and receives the bulk of its funding through SWAMP. A general description of the monitoring efforts that will be implemented in Region 3 through CCAMP over the next five years is provided in this document. Specific monitoring planned for 2006-07 is described in more detail.

The basic CCAMP study design has been in place since the inception of the CCAMP program in 1998. CCAMP employs a tributary-based approach to characterize all major waterbodies in the Region, as well as larger tributary inputs to those waterbodies. Long-term monitoring sites are selected at major tributary inputs and at the mainstem upstream of each tributary input, and “focused” monitoring sites are placed at other locations of interest in the watershed (such as above and below specific land uses, point sources, best management practices, or other areas in need of characterization).

The CCAMP program monitors and assesses all major waterbodies in the Region using two monitoring strategies: 1) coastal confluences monitoring, which involves long term trend monitoring at the lower ends of all of the larger coastal streams and rivers in the Region, and 2) watershed rotation area monitoring, where the Region is divided into five watershed areas and tributary based sampling is conducted each year in one of the areas (Figure 1). Over a five-year period all of the Hydrologic Units in the Region are monitored and evaluated. Watershed sites are revisited on a five year basis, allowing detection of change over time.

One of the primary purposes of CCAMP is to support the Clean Water Act 303(d) listing process and the 305(b) water quality assessment report. Assessment is consistent with the State’s 303(d) Listing Policy (2004), in following one of two decision-making approaches to determine if beneficial uses are supported: 1) percent exceedance of water quality criteria or other accepted standards, using a binomial distribution (10% exceedance with 90% certainty), or 2) a weight-of-evidence approach, where data from multiple types of monitoring (biological, physical and chemical) are considered to evaluate beneficial use support. This latter approach is particularly important when evaluating problems for which no water quality criteria exist.

CCAMP data is also heavily used by permit staff, enforcement staff, and others for regulatory and management decision-making. The CCAMP program addresses a wide variety of water quality parameters and beneficial use questions with the intent providing information to inform further action by agency staff. The sampling design strives to provide a maximal amount of information within one sampling framework to support this broad mission. Further follow-up through enforcement staff, TMDL staff or others provides additional detail to understand the full scope of problems identified by CCAMP.

## CCAMP Mission and Goals

The CCAMP mission statement is to collect, assess and disseminate water quality information to aid decision makers and the public in maintaining, restoring and enhancing water quality and associated beneficial uses in the Central Coast Region. General programmatic goals of the CCAMP monitoring program are to:

- Determine the status and trends of surface, estuarine and coastal water quality and associated beneficial uses in the Central Coast Region
- Coordinate with other data collection efforts
- Provide information in easily accessible forms to support decision-making

The scope of CCAMP monitoring activities in estuarine and marine areas is minimal because of program funding constraints. Characterization of these areas is being undertaken primarily through grant funding, restructured permit monitoring and collaboration with other agency programs. Within the five year period addressed by this work plan, no SWAMP funds are anticipated for regional assessment work in estuaries or marine areas.

## CCAMP Monitoring Questions and Objectives

CCAMP questions have been adapted from those posed in the 1999 SWAMP Site-Specific Monitoring Guidance related to beneficial use support. For each question, we have identified objectives, one or more associated beneficial uses, applicable water quality criteria that address these objectives, and the monitoring approach we are following. In addition, we have identified the limitations associated with our monitoring approach. We are screening widely for beneficial use support under a uniform monitoring strategy that is consistent with the requirements of the 303(d) listing policy. Given program funding and staffing, this maximizes the information we provide to decision-makers for their use and further investigation.

### **Is there evidence that it is unsafe to swim?**

#### **Are swimming conditions improving or getting worse?**

**Beneficial Use:** Water Contact Recreation (REC-1)

**Objective(s):** At sites throughout water bodies that are used for swimming, or that drain to areas used for swimming, screen for indications of bacterial contamination by determining percent of samples exceeding adopted water quality objectives and EPA mandated objectives. Screen for statistically significant annual trends at sites where at least two years of data has become available, using Seasonal Kendall or other non-parametric tests for significance. CCAMP data as well as data collected by local agencies and organizations will be used to assess shoreline and creek conditions.

**Monitoring Approach:** Monthly monitoring for indicator organisms (e.g. *E. coli*, fecal coliform, *Enterococcus sp.*); compilation of other data sources

**Assessment Limitations:** CCAMP currently samples for *E. coli*, fecal coliform and total coliform; assessments are typically based on these parameters. Trend assessment is conducted only where at least two years of monthly data are available for analysis.

**Criteria:**

- 10% of total samples over 400 MPN/100 mL fecal coliform
- 10% of total samples over 235 MPN/100 mL *E. coli*
- Statistically significant annual trends, based on Seasonal Kendall or other non-parametric tests for significance.

**Is there evidence that it is unsafe to drink the water?**

**Is there evidence that drinking water quality is improving or getting worse?**

**Beneficial Use:** Municipal and Domestic Water Supply (MUN)

**Objective(s):** At sites throughout water bodies that are sources of drinking water or recharge ground water, determine percent of samples that exceed drinking water standards or adopted water quality objectives used to protect drinking water quality. Screen for statistically significant annual trends at sites where at least two years of monthly data has become available,

**Monitoring Approach:** Monthly sampling for nitrate and pH.

**Assessment Limitations:** At this time, CCAMP does not sample for metals or organic chemicals in water; assessment is based on objectives for conventional parameters only.

**Criteria:**

- Nitrate (as N) over 10 mg/L
- pH under 6.5 or above 8.3
- Statistically significant annual trends, based on parametric or non-parametric tests for significance, as appropriate.

**Is there evidence that it is unsafe to eat fish or other aquatic resources?**

**Beneficial Uses:** Commercial and Sport Fishing (COMM), Shellfish Harvesting (SHELL)

**Objective(s):** At sites located near the lower ends of streams and rivers, and in lakes, enclosed bays and estuaries, screen for chemical pollutants by determining the concentration of chemical contaminants in fish and shellfish samples, and assessing whether samples exceed several critical threshold values of potential human impact (advisory or action levels).

**Monitoring Approach:** Fish and mussel tissue collection and chemical analysis

**Assessment Limitations:** The typical array of chemicals analyzed by the SWAMP program does not contain most currently applied pesticides, pharmaceuticals, and numerous other synthetic organic chemicals. At this time, sampling does not occur with sufficient sample count or regularity to conduct trend assessment at most sites. Because of funding shifts, sampling is primarily conducted through the SWAMP Statewide bioaccumulation sampling strategy; consequently sampling location does not necessarily coincide with watershed rotation monitoring. CCAMP opportunistically evaluates data collected through SWAMP, grant projects, and other sources.

**Criteria:**

- Exceedances of Office of Environmental Health Hazard Assessment Criteria, U.S. Food and Drug Administration Action Levels (USFDA, 1984) or National academy of Sciences Guidelines for fish and shellfish tissue (NAS, 1973)

**Is there evidence that aquatic life is not protected?**

**Are there significant trends in conditions for aquatic life?**

**Beneficial Uses:** Cold Freshwater Habitat (COLD); Warm Freshwater Habitat (WARM); Spawning (SPAWN)

**Objective(s):** At sites along the main stem and at the lower ends of major tributaries of streams and rivers, screen for indications of water quality and sediment degradation for aquatic life and related uses, using several critical threshold values of toxicity, biostimulation, benthic community condition, habitat condition, and physical and chemical condition.

**Monitoring Approach:** Spring synoptic sampling for sediment and water column toxicity, sediment chemistry, benthic invertebrate assemblages, and associated habitat quality. Toxicity Identification Evaluation and/or chemistry follow-through for toxic sites. Monthly conventional water quality monitoring for nutrients, dissolved oxygen, pH, turbidity and water temperature. Pre-dawn or 24-hour continuous sampling for dissolved oxygen sags.

**Assessment Limitations:** CCAMP samples sediment for an array of metals and organic chemicals commonly analyzed by the State Mussel Watch Program. This array does not contain all currently applied pesticides, pharmaceuticals, and numerous other synthetic organic chemicals. Habitat sampling is conducted only in association with benthic invertebrate sampling and is not comprehensive. Trend assessment is limited to data with sufficient sample count for statistical reliability (primarily monthly chemical sampling and bioassessment), at sites where at least two years of data has become available.

**Criteria:**

- Sediment or water toxicity effects significantly greater than reference tests and survival, growth, or reproduction less than 80% of control
- Sediment concentrations of organic chemicals above detection limits
- Tissue concentrations of organic chemicals over established U.S. Fish and Wildlife and National Academy of Sciences guidelines for protection of aquatic life. Tissue concentrations for chemicals without guidelines above detection limits.
- Dissolved oxygen levels lower than 7.0 mg/L in cold water streams and 5.0 mg/l in warm water streams
- pH levels lower than 7.0 or above 8.5
- Unionized ammonia levels over 0.025 mg/L as N
- Biostimulatory risk rank falls above scoring range of high quality sites (>0.4)
- Index of Biotic Integrity falls below scoring range of high quality sites (<6.0)
- Statistically significant annual trends, based on parametric or non-parametric tests for significance, as appropriate.

**Is there evidence that water is unsafe for agricultural use?**

**Is there evidence of trends in water quality for agricultural uses?**

**Beneficial Use:** Agricultural supply (AGR)

**Objective(s):** At sites throughout waterbodies that are used for agricultural purposes, determine percent of samples with concentrations of chemical pollutants above screening values or adopted water quality objectives used to protect agricultural uses. Screen for statistically significant annual trends at sites where at least two years of data have become available.

**Monitoring Approach:** Monthly sampling for nutrients and salts.

**Assessment Limitations:** CCAMP does not typically sample for all of the parameters identified in the Central Coast Water Quality Control Plan for protection of agricultural beneficial uses.

**Criteria:**

- pH below 6.5 or above 8.3
- Electrical conductivity over 3000 for salinity
- Chloride over 106 mg/L
- Boron over 5.0 mg/L
- Sodium over 69 mg/L
- Ammonium over 30 mg/L
- Nitrate over 30 mg/L as N
- Statistically significant annual trends, based on parametric or non-parametric tests for significance, as appropriate.

**Is there evidence of impairment to aesthetics or other non-contact recreational uses?**

**Beneficial Use: Non-Contact Water Recreation (REC-2)**

**Objective(s):** At sites throughout waterbodies that are used for non-contact recreation, screen for indications of bacterial contamination by determining the percent of samples exceeding adopted water quality objectives and assess aesthetic condition for protection of non-contact water recreation

**Monitoring Approach:** Monthly sampling for pathogen indicator organisms (*E. coli*, total and fecal coliform); monthly qualitative assessment of % algal cover, presence of scum, odor, trash etc.

**Assessment Limitations:** Qualitative data may have relatively large sampling error.

**Criteria:**

- pH under 6.5 or over 8.3
- 10% of samples over 4000 MPN/100 ml fecal coliform
- Dry weather turbidity persistently over 10 NTU
- Algal cover persistently over 25%
- Scum, odor, trash, oil films present

**General Characterization of the Central Coast Region**

A summary of water quality and general characteristics of each of the Hydrologic Units of the Central Coast Region is provided in Appendix A. Each of these Hydrologic Units (and several larger Hydrologic Subareas) is monitored continuously (monthly) at a long-term coastal confluence site, just above saltwater influence. The Santa Maria and Soda Lake Hydrologic Units, the rotational areas for 2006-07, are also described in the Annual work plan portion of this document.

## Intra- and Inter-agency Coordination

CCAMP staff is coordinating with other Region 3 staff and other programs to ensure consistency with SWAMP in data gathering methods, data quality objectives, and data reporting formats.

Table 1 summarizes monitoring activities in Region 3.

**Table 1. Intra- and Inter-agency monitoring in coordination with CCAMP.**

Monitoring Activity	Monitoring Program description	Available Data Format	Using SWAMP QAMP	Using SWAMP reviewed QAPP	Data format SWAMP compatible	Data used for 303(d) and 305(b) analysis
CCAMP	CCAMP watershed rotation monitoring.	R3 has data in electronic format (SWAMP compatible)	X		X	X
CCAMP	CCAMP coastal confluences monitoring at creek mouths.	Ongoing. R3 has data in electronic format (SWAMP compatible)	X		X	X
TMDL	TMDL monitoring for loading assessments in Region 3 streams including Pajaro, Aptos, San Lorenzo, Chorro, Los Osos, San Luis Obispo, Santa Maria and a number of tributary streams.	Data currently being collected and planned over the next several years. R3 has most data available in electronic format				X
Cooperative Monitoring Program for Agriculture	Agriculture monitoring is required in association with irrigation discharge waiver	Program provides data to CCAMP in SWAMP batch upload format and has a SWAMP reviewed QAPP		X	X	X
Grant Projects	Contractors are required to meet with Region 3 quality assurance staff in the first quarter of the grant, to discuss development of the QAPP, Monitoring Plan, and data management.	Data will be submitted in electronic format using SWAMP batch upload templates. Most QAPP are SWAMP reviewed.		X	X	X
Sanctuary Integrated Assessment and Monitoring Project (SAM)	This grant project is accumulating multiple data sources into the SWAMP batch upload format for assessment purposes	SWAMP batch upload format; data sources are evaluated for consistency with SWAMP QAPP		X	X	X

## CCAMP Monitoring Approaches

The CCAMP strategy of establishing and maintaining permanent long term monitoring sites provides a framework for trend analysis and detection of emerging water quality problems. CCAMP uses a variety of monitoring approaches to characterize status and trends of watersheds. The CCAMP program design includes monthly monitoring for conventional water quality (CWQ) and flow at all sites. At a subset of sites, generally selected based on availability of funds and hydrogeomorphological considerations or special interest (such as known discharges or existing TMDLs) other monitoring approaches are applied. These include toxicity, sediment



chemistry, tissue chemistry, benthic macroinvertebrate and habitat assessment. As funding increases these additional monitoring approaches will be applied to more sites.

In order to develop a broad picture of the overall health of waters in Region 3, a similar baseline monitoring approach is applied in each watershed and coastal confluence site. This provides data comparability across the Region and allows for prioritization of problems across a relatively large spatial scale. Watershed characterization involves three major components: acquisition and evaluation of existing data, monitoring of surface water and habitat quality, and developing a watershed assessment based on findings.

### **Evaluation of existing sources of data**

Existing sources of data are evaluated for pollutants of concern, historic trends, data gaps, etc. These include Department of Health Services, USGS, Department of Fish and Game, Department of Pesticide Regulation, Toxic Substances Monitoring Program, NPDES discharge data, and other sources. Data from County, City, and other selected programs are also acquired. CCAMP also utilizes previous CCAMP data as well as data collected by other Regional Board monitoring programs, including the irrigated agriculture waiver monitoring program, stormwater monitoring programs and TMDL monitoring. Selected data is compiled into the CCAMP data base format and used along with current data collected by CCAMP to evaluate criteria exceedances, pollutant levels which warrant attention, beneficial use impairment, and other pertinent information. These data are also evaluated prior to initiation of monitoring in a watershed rotation areas to determine if the site list needs to be modified.

### **General monitoring design**

Monitoring sites selection is based on several factors. For all sites (rotation area and coastal confluence) safe, all-weather access is a priority for monthly conventional water quality monitoring activities. Many sites are located at bridges where sampling devices can be suspended during periods of high flow. Watershed site selection targets the primary discharge point of the watershed, the discharge of major tributary which drains the watershed, and multiple locations along the main stem usually upstream from major tributary inputs. Some sites are also located above and below areas of significant human activity, including urban development, agriculture, and point source discharges.

Watershed rotation monitoring began in 1998 in the Pajaro watershed. The watershed rotation schedule moves from the Pajaro and Big Basin area, to the Salinas, the Santa Maria, the Santa Barbara coast, and finally the Santa Lucia coast, over the course of five years. Monthly watershed rotation area monitoring begins in January of a given year and extends 15 months. At a subset of the watershed rotation area sites additional monitoring is conducted. Rapid bioassessment for benthic invertebrates is conducted upstream of conventional water quality sites (100m), out of the immediate influence of bridges in two consecutive springs (April – June). Sediment toxicity is also collected at this time. Water column toxicity is conducted at conventional water quality sampling locations twice annually, in wet and dry season flows. Sediment chemistry is conducted at the end of the fiscal year, in June, and is limited by remaining laboratory contract funds.

Coastal confluence monitoring was initiated in 2001 at 33 of the Region's coastal streams and rivers. Coastal confluences program sites were selected based on watershed size and/or known water quality concerns in the watershed. Sampling sites are located on the lowest reach of the creek or river but above the coastal lagoon and tidal influence whenever possible. Site selection is constrained by site accessibility. Monthly conventional water quality monitoring is ongoing at these sites. When funding allows additional monitoring includes bioassessment for benthic invertebrates, toxicity and sediment chemistry. Continuous monitoring of these waters just upstream of their confluence with the Pacific Ocean is used for long term trend analysis, information on pollutant loading to the ocean, and to provide regular information on watersheds that are not the focus of the current watershed rotation area monitoring.

### **Monitoring Methods**

CCAMP uses a variety of monitoring approaches to characterize status and trends at monitoring sites. The CCAMP program design includes monthly monitoring for conventional water quality (CWQ) and flow at all sites. At a subset of sites other monitoring approaches are applied. These include sediment chemistry and toxicity, tissue chemistry, benthic macroinvertebrate assessment and habitat assessment.

### **Conventional Water Quality**

Basic conventional pollutants are monitored monthly at all coastal confluence and watershed rotation sites following the CCAMP SOP (Puckett, 2002). Monthly sampling provides an opportunity to evaluate seasonal variability as well as a variety of flow conditions.. Sampling is maintained on an even monthly interval without regard for timing of weather events. Even-interval sampling can be evaluated for long-term trends using time-series analysis techniques, such as the Mann-Kendall or seasonal Kendall tests described by the U.S. EPA in its guidance on Nonpoint Source Monitoring (EPA 1997).

CCAMP uses a multi-analyte probe to measure several parameters in the field, and collects grab samples to be analyzed by the Regional Board's contract laboratory. A Hydrolab DS4a multi-analyte probe is used to collect data for dissolved oxygen, pH, water temperature, turbidity, conductivity, salinity and chlorophyll *a*. All field equipment is calibrated using certified calibration standards and following the manufacturer specifications prior to and following each sampling event. Calibration records are maintained at the Region 3 laboratory and are used to determine instrument accuracy. Field probe measurements are stored electronically in the field and downloaded directly to the database. All field measurements (100%) are checked against the field data sheet for accuracy. In the field, observations of air temperature, algal growth, scum, odor, and other indications of water and habitat conditions are also recorded.

Flow is estimated using a number of means. Wherever possible, sites are located near existing county and USGS gages. At other sites, flow is directly measured using a top setting rod and pygmy bucket wheel. Flow measurements are taken at a minimum of ten locations across a transect; if the wetted width is more than 20 feet additional measurements are taken. When flow is not measurable it is estimated using stream profiles, stage gages and flow calibration curves. In some locations flow measurements are not possible.

Samples to be analyzed by the Regional Board’s contract laboratory are collected at each site in clean bottles provided by the contract laboratory. Blind field replicates are collected for 5% of samples collected. Water samples are bottled as appropriate and held at 4°C, before being transferred to the laboratory for analysis. Chain-of-Custody (COC) documentation is maintained for all samples. Samples are analyzed for analytes shown in Table 2. Quality assurance procedures at the laboratory are consistent with SWAMP approved quality assurance requirements and follow U.S. EPA approved methods (BC Laboratories 2006). The SWAMP Quality Assurance Program Plan specifies target reporting limits for specific analyses (Puckett 2002).

Table 2. Conventional water quality parameters and methods

Analyte	Method
Nitrate as N	EPA 300.0
Nitrite as N	EPA 353.2
Total Ammonia as N	EPA 350.1
Total Phosphorus as P	EPA 365.4
Orthophosphate as P	EPA 365.1
Total Dissolved Solids	EPA 160.1
Fixed and Volatile Dissolved Solids	EPA 160.4
Hardness as CaCO <sub>3</sub>	SM 2340B
Total Suspended Solids	EPA 160.2
Fixed and Dissolved Suspended Solids	EPA 160.4
Calcium	EPA 200.7
Magnesium	EPA 200.7
Boron, dissolved	EPA 200.7
Sodium	EPA 200.7
Chloride	EPA 300.0
Total and Fecal Coliform	25-tube dilution
E. coli	Colilert

### **Benthic Macroinvertebrate and Physical Habitat Sampling**

Benthic macroinvertebrate assemblages are indicators of stream health. Different species of invertebrates respond differently to water pollution and habitat degradation and provide information on biological integrity. Benthic macroinvertebrate community assemblages will be sampled at nine coastal confluence sites and five Santa Maria watershed rotation sites. There are several sites in the lower Santa Maria and Oso Flaco watersheds that are monitored by the Ag waiver program. Benthic invertebrates are collected each spring at these sites and this data is available in SWAMP importable formats.

Benthic macroinvertebrate communities are sampled using protocols and quality assurance guidance modified from Western Environmental Monitoring and Assessment Program (WEMAP) protocols and is currently being reviewed by SWAMP for statewide approval. These

standard operating procedures will be available by the 2007 monitoring season. Two samples are collected from each site. At all sites, a composite sample is collected using a multi-habitat approach in which one sample is collected at each of eleven transects evenly spaced throughout a 150 meter reach. When riffle habitat is available a second composite sample is collected from eight randomly identified one by one foot quadrates within the riffles. This sample collection methodology is called targeted riffle. When stream morphology limits riffle habitat, the second composite sample targets stream margins. One grab is collected at each of eleven transects evenly spaced throughout a 150 meter reach; each of these is collected by alternating between margin and center habitats.

Physical habitat quality is assessed at each sampling reach according to State protocols, using the habitat assessment scoring methods developed by the SWAMP bioassessment committee, and modeled after the WEMAP protocol for physical habitat. The habitat of the creek reach of interest is characterized according to geomorphic parameters, including bankfull width, slope, particle size, sinuosity, depth and other features. Geomorphic characteristics, drainage area and upstream river miles are considered during data evaluation.

### **Sediment Chemistry**

Some organic chemicals are found adhered to fine sediments; metals can also be found at elevated concentrations in sediment. Organic chemicals and metals may also bioaccumulate in the tissues of aquatic organisms and at elevated concentrations can be directly toxic. The Central Coast Basin Plan has a narrative objective for pollutants in sediment, and therefore CCAMP utilizes several peer-reviewed criteria to evaluate sediment data for probable effects, including NOAA Effects Range Medium values (ERMs) (Long, et al, 1998) and Florida Probable Effects Levels (PELs) (MacDonald et al., 1992, 1996). Laboratory analysis includes polyaromatic hydrocarbons, organochlorine and organophosphate chemicals, metals, particle size distribution, and total organic carbon. The SWAMP Quality Assurance Management Plan (QAMP) contains detailed information on QA/QC procedures, methods and reporting limits (Puckett 2002).

### **Toxicity Sampling**

CCAMP staff will collect two water samples and one sediment sample for toxicity analysis at five watershed rotation area sites and at nine coastal confluence sites. For sediment toxicity, pre-cleaned Teflon™ scoops are used to collect the top 2 cm of sediment from five or more locations at each site. The scooped samples are collected in a pre-cleaned glass composite jar. The sample is subsequently homogenized thoroughly and aliquoted into pre-cleaned sample jars (as appropriate) for chemical or toxicological analysis. Samples are then stored at 4°C and shipped with appropriate COC and handling procedures to the analytical laboratories. Bed sediment sampling procedures are detailed in the SWAMP QAMP (Puckett 2002).

Ten-day sediment toxicity testing is performed at the UC Davis – Granite Canyon Marine Pollution Control Laboratory using *Hyalella azteca* according to standard EPA protocols (EPA 2000). For each sediment sample, eight replicates each containing 10 *H. azteca* individuals are tested. Endpoints recorded after ten days are survival and growth (as dry weight). The Granite Canyon quality assurance/quality control procedures and standard operating procedures in the SWAMP QAMP provide more information on these analyses (Puckett 2002).

CCAMP staff collects water samples for toxicity analysis, targeting both wet weather (November – January) and base flows (May – July). Three test species are used for each sampling event; *Ceriodaphnia dubia* (water fleas), *Pimephales Promelas*, (fathead minnows) and *Selanastrum capricornatum* (algal species). Water collection follows SWAMP Standard Operating Procedures (SOP). Five percent of samples are collected in duplicate for quality assurance purposes. Samples are stored at 4°C and shipped with appropriate COC and handling procedures to the analytical laboratories.

**Beneficial use assessment**

In the Central Coast Region's Basin Plan (CCRWQCB 1994), virtually all major rivers and streams and their immediate tributaries are designated for commercial and sport fishing, contact and non-contact recreation, groundwater recharge, municipal and domestic supply, cold water fisheries, spawning, and migration beneficial uses. Many also support threatened and endangered species and biological habitats of special significance. Because these important beneficial uses tend to be universal in the Region and require most stringent water quality objectives, the CCAMP suite of indicators targets these beneficial uses particularly, and is applied uniformly to all sites.

**CCAMP Monitoring Sites**

Locations to be monitored for each of five watershed rotation years and for ongoing coastal confluences monitoring are shown in Table 3. All sites are monitored for conventional water quality. A subset of these sites is monitored for benthic macroinvertebrates, sediment chemistry, toxicity, and tissue bioaccumulation.

**Table 3. Central Coast Ambient Monitoring Program Site List**

Rotation Year	HSA	Waterbody	Site Tag	Site Description
Ongoing	30413	Aptos Creek	304APT	304APT-Aptos Creek @ Spreckles Drive
Ongoing	30420	Gazos Creek	304GAZ	304GAZ-Gazos Creek above lagoon @ Highway 1
Ongoing	30412	San Lorenzo River	304LOR	304LOR-San Lorenzo above estuary @ Laurel Street
Ongoing	30411	Scott Creek	304SCO	304SCO-Scott Creek Lagoon @ Highway 1
Ongoing	30413	Soquel Creek	304SOK	304SOK-Soquel Creek @ Knob Hill
Ongoing	30411	Waddell Creek	304WAD	304WAD-Waddell Creek Lagoon @ Highway 1
Ongoing	30510	Pajaro River	305THU	305THU-Pajaro River @ Thurwachter Bridge
Ongoing	30700	Carmel River	307CML	307CML-Carmel River @ Highway 1
Ongoing	30800	Big Creek	308BGC	308BGC-Big Creek above Highway 1
Ongoing	30800	Big Sur River	308BSR	308BSR-Big Sur River @ Andrew Molera foot bridge
Ongoing	30800	Willow Creek	308WLO	308WLO-Willow Creek @ Highway 1
Ongoing	30910	Salinas River (Lower)	309DAV	309DAV-Salinas River @ Davis Road
Ongoing	30910	Old Salinas River	309OLD	309OLD-Old Salinas River @ Monterey Dunes Way
Ongoing	30910	Tembladero Slough	309TDW	309TDW-Tembladero Slough @ Molera Road
Ongoing	31012	Arroyo de la Cruz Creek	310ADC	310ADC-Arroyo de la Cruz @ Highway 1
Ongoing	31031	Arroyo Grande Creek(below res.)	310ARG	310ARG-Arroyo Grande Creek @ 22nd Street
Ongoing	31026	Pismo Creek	310PIS	310PIS-Pismo Creek above Highway 101
Ongoing	31025	San Luis Obispo Creek	310SLB	310SLB-San Luis Obispo Creek @ San Luis Bay Drive
Ongoing	31014	Santa Rosa Creek	310SRO	310SRO-Santa Rosa Creek @ Moonstone Drive
Ongoing	31013	San Simeon Creek	310SSC	310SSC-San Simeon Creek @ State Park foot bridge
Ongoing	31022	Chorro Creek	310TWB	310TWB-Chorro Creek @ South Bay Boulevard
Ongoing	31210	Santa Maria River	312SMA	312SMA-Santa Maria River above Estuary
Ongoing	31300	San Antonio Creek	313SAI	313SAI-San Antonio Creek @ San Antonio Road West
Ongoing	31410	Santa Ynez River(below res.)	314SYN	314SYN-Santa Ynez River @ 13th Street
Ongoing	31532	Arroyo Burro Creek	315ABU	315ABU-Arroyo Burro Creek @ Cliff Drive
Ongoing	31531	Atascadero Creek(315)	315ATA	315ATA-Atascadero Creek @ Ward Drive
Ongoing	31534	Carpinteria Creek	315CRP	315CRP-Carpinteria Creek below Carpenteria Ave
Ongoing	31534	Franklin Creek	315FRC	315FRC-Franklin Creek @ Carpenteria Avenue
Ongoing	31510	Canada de la Gaviota	315GAV	315GAV-Canada de la Gaviota @ State Park entrance
Ongoing	31532	Mission Creek	315MIS	315MIS-Mission Creek @ Montecito Street
Ongoing	31534	Rincon Creek	315RIN	315RIN-Rincon Creek @ Bates Road, u/s Highway 101
Ongoing	31510	Jalama Creek	315JAL	315JAL-Jalama Creek u/s County Park @ Rail Road Trussels
Ongoing	30800	Little Sur River	308LSR	308LSR-Little Sur River @ Highway 1
2006	30600	Carneros Creek	306CAR	306CAR-Carneros Creek in Los Lomas @ Blohm Road
2006	30910	Salinas Reclamation Canal	309ALD	309ALD-Salinas Reclamation Canal @ Boranda Road
2006	30910	Salinas Reclamation Canal	309ALU	309ALU-Salinas Reclamation Canal @ Airport Road
2006	30981	Atascadero Creek(309)	309ATS	309ATS-Atascadero Creek @ Highway 41
2006	30910	Salinas Reclamation Canal	309AXX	309AXX-Salinas Reclamation Canal Storm Drain @ Airport Road
2006	30940	Salinas River (Mid)	309DSA	309DSA-Salinas River d/s San Ardo @ Cattleman Road
2006	30920	Gabilan Creek	309GAB	309GAB-Gabilan Creek @ Independence and East Boranda
2006	30930	Salinas River (Mid)	309GRN	309GRN-Salinas River @ Elm Road in Greenfield
2006	30940	Salinas River (Mid)	309KNG	309KNG-Salinas River @ Highway 101 in King City
2006	30940	San Lorenzo Creek	309LOK	309LOK-San Lorenzo Creek @ First Street in King City
2006	30970	San Lorenzo Creek	309LOR	309LOR-San Lorenzo Creek @ Bitterwater Road east of King City
2006	30981	Nacimiento River(below res.)	309NAC	309NAC-Nacimiento River above Highway 101

2006	30981	Salinas River (Upper)	309PSO	309PSO-Salinas River @ 13th Street in Paso Robles
2006	30920	Quail Creek	309QUA	309QUA-Quail Creek @ Potter Road
2006	30910	Santa Rita Creek	309RTA	309RTA-Santa Rita Creek @ Santa Rita Park
2006	30910	Salinas River (Lower)	309SAC	309SAC-Salinas River @ Chualar bridge on River Road
2006	30981	San Antonio River(below res.)	309SAN	309SAN-San Antonio River @ Highway 101
2006	30981	Salinas River (Upper)	309SAT	309SAT-Salinas River @ Highway 41 bridge
2006	30910	Salinas River (Lower)	309SDR	309SDR-Salinas Storm Drain u/s Davis Road
2006	30910	Salinas River (Mid)	309SAS	309SAS-Salinsa River @ Soledad Highway 101 bridge
2006	30960	Arroyo Seco River	309SEC	309SEC-Arroyo Seco River @ Elm Street
2006	30930	Arroyo Seco River	309SET	309SET-Arroyo Seco River @ Thorne Road
2006	30981	Salinas River (Upper)	309SUN	309SUN-Salinas River u/s Nacimiento @ Bradley Road
2006	30910	Tembladero Slough	309TEM	309TEM- Tembladero Slough @ Preston Road
2006	30981	Salinas River (Upper)	309USA	309USA-Salinas River u/s San Ardo @ the Bradley Bridge
2006	31700	Cholame Creek	317CHO	317CHO-Cholame Creek @ Bitterwater Road
2006	31700	Estrella River	317ESE	317EST-Estrella River @ Estrella Road
2006	31700	Estrella River	317EST	317EST-Estrella River @ Airport Road
2007	31100	Soda Lake	311SLN	311SLN-Soda Lake Culverts @ Seven Mile Road
2007	31230	Alamo Creek	312ALA	312ALA-Alamo Creek at Alamo Creek Road
2007	31210	Blosser Channel	312BCD	312BCD-Blosser Channel d/s of groundwater recharge ponds
2007	31210	Bradley Cyn Creek	312BCF	312BCF-Bradley Canyon diversion channel @ Foxen Canyon Road
2007	31210	Bradley Channel	312BCU	312BCU-Bradley Channel u/s of ponds @ Magellan Drive
2007	31220	LaBrea Creek	312BRE	312BRE-LaBrea Creek us Sisquoc River
2007	31230	Cuyama River(above res.)	312CAV	312CAV-Cuyama River @ Highway 33
2007	31230	Cuyama River(above res.)	312CCC	312CCC-Cuyama River d/s Cottonwood Canyon
2007	31230	Cuyama River(below res.)	312CUT	312CUT-Cuyama River below Twitchell @ White Rock Lane
2007	31230	Cuyama River(above res.)	312CUY	312CUY-Cuyama River d/s Buckhorn Road
2007	31230	Huasna River	312HUA	312HUA-Husana River @ Husana Townsite Road
2007	31210	Green Valley Creek	312GVS	312GVS-Green Valley Creek @ Simas Road
2007	31210	Green Valley Creek Tributary	312GVT	312GVT-Green Valley Creek Tributary @ Brown Road
2007	31210	Main Street Canal	312MSD	312MSD-Main Street Canal u/s Ray Road @ Highway 166
2007	31210	Main Street Canal	312MSS	312MSS-Main Street Canal East of Hansen Street
2007	31210	Nipomo Creek	312NIP	312NIP-Nipomo Creek @ Highway 166
2007	31210	Nipomo Creek	312NIT	312NIT-Nipomo Creek @ Tefft Street
2007	31210	Oso Flaco Creek	312OFC	312OFC-Oso Flaco Creek @ Oso Flaco Lake Road
2007	31210	Oso Flaco Lake	312OFL	312OFL-Oso Flaco Lake @ culvert
2007	31210	Oso Flaco Creek Triutary	312BSR	312BSR-Oso Flaco Creek Tributary at Bonita School Road
2007	31210	Little Oso Flaco Creek	312OFN	312OFN-Little Oso Flaco Creek
2007	31210	Betteravia Lakes	312OLA	312OLA-Betteravia Lakes at Black Road
2007	31210	Orcutt Solomon Creek	312ORB	312ORB-Orcutt-Solomon Creek @ Black Road
2007	31210	Orcutt Solomon Creek	312ORC	312ORC-Orcutt-Solomon Creek u/s Santa Maria River
2007	31210	Orcutt Solomon Creek	312ORI	312ORI-Orcutt-Solomon Creek @ Highway 1
2007	31210	Orcutt Solomon Creek	312ORS	312ORI-Orcutt-Solomon Creek @ Solomon Road
2007	31210	Santa Maria River	312SBC	312SBC-Santa Maria River @ Bull Canyon Road
2007	31220	Sisquoc River	312SIS	312SIS-Sisquoc River @ Santa Maria Way
2007	31220	Sisquoc River	312SIV	312SIV-Sisquoc River u/s Tepusquet Road
2007	31210	Santa Maria River	312SMI	312SMI-Santa Maria River @ Highway 1
2008	31300	San Antonio Creek	313SAB	313SAB-San Antonio Creek @ Rancho de las Flores Bridge, Hwy 135
2008	31300	San Antonio Creek	313SAC	313SAC-San Antonio Creek @ RR Bridge - Lagoon



2008	31410	San Miguelito Creek	314MIG	314MIG-San Miguelito Creek @ W. North Ave
2008	31410	Salsipuedes Creek(314)	314SAL	314SAL-Salsipuedes Creek @ Santa Rosa Road
2008	31410	Santa Ynez River(below res.)	314SYC	314SYC-Santa Ynez River d/s Lake Cachuma @ Highway 154
2008	31410	Santa Ynez River(below res.)	314SYF	314SYF-Santa Ynez River d/s Lompoc @ Floordale
2008	31410	Santa Ynez River(below res.)	314SYI	314SYI-Santa Ynez River @ Highway 101
2008	31410	Santa Ynez River(below res.)	314SYL	314SYL-Santa Ynez River u/s Lompoc @ Highway 246
2008	31410	Santa Ynez River(above res.)	314SYP	314SYP-Santa Ynez River @ Paradise Road
2008	31532	Arroyo Burro Creek	315ABH	315ABH-Arroyo Burro Creek @ Hope Street
2008	31531	Glenn Annie Creek	315ANN	315ANN-Glenn Annie Creek u/s Hollister Road
2008	31534	Arroyo Paredon	315APC	315APC-Arroyo Paredon Creek @ Via Real
2008	31531	Atascadero Creek(315)	315ATU	315ATU-Atascadero Creek @ Patterson Avenue
2008	31510	Bell Creek	315BEL	315BEL-Bell Creek on Bacara Resort Access Road
2008	31510	El Capitan Creek	315CAP	315CAP-El Capitan Creek d/s Highway 101
2008	31534	Carpinteria Creek	315CAU	315CAU-Carpenteria Creek @ Highway 192
2008	31531	Devereux Slough	315DEV	315DEV-Devereux Slough @ the Golf Course culvert
2008	31510	Dos Pueblos Canyon Creek	315DOS	315DOS-Dos Pueblos Canyon Creek @ Highway 101
2008	31510	Canada de la Gaviota	315GAI	315GAI-Canada de la Gaviota @ Highway 1
2008	31531	Los Carneros Creek	315LCR	315LCR-Los Carneros Creek @ Hollister Road
2008	31532	Mission Creek	315MIU	315MIU-Mission Creek @ Cathedral Oaks Road
2008	31532	Montecito Creek	315MTC	315MTC-Montecito Creek @ Jamison Lane
2008	31531	Maria Ygnacio Creek	315MYC	315MYC-Maria Ynacio Creek @ Patterson Avenue
2008	31533	Romero Creek	315ROM	315ROM-Romero Creek @ Jamison Lane
2008	31510	Canada del Refugio	315RSB	315RSB-Canada del Refugio u/s Highway 101
2008	31533	Sycamore Creek	315SCC	315SCC-Sycamore Creek @ Punta Gorda Street
2008	31531	San Jose Creek	315SJC	315SJC-San Jose Creek @ Kellogg Boulevard
2008	31534	Santa Monica Creek	315SMC	315SMC-Santa Monica Creek @ Carpenteria Avenue
2008	31531	San Pedro Creek	315SPC	315SPC-San Pedro Creek d/s of Hollister Road
2008	31510	Tecolote Creek	315TCI	315TCI-Tecolote Creek @ Bacara Resort access Road
2008	31534	Toro Canyon Creek	315TOR	315TOR-Toro Canyon Creek @ Via Real
2008	31532	San Ysidro Creek	315YSI	315YSI-San Ysidro Creek @ Jamison Lane
2009	31022	Chorro Creek	310CAN	310CAN-Chorro Creek @ Canet Road
2009	31023	Warden Creek	310TUR	310TUR-Warden Creek @ Turri Road
2009	30700	Carmel River	307CMD	307CMD-Carmel River @ Schulte Road
2009	30700	Carmel River	307CMN	307CMN-Carmel River @ Nason Road, Community Park
2009	30700	Carmel River	307CMU	307CMU-Carmel River @ Esquiline Road
2009	30700	Tularcitos Creek	307TUL	307TUL-Tularcitos Creek @ Carmel Valley Road
2009	30800	Big Sur River	308BSU	308BSU-Big Sur River @ Pfeiffer Big Sur State Park
2009	30800	Garrapata Creek	308GAR	308GAR-Garapata Creek @ Garapata Creek Road
2009	30800	Limekiln Creek	308LIM	308LIM-Limekiln Creek @ Limekiln State Park
2009	30800	Little Sur River	308LSU	308LSU-Little Sur River @ Old Coast Road
2009	30800	Mill Creek	308MIL	308MIL-Mill Creek @ Mill Creek Picnic Area
2009	30800	San Jose Creek	308SJC	308SJC-San Jose Creek @ Private Road Access
2009	31031	Arroyo Grande Creek(below res.)	310AGB	310AGB-Arroyo Grande Creek @ Biddle Park
2009	31031	Arroyo Grande Creek(below res.)	310AGF	310AGF-Arroyo Grande Creek @ Fair Oaks
2009	31031	Arroyo Grande Creek(below res.)	310AGS	310AGS-Arroyo Grande Creek @ Strother Park
2009	31031	Los Berros Creek	310BER	310BER-Los Berros Creek @ Valley Road
2009	31016	Cayucos Creek	310CAY	310CAY-Cayucos Creek @ Cayucos Creek Road and Highway 1
2009	31025	Coon Creek	310COO	310COO - Coon Creek @ Pecho Valley Road

2009	31021	Morro Creek	310MOR	310MOR-Morro Creek @ Lila Keiser Park
2009	31017	Old Creek(above res.)	310OLD	310OLD-Old Creek @ Cottontail Creek Road
2009	31013	Pico Creek	310PCO	310PCO-Pico Creek @ Highway 1
2009	31024	Prefumo Creek	310PRE	310PRE-Prefumo Creek @ Calle Joaquin
2009	31024	Stenner Creek	310SCN	310SCN-Stenner Creek @ Nipomo street
2009	31011	San Carpofofo Creek	310SCP	310SCP-San Carpofofo Creek @ Highway 1
2009	31024	San Luis Obispo Creek	310SLC	310SLC-San Luis Obispo Creek @ Cuesta Park
2009	31024	San Luis Obispo Creek	310SLM	310SLM-San Luis Obispo Creek @ Mission Plaza
2009	31024	San Luis Obispo Creek	310SLV	310SLV-San Luis Obispo Creek @ Los Osos Valley Road
2009	31014	Santa Rosa Creek	310SRU	310SRU-Santa Rosa Creek @ Ferrasci Road
2009	31013	San Simeon Creek	310SSU	310SSU-San Simeon Creek @ San Simeon Road
2009	31018	Toro Creek	310TOR	310TOR-Toro Creek u/s Highway 1
2009	31015	Villa Creek	310VIA	310VIA-Villa Creek u/s Highway 1
2010	30413	Aptos Creek	304APS	304APS-Aptos Creek at Nisene Marks park road
2010	30412	Arana Gulch Creek	304ARA	304ARA-Arana Gulch below golf course
2010	30412	Bear Creek	304BEP	304BEP-Bear Creek @ Elks Park
2010	30412	Boulder Creek	304BH9	304BH9-Boulder Creek @ Highway 9
2010	30412	San Lorenzo River	304RIV	304RIV-San Lorenzo River @ Crossing Road
2010	30411	Scott Creek	304SCM	304SCM-Scott Creek above Mill Creek
2010	30412	San Lorenzo River	304SL9	304SL9-San Lorenzo River @ Highway 9
2010	30412	San Lorenzo River	304SLB	304SLB-San Lorenzo River @ Big Trees
2010	30412	San Lorenzo River	304SLE	304SLE-San Lorenzo @ Elks Park above Bear Creek
2010	30413	Soquel Creek	304SOU	304SOU-Soquel Creek @ Soquel Creek Road
2010	30413	Valencia Creek	304VAL	304VAL-Valencia Creek u/s Aptos Creek Confluence
2010	30412	Zayante Creek	304ZAY	304ZAY-Zayante Creek @ Graham Hill Road
2010	30550	San Benito River	305BRI	305BRI-San Benito River, Bridge d/s Willow Creek
2010	30530	Carnadero Creek	305CAN	305CAN-Carnadero Creek above Pajaro River
2010	30510	Pajaro River	305CHI	305CHI-Pajaro River @ Chittenden Gap
2010	30510	Salsipuedes Creek	305COR	305COR-Salsipuedes Creek d/s of Corralitos Creek
2010	30510	Corralitos Creek	305COR2	305COR2-Upper Corralitos Creek
2010	30530	Pajaro River	305FRA	305FRA-Miller's Canal @ Frazier Lake Road
2010	30510	Furlong Creek	305FUF	305FUF-Furlong Creek @ Fraiser Lake Road
2010	30510	Harkins Slough	305HAR	305HAR-Harkins Slough @ Harkins Slough Road
2010	30530	Llagas Creek(below res.)	305HOL	305HOL-Llagas Creek @ Holsclaw and Leavesley Roads
2010	30530	Llagas Creek(below res.)	305LLA	305LLA-Llagas Creek @ Bloomfield Avenue
2010	30510	Pajaro River	305MUR	305MUR-Pajaro River @ Murphy's Crossing
2010	30540	Pacheco Creek	305PAC	305PAC-Pacheco Creek @ San Felipe Road
2010	30520	Pajaro River	305PAJ	305PAJ-Pajaro River @ Betabel Road
2010	30550	San Benito River	305SAN	305SAN-San Benito @ Y Road
2010	30510	San Juan Creek	305SJM	305SJM-San Juan Creek @ Anzar
2010	30510	Struve Slough	305STL	305STL-Struve Slough @ Lee Road
2010	30550	Tres Pinos Creek	305TRE	305TRE-Tres Pinos Creek
2010	30530	Uvas Creek(below res.)	305UVA	305UVA-Uvas Creek @ Bloomfield Avenue
2010	30510	Watsonville Slough	305WSA	305WSA-Watsonville Slough @ San Andreas Road

## Deliverables

A schedule of the monitoring plan deliverables is provided in Table 4. This timeline is dependent on delivery of final data from the various contract laboratories. However, the desired delivery dates are shown below. Annual workplans and annual reports will follow SWAMP specified formats.

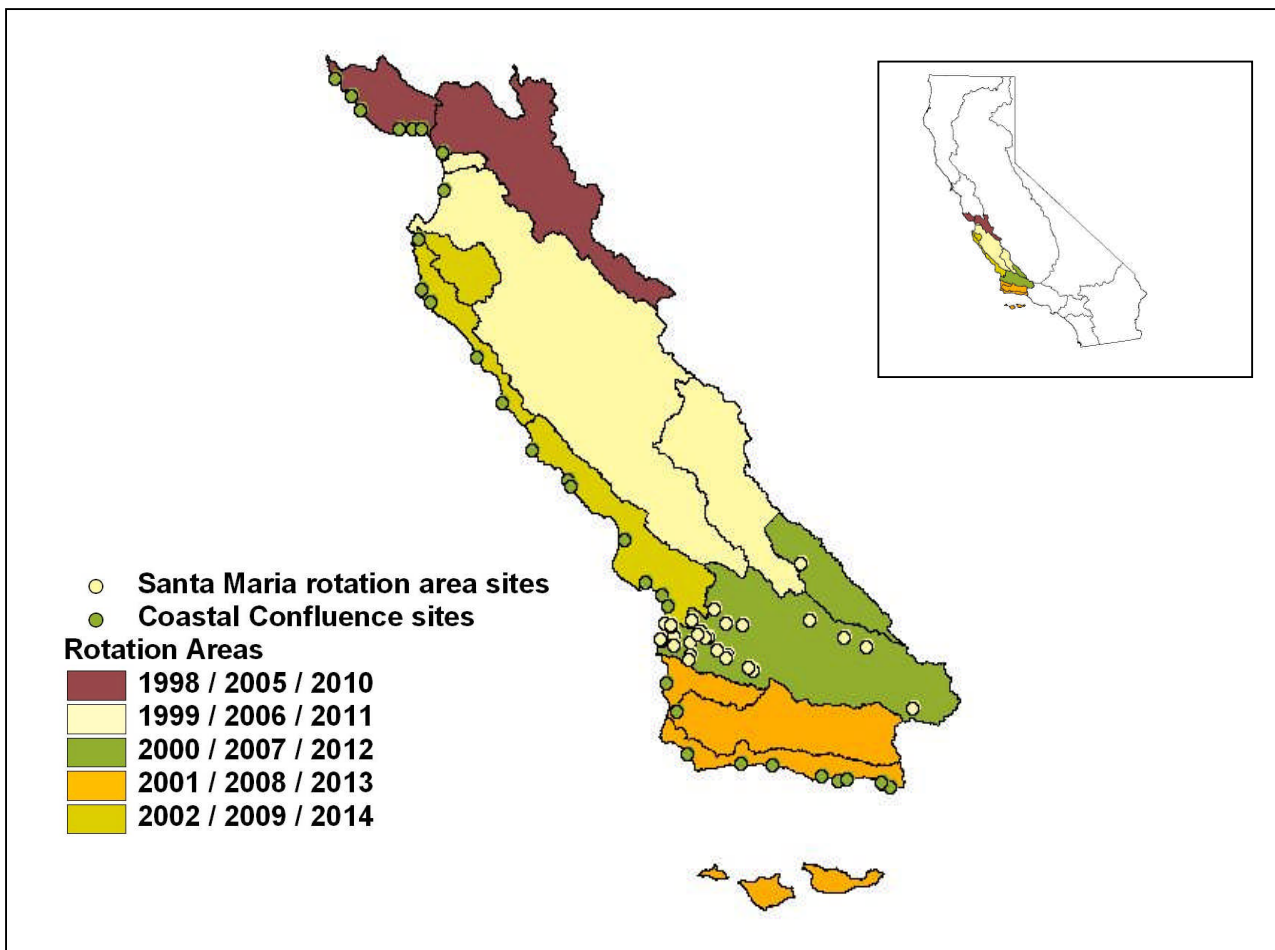
Table 4. Monitoring schedule and deliverables.

<b>Task Deliverable</b>	<b>Time line / target date</b>	<b>Task completed</b>
SWAMP annual reports 2000/01 - Santa Maria	February 2007 (submitted for peer review)	May 2007 (final complete)
SWAMP annual reports 2001/02 – San Antonio, Santa Ynez and South Coast	February 2007 (submitted for peer review)	June 2007 (final complete)
SWAMP annual reports 2002/03 – Santa Lucia and Estero Bay	February 2007 (submitted for peer review)	
2003 Harbors study final data delivery	November 2004	August 2005
2003 Harbors study final report	December 2006	June 2007
Data export to SWAMP (1998 – 2003) temp side	December 2006	December 2006
Data export to SWAMP (2004) temp side	December 2007	
FY 06-07 Annual R3 workplan for peer review	September 2006	September 2006
2005 - Pajaro & North Coast rotation area TOX and BMI final data delivery	April 2007	April 2007
FY 07-08 Annual R3 workplan	August 2007	
SWAMP annual report 2005 - Pajaro & North Coast rotation area	March 2008	
Coastal confluences annual report (with 05-06 data)	February 2008	
2006 - Salinas rotation area TOX and BMI final data delivery	April 2008	
SWAMP annual report 2005 - Salinas watershed rotation area	March 2009	

## Annual Plan

Watershed rotation monitoring during FY 2006-07 will mark the second round of sampling in the Santa Maria Hydrologic Unit; Initial monitoring was conducted January 2000 – March 2001. CCAMP will also continue monitoring at the 33 coastal confluence sites which have been monitored continuously since April 2001. Figure 1 shows the spatial representation of the coastal confluence and 2007 watershed rotation area sites relative to the five watershed rotation areas in Region 3.

Figure 1. Region 3 watershed rotation areas and coastal confluence sites planned for CCAMP monitoring in 2007.



## Monitoring Approach

The general timing of monitoring types associated with the various overlapping monitoring projects is shown in Table 5. Funds from fiscal year 06-07 will be used to complete the Salinas area rotation sampling and to begin the Santa Maria area rotation sampling. SWAMP funds for this fiscal year will be used for the following monitoring activities and projects. Note that Salinas toxicity and benthic macroinvertebrate monitoring is not listed as it is funded by other sources.

- Conventional Water Quality (Monthly)
  - Coastal confluences - 12 monthly samples at 33 sites (July 06- June 07)
  - Salinas rotation area – 9 monthly samples at 33 sites (July 06 - March 07)
  - Santa Maria rotation area - 6 monthly samples at 29 sites (Jan 06-June 07)
- Benthic Macroinvertebrates and Habitat Assessment (Spring, April – June)
  - Coastal confluences - 15 sites (Spring 07 and Spring 08)
  - Santa Maria rotation area - 6 sites (Spring 07 and Spring 08)
- Toxicity (one sediment sample in Spring and two water samples in summer and winter)
  - Santa Maria rotation area - 14 sites

**Table 5. Time schedule of monitoring types at CCAMP sites showing conventional water quality (CWQ), benthic macroinvertebrates (BMI), sediment toxicity (S Tox) and water toxicity (H2O Tox).**

Monitoring Types	2006				2007				2008	
	Jan-06	Mar-06	Jul-06	Dec-06	Jan-07	Mar-06	Jul-07	Dec-07	Jan-08	Mar-08
<b>Coastal Confluences</b>										
CWQ										
BMI										
S. Tox										
H2O Tox										
<b>Salinas Rotation Area</b>										
CWQ										
BMI										
S. Tox										
H2O Tox										
<b>Santa Maria Rotation Area</b>										
CWQ										
BMI										
S. Tox										
H2O Tox										

### **Site-specific Monitoring Activities**

CCAMP monitoring conducted during FY 2006-07 will consist of continued monthly monitoring at coastal confluence sites and in January 2007 the initiation of watershed rotation area monitoring in the Santa Maria (312) and Soda Lake (311) Hydrologic Units. Figure 2 shows the watershed rotation area sites and Figure 3 shows the coastal confluence sites. Monitoring activity schedules for specific coastal confluence and watershed rotation areas sites is shown in Table 4.

Funding sources for watershed and coastal confluence sampling includes SWAMP, as well as CCAMP's Endowment Fund, held by the Bay Foundation of Morro Bay. Several special projects are also anticipated, which will be funded through other sources and are not described in detail in this work plan. For example, CCAMP is supporting work by the California Department of Fish and Game to analyze sea otter tissues for bioaccumulated chemicals; data will be used to determine if there are associations between high tissue burdens of chemicals and impaired immune function and increased rates of mortality from disease. We have also provided CDFG and U.C. Davis funding to sample mussels and other invertebrates for specific pathogens known to be of concern for sea otter health. This work will help us understand mechanisms and sources of infection in several geographic areas of concern in marine waters of the Central Coast Region.

CCAMP coordinates with monitoring activities of the Cooperative Monitoring Program for Irrigated Agricultural (Ag Monitoring). Monitoring conducted by the Ag Monitoring program in the lower Santa Maria and Oso Flaco watersheds includes monthly conventional monitoring for a subset of the CCAMP analyte list (probe measurements, nutrients and TDS), spring benthic macroinvertebrate collection following the California Aquatic Bioassessment Program protocols (Harrington 1999) and water and sediment toxicity monitoring during both wet and dry seasons at all sites. Several CCAMP sites are co-located with Ag Monitoring program sites; CCAMP samples these sites for conventional water quality to ensure that the full complement of CCAMP parameters is collected. CCAMP does not collect toxicity and benthic macro-invertebrate data at these sites. Instead, data is shared between the two programs (Table 6).

Table 6. FY 2006-07 monitoring activities planned for coastal confluence and 2007-watershed rotation area sites.

Project	Site Name	CWQ	Water Tox	Sed Tox	BMI	Project	Site Name	CWQ	Water Tox	Sed Tox	BMI
WRA	311SLN	X				CC	304GAZ	X			X
WRA	312ALA	X	X	X	X	CC	304LOR	X	X	X	X
WRA	312BCD	X				CC	304SCO	X			
WRA	312BCF	X	AG	AG	AG	CC	304SOK	X			X
WRA	312BCU	X	AG	AG	AG	CC	304WAD	X			
WRA	312BRE	X			X	CC	305THU	X			
WRA	312CAV	X			X	CC	307CML	X			X
WRA	312CCC	X				CC	308BGC	X			
WRA	312CUT	X	X	X	X	CC	308BSR	X	X	X	X
WRA	312CUY	X	X	X		CC	308LSR	X			
WRA	312GVS	X	AG	AG	AG	CC	308WLO	X			X
WRA	312GVT	X	X	X		CC	309DAV	X	X	X	X
WRA	312HUA	X				CC	309OLD	X			
WRA	312MSD	X	AG	AG	AG	CC	309TDW	X			
WRA	312MSS	X	X			CC	310ADC	X			
WRA	312NIP	X				CC	310ARG	X	X	X	X
WRA	312NIT	X	X	X	X	CC	310PIS	X			
WRA	312OFC	X	AG	AG	AG	CC	310SLB	X	X	X	X
WRA	312OFL	X	X	X		CC	310SRO	X			
WRA	312OFN	X	AG	AG	AG	CC	310SSC	X			
WRA	312ORB	X				CC	310TWB	X			
WRA	312ORC	X	AG	AG	AG	CC	313SAI	X	X	X	X
WRA	312ORI	X	AG	AG	AG	CC	314SYN	X	X	X	X
WRA	312ORS	X				CC	315ABU	X	X	X	
WRA	312SAL	X				CC	315ATA	X			
WRA	312SBC	X				CC	315CRP	X			
WRA	312SIS	X				CC	315FRC	X			
WRA	312SIV	X			X	CC	315GAV	X			X
CC	312SMA	X	AG	AG	AG	CC	315JAL	X			X
WRA	312SMI	X	AG	AG	AG	CC	315MIS	X			
CC	304APT	X			X	CC	315RIN	X	X	X	X

Figure 2. CCAMP monitoring sites located in the Santa Maria watershed rotation area, including Santa Maria and Soda Lake Hydrologic Units.

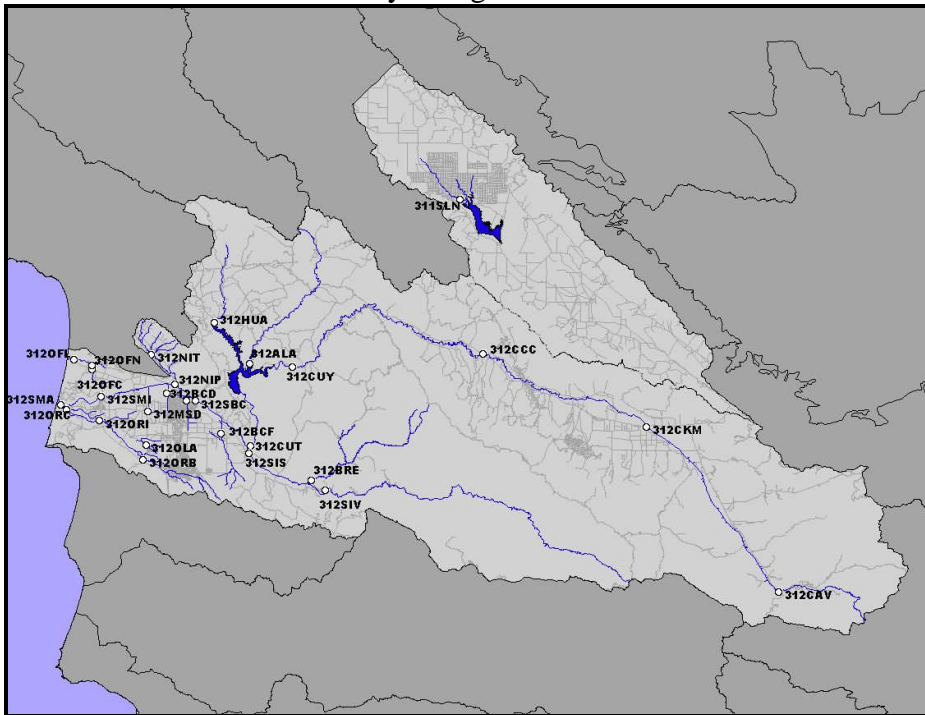
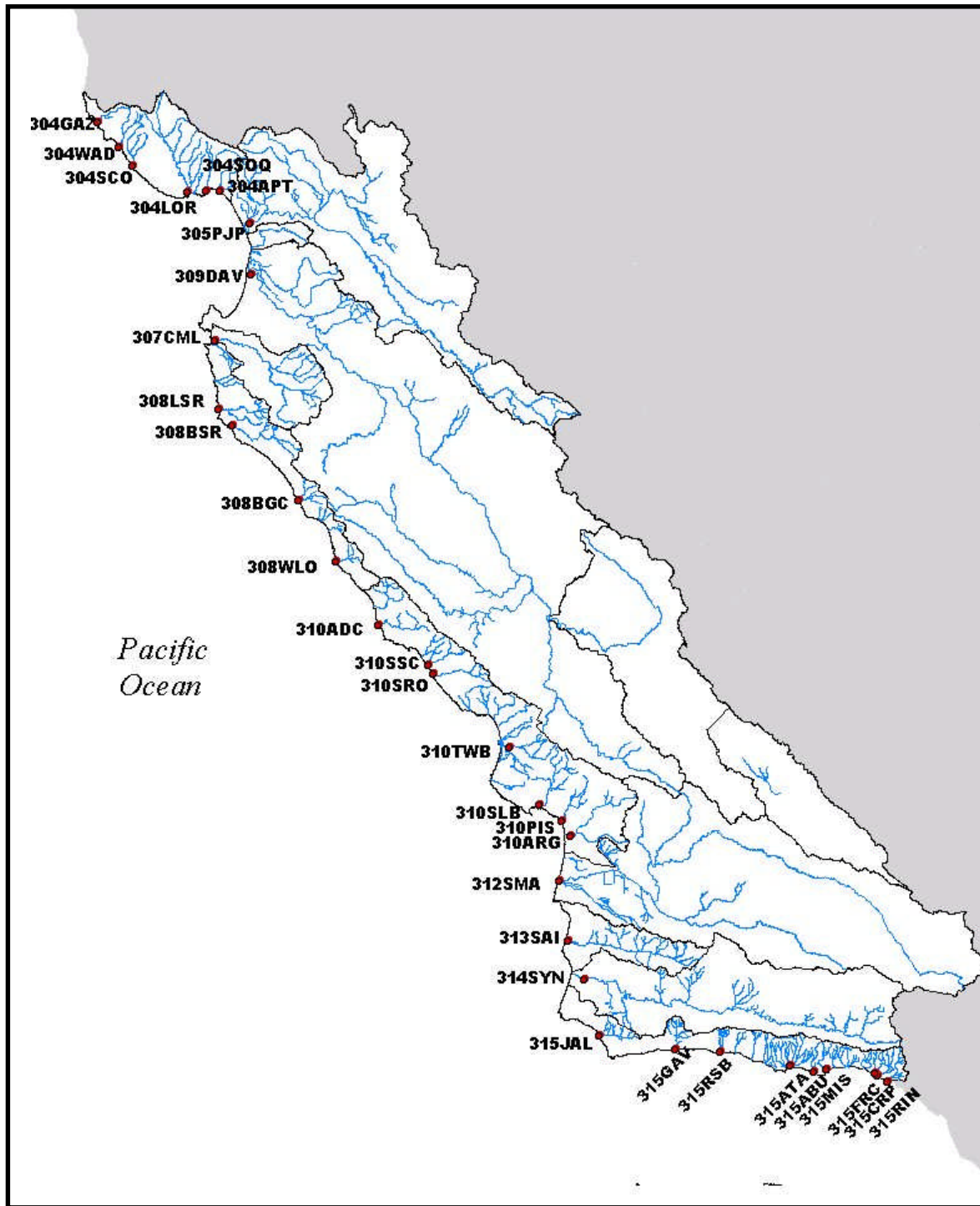




Figure 3. Coastal confluence site locations in Region 3



## **Monitoring Methods**

CCAMP uses a variety of monitoring approaches to characterize status and trends at monitoring sites. The CCAMP program design includes monthly monitoring for conventional water quality (CWQ) and flow at all sites. At a subset of sites other monitoring approaches are applied. These include sediment chemistry and toxicity, tissue chemistry, benthic macroinvertebrate assessment and habitat assessment. Detailed descriptions of these methods and references to the associated standard operating procedures follow.

### **Conventional Water Quality**

The Central Coast Basin Plan has identified several numeric objectives for conventional pollutants. Basic conventional pollutants are monitored monthly at all coastal confluence and watershed rotation sites following the CCAMP SOP (Puckett, 2002). Monthly sampling provides an opportunity to evaluate seasonal variability as well as a variety of flow conditions. Sampling is maintained on an even monthly interval without regard for timing of weather events. Even-interval sampling can be evaluated for long-term trends using time-series analysis techniques, such as the Mann-Kendall or seasonal Kendall tests described by the U.S. EPA in its guidance on Nonpoint Source Monitoring (EPA 1997).

CCAMP uses a multi-analyte probe to measure several parameters in the field, and collects grab samples to be analyzed by the Regional Board's contract laboratory. A Hydrolab DS4a multi-analyte probe is used to collect data for dissolved oxygen, pH, water temperature, turbidity, conductivity, salinity and chlorophyll *a*. All field equipment is calibrated using certified calibration standards and following the manufacturer specifications prior to and following each sampling event. Calibration records are maintained at the Region 3 laboratory and are used to determine instrument accuracy. Field probe measurements are stored electronically in the field and downloaded directly to the database. All field measurements (100%) are checked against the field data sheet for accuracy. In the field, observations of air temperature, algal growth, scum, odor, and other indications of water and habitat conditions are also recorded.

Flow is estimated using a number of means. Wherever possible, sites are located near existing county and USGS gages. At other sites, flow is directly measured using a top setting rod and pygmy bucket wheel. Flow measurements are taken at a minimum of ten locations across a transect; if the wetted width is more than 20 feet additional measurements are taken. When flow is not measurable it is estimated using stream profiles, stage gages and flow calibration curves. In some locations flow measurements are not possible.

Samples to be analyzed by the Regional Board's contract laboratory are collected at each site in clean bottles provided by the contract laboratory. Blind field replicates are collected for 5% of samples collected. Water samples are bottled as appropriate and held at 4°C, before being transferred to the laboratory for analysis. Chain-of-Custody (COC) documentation is maintained for all samples. Samples are analyzed for nutrients, dissolved solids, suspended solids, salts and coliforms. Quality assurance procedures at the laboratory are consistent with SWAMP approved quality assurance requirements and follow U.S. EPA approved methods (BC Laboratories 2006).

The SWAMP Quality Assurance Program Plan specifies target reporting limits and analytical methods for specific analyses (Puckett 2002).

### **Benthic Macroinvertebrate and Physical Habitat Sampling**

Benthic macroinvertebrate assemblages are indicators of stream health. Different species of invertebrates respond differently to water pollution and habitat degradation and provide information on biological integrity. CCAMP will conduct benthic macroinvertebrate community assemblage monitoring at fifteen coastal confluence sites and six Santa Maria watershed rotation sites. There are several sites in the lower Santa Maria and Oso Flaco watersheds that are monitored by the Ag waiver program. Benthic invertebrates are collected each spring at these sites and this data is available in SWAMP importable formats.

Benthic macroinvertebrate communities are sampled using protocols and quality assurance guidance modified from Western Environmental Monitoring and Assessment Program (WEMAP) protocols and is currently being reviewed by SWAMP for statewide approval. These standard operating procedures will be available by the 2007 monitoring season. Two samples are collected from each site. At all sites, a composite sample is collected using a multi-habitat approach in which one sample is collected at each of eleven transects evenly spaced throughout a 150 meter reach. When riffle habitat is available a second composite sample is collected from eight randomly identified one by one foot quadrates within the riffles. This sample collection methodology is called targeted riffle. When stream morphology limits riffle habitat, the second composite sample targets stream margins. One grab is collected at each of eleven transects evenly spaced throughout a 150 meter reach; each of these is collected by alternating between margin and center habitats.

Physical habitat quality is assessed at each sampling reach according to State protocols, using the habitat assessment scoring methods developed by the SWAMP bioassessment committee, and modeled after the WEMAP protocol for physical habitat. This assessment is qualitative in nature and can be fairly subjective. Therefore, field crews intercalibrate their assessments with WEMAP staff prior to conducting fieldwork. The habitat of the creek reach of interest is characterized according to geomorphic parameters, including bankfull width, slope, particle size, sinuosity, depth and other features. Geomorphic characteristics, drainage area and upstream river miles are considered during data evaluation.

### **Sediment Chemistry**

Some organic chemicals are found adhered to fine sediments; metals can also be found at elevated concentrations in sediment. Organic chemicals and metals may also bioaccumulate in the tissues of aquatic organisms and at elevated concentrations can be directly toxic. The Central Coast Basin Plan has a narrative objective for pollutants in sediment, and therefore CCAMP utilizes several peer-reviewed criteria to evaluate sediment data for probable effects, including NOAA Effects Range Medium values (ERMs) (Long, et al, 1998) and Florida Probable Effects Levels (PELs) (MacDonald, et al., 1992, 1996). Sediment samples are analyzed by Department of Fish and Game laboratories at Rancho Cordova and Moss Landing, and on occasion by the Regional Board's contracted private laboratory. Laboratory analysis includes polyaromatic hydrocarbons, organochlorine and organophosphate chemicals, metals, particle size distribution,

and total organic carbon. The SWAMP Quality Assurance Management Plan (QAMP) contains detailed information on QA/QC procedures, methods and reporting limits (Puckett 2002).

Sediment samples for chemistry will not be collected at coastal confluence or watershed rotation area sites unless there is available money in the Region 3 lab contract at the end of the fiscal year. If funds are available, watershed rotation area sites will be prioritized using available data and information, including water quality, toxicity and bioassessment data.

### **Toxicity Sampling**

CCAMP staff will collect two water samples and one sediment sample for toxicity analysis at fourteen watershed rotation area sites. In addition, The Ag waiver monitoring program will conduct toxicity monitoring at nine sites in the lower watershed. Ag waiver program monitoring will include two water and two sediment toxicity sampling events. These data will be combined with CCAMP data for assessment of waterbodies in the Santa Maria Watershed. Sediment samples are collected by CCAMP staff in concert with bioassessment samples (May – June 2007), and sampling targets fine grain sediments. Sampling follows the SWAMP SOP for sediment collection and is summarized here. Pre-cleaned Teflon™ scoops are used to collect the top two cm of sediment from five or more locations at each site. The scooped samples are collected in a pre-cleaned glass composite jar. The sample is subsequently homogenized thoroughly and aliquoted into pre-cleaned sample jars (as appropriate) for chemical or toxicological analysis. Samples are then stored at 4°C and shipped with appropriate COC and handling procedures to the analytical laboratories. Bed sediment sampling procedures are detailed in the SWAMP QAMP (Puckett 2002).

Ten-day sediment toxicity testing is performed at the UC Davis – Granite Canyon Marine Pollution Control Laboratory using *Hyalella azteca* according to standard EPA protocols (EPA 2000). For each sediment sample, eight replicates each containing 10 *H. azteca* individuals are tested. Endpoints recorded after ten days are survival and growth (as dry weight). The Granite Canyon quality assurance/quality control procedures and standard operating procedures in the SWAMP QAMP provide more information on these analyses (Puckett 2002).

CCAMP staff will collect water samples for toxicity analysis. This sampling will target both wet weather (November – January) and base flows (May – July). Three test species will be used for each sampling event; *Ceriodaphnia dubia* (water fleas), *Pimephales Promelas*, (fathead minnows) and *Selanastrum capricornatum* (algal species). Water collection will follow SWAMP Standard Operating Procedures (SOP), summarized here. Precleaned one-gallon glass amber jugs are provided by the contract lab. Facing upstream the jugs are rinsed with creek water three times and then filled completely, leaving no head space. Four gallons are collected for each site and five percent of the total samples are collected in duplicate for quality assurance purposes. Samples are stored at 4°C and shipped with appropriate COC and handling procedures to the analytical laboratories.

## **Watershed Characterizations**

The 2007 watershed rotation area includes the Oso Flaco and Soda Lake watersheds in San Luis Obispo County as well as the Santa Maria River watershed, which has major tributaries in both San Luis Obispo and Santa Barbara Counties. Each of these watersheds is discussed in detail below.

Additionally, several watersheds will be monitored as part of the Coastal Confluence component of the CCAMP monitoring strategy. These include coastal creeks and rivers of the Santa Cruz coast, Pajaro River, Salinas River, Big Sur coast, San Luis Obispo county coast and Santa Ynez River, San Antonio River and Santa Barbara County coast. Each of these watersheds is discussed in some detail in Appendix A.

### **Soda Lake Hydrologic Unit 311.00**

The Carrizo Plain Hydrologic Unit is located in the eastern portion of San Luis Obispo County. This is a geologically and biologically unique area. A large portion of the land is protected in the "Carrizo Plain Natural Area (CPNA), a cooperative effort since 1985 between the Bureau of Land Management (BLM), the California Department of Fish and Game (CDFG), and The Nature Conservancy (TNC).

The Carrizo Plain is a basin-shaped watershed without an outlet to the ocean, formed by the Temblor Mountains to the northeast, and the Caliente Mountains to the Southwest. The San Andreas Fault cuts along the base of the Temblor Range, resulting in striking geological features such as displaced streambeds and sheared hillsides. The Pleistocene uplift of the Temblors resulted in capture of runoff within the central Carrizo Plain to form Soda Lake, a 3,000 acre ephemeral alkaline lake at the center of the Plains. Erosion by southern tributaries of the Salinas River has resulted in capture of the more northerly portions of the Plain, so that this area now drains to the Salinas River. Soda Lake provides important habitat for migratory birds and is one of the largest undisturbed alkali wetlands in California. Without an outlet, water from the lake evaporates, leaving behind residual sulphates and carbonates. The lake is currently identified as impaired by ammonia on the Clean Water Act Section 303(d) list. Ammonia concentrations measured in a tributary to the lake on Seven-Mile Road showed one of five samples collected there had unionized ammonia concentrations above the Basin Plan objective. Water temperatures in this basin contribute to the risk of elevated unionized ammonia.

The CPNA is 250,000 acres of cattle ranching and dryland farming, rural residential and large areas of relatively undisturbed habitat. The Carrizo Plain supports many endangered, threatened and rare plant and animal species and contains some of the last remnants of the once vast San Joaquin Valley grassland habitat.

### **Santa Maria Hydrologic Unit 312.00**

The Santa Maria River Hydrologic Unit includes all areas tributary to the Cuyama River, Sisquoc River, and Santa Maria River. At 1,880 square miles (1.2 million acres) the Santa Maria River watershed is one of the larger coastal drainage basins of California. The Cuyama River and Sisquoc River originate in north and south slopes of the Los Padres National Forest wilderness areas. The Santa Maria River is formed by the confluence of the Cuyama and Sisquoc approximately 7 miles southwest of Santa Maria.

The upper Sisquoc River is in a reasonably natural state with much of the watershed located in National Forest and large ranches. Within the Los Padres Forest Service boundary, the upper 33 miles of the Sisquoc is listed as a National Wild and Scenic River and is important spawning habitat to steelhead trout (*Oncorhynchus mykiss*). Major tributaries to the Sisquoc River include La Brea Creek, Horse Canyon Creek and Tepusquet Canyon Creek.

The Cuyama River headwaters are in Ventura county where it is also in reasonably natural state (above Highway 33) and National Forest areas and large ranches are the primary land use. Below Sierra Madre Road and throughout its length in San Luis Obispo County the channel of the Cuyama has been highly altered to better align with State Highway 166. Much of the upper Cuyama watershed is made up of sedimentary marine deposits that are naturally erosive. As a result, the river carries a heavy sediment load. The Twitchell reservoir (completed in 1958) is located on the Cuyama River six miles above the confluence with the Sisquoc River. The dam traps much of the sediment contained in the Cuyama flows and prevents migration of steelhead upstream to tributaries of Alamo Creek and Huasna River where they historically spawned.

The Santa Maria valley is a broad flat valley, protected from flooding by levees and a series of flood control channels and basins. The lower Santa Maria River Watershed, including the Santa Maria River, is highly altered. The river has a very sandy, braided channel and is levied along much of its length. It is a "losing" stream, meaning that surface water flow tends to rapidly infiltrate into underlying permeable layers. The river is the major source of recharge to the Santa Maria groundwater basin. Urban runoff and associated pollutants also tend to infiltrate, rather than flow to the Santa Maria River.

Nipomo Creek drains the Nipomo valley and joins the Santa Maria River just west of US Highway 101. Solomon (Orcutt) creek drains the Orcutt area and joins the Santa Maria River near its outlet to the Pacific Ocean. Oso Flaco Lake and its drainage, though not part of the Santa Maria watershed, are included in Hydrologic Unit 312.00 and will be included in this sampling rotation. Oso Flaco is north of the Santa Maria Estuary.

Major activities in the Santa Maria watershed include irrigated and dryland agriculture, oil production, and urban development. Twitchell Reservoir serves important flood control and water recharge functions. Sedimentation of this reservoir is reducing its water storage capacity, and if allowed to continue will affect the reservoir's flood control capacity. Pollutants of known concern in the watershed include nitrates and total dissolved solids in groundwater, organochlorine pesticides in the estuary, and petroleum production byproduct (diluent) in ground and surface water of the Guadalupe Dunes and nearby areas. Currently, TMDLs for nitrate and coliform are being prepared by Regional board staff for the watershed. Those waters that are

identified as impaired and are included on the Clean Water Act section 303(d) list are identified in Table 7. The majority of these impairments were identified as a result of CCAMP monitoring in this watershed between January 2000 and March 2001. These data can be viewed on the CCAMP website (<http://www.ccamp.org/ca0/3/312/312BySiteProj.htm>).

Table 7. Clean Water Act section 303(d) listed waters in the Santa Maria Hydrologic Unit

<b>Waterbody</b>	<b>Pollutant / Stressor</b>
Alamo Creek	Fecal coliform
Bradley Canyon Creek	Ammonia Nitrate Fecal coliform
Bradley Channel	Nitrate Fecal coliform
Cyuama River	Boron
Main Street Canal	Ammonia Nitrate
Nipomo Creek	Fecal coliform
Oso Flaco Creek	Ammonia Nitrate Fecal coliform
Oso Flaco Lake	Dieldrin
Orcutt Solomon Creek	Ammonia Nitrate Fecal coliform Chlorpyrifos Dieldrin DDT
Santa Maria River	Ammonia Nitrate Fecal coliform Chlorpyrifos Dieldrin Endrin DDT

## **Budget**

The Region 3 allotment from the SWAMP program for FY 2006-07 is \$260,100. Other funding sources applied toward monitoring activities include roll over from 2005-06 SWAMP funds and the CCAMP endowment fund. Budget allocations to different elements of the program are shown. Because funds are provided on a fiscal year basis and sampling rotation years are managed on a calendar year basis, the budget reflects continuation of the coastal confluence monitoring that was initiated in the previous fiscal year and the initiation of the 2007 watershed

rotation area in the Santa Maria and Soda Lake Hydrologic Units. However, the FY 06-07 funds are allocated to conventional water quality data collected July 2006- June 2007 and benthic macroinvertebrate and toxicity monitoring at Santa Maria rotation areas and coastal confluence sites. Table 8 shows the CCAMP budget for FY –2006-07, including all currently available funding sources.



**Table 8 - CCAMP Budget FY 2006-07**

	Sites	Duplicate samples/event	\$/Sample	Sample events/yr	Total Samples	Total	Funding	CCAMP Endowment	SWAMP Master Contract	R3 Lab Contract	Monterey County Foundation Endowment	Sum
<b>Salinas and Elkhorn Watersheds (July 06-April 07)</b>												
CWQ BC Pricing 2003- 2005	32	2	\$235	4	136	\$31,960				\$6,616	\$25,344	
Chlorophyll a			\$60		20	\$1,200				\$1,200		
CWQ BC Pricing 2006 - 2008	32	2	\$219	5	170	\$37,230				\$37,230		
Sediment Tox-Hyallela 10D with ELISA			\$970	1	0	\$0					\$0	
Sediment Total Organic Carbon (TOC)			\$60	1	0	\$0					\$0	
Ceriodaphnia 7-day Survival & Reproduction (one of EPA 3-spp)	21	2	\$350	2	46	\$16,100					\$16,100	
Pimephales (fathead minnow) 7-day test (one of EPA 3-spp)	21	2	\$400	2	46	\$18,400					\$18,400	
Senastrum (algae) test (one of EPA 3-spp)	21	2	\$300	2	46	\$13,800					\$13,800	
ELISA for Diazinon	21	2	\$85	2	46	\$3,910					\$3,910	
ELISA for Chlorpyrifos	21	2	\$85	2	46	\$3,910					\$3,910	
Sample sorting, taxonomy, QA, Report (no collection) - 600 count	17	1	\$365	1	18	\$6,570					\$6,570	
TIE as needed	2		\$3,990			\$7,980					\$7,980	
<b>Watershed Characterization subtotal</b>						<b>\$141,060</b>		<b>\$0</b>	<b>\$0</b>	<b>\$45,046</b>	<b>\$96,014</b>	<b>\$</b>
<b>Coastal Confluences (July 06 - June 07)</b>												
CWQ BC Pricing 2003- 2005	33	2	\$235	4	140	\$32,900				\$32,900	\$0	
CWQ BC Pricing 2006 - 2008	33	2	\$219	8	280	\$61,320				\$61,320		
Total Organic Carbon (TOC) - sediment			\$65		0	\$0			\$0			
Grain size (GS; full analysis = phi scale) - sediment			\$136	1	0	\$0			\$0			
Amphipod 10-d Survival (Hyaella)--acute			\$950	1	0	\$0			\$0			
Ceriodaphnia 7-day Survival & Reproduction (one of EPA 3-spp)			\$750	2	0	\$0			\$0			
Pimephales (fathead minnow) 7-day test (one of EPA 3-spp)			\$775	2	0	\$0			\$0			
Senastrum (algae) test (one of EPA 3-spp)			\$750	2	0	\$0			\$0			
Cooler Shipping			\$78	2	0	\$0			\$0			
Scoops (lab will provide pre-cleaned scoops for sediment sampling and then clean scoops after sampling)			\$11	2	0	\$0			\$0			
Sample sorting, taxonomy, QA, Report (no collection) - 600 count	16	16	\$650	1	32	\$20,800			\$20,800			
TIE as needed			\$3,990		0	\$0						
<b>Coastal Confluences subtotal</b>						<b>\$115,020</b>		<b>\$0</b>	<b>\$20,800</b>	<b>\$94,220</b>	<b>\$0</b>	<b>\$</b>

**Table 8, cont. - CCAMP Budget FY 2006-07**

	Sites	Duplicate samples/event	\$/Sample	Sample events/yr	Total Samples	Total	Funding	CCAMP Endowment	SWAMP Master Contract	R3 Lab Contract	Monterey County Foundation Endowment	Su
<b>Santa Maria Watershed (January 07 - June 07)</b>												
CWQ BC Pricing 2006 - 2008	29	2	\$219	6	186	\$40,734				\$40,734		
<b>Water Toxicity Feb 2007</b>												
Ceriodaphnia 7-day Survival & Reproduction (one of EPA 3-spp)	13	1	\$717	1	14	\$10,038			\$10,038			
Pimephales (fathead minnow) 7-day test (one of EPA 3-spp)	13	1	\$717	1	14	\$10,038			\$10,038			
Selenastrum (algae) test (one of EPA 3-spp)	13	1	\$717	1	14	\$10,038			\$10,038			
ELISA for Diazinon	13	1	\$35	1	14	\$490			\$490			
ELISA for Chlorpyrifos	13	1	\$35	1	14	\$490			\$490			
Cooler Shipping (H2O tox to ATL)	14		\$78	1	14	\$1,092			\$1,092			
<b>Sediment Toxicity Spring 2008</b>												
Amphipod 10-d Survival (Hyaella)--acute	12	1	\$950	1	13	\$12,350			\$12,350			
Scoops (lab will provide pre-cleaned scoops for sediment sampling and then clean scoops after sampling)	12	1	\$11	1	13	\$143			\$143			
Total Organic Carbon (TOC) - sediment	12	1	\$65	1	13	\$845			\$845			
Grain size (GS; full analysis = phi scale) - sediment	12	1	\$136	1	13	\$1,768			\$1,768			
<b>Water Toxicity June 2007</b>												
Ceriodaphnia 7-day Survival & Reproduction (one of EPA 3-spp)	10	1	\$750	1	11	\$8,250			\$8,250			
Pimephales (fathead minnow) 7-day test (one of EPA 3-spp)	10	1	\$775	1	11	\$8,525			\$8,525			
Selenastrum (algae) test (one of EPA 3-spp)	10	1	\$750	1	11	\$8,250			\$8,250			
Cooler Shipping (H2O tox to ATL)	10	1	\$78	1	11	\$858			\$858			
Sample sorting, taxonomy, QA, Report (no collection) - 600 count	6	6	\$650	1	12	\$7,800			\$7,800			
Sample sorting, taxonomy, QA, Report (no collection) - 600 count	4	4	\$681	1	8	\$5,448			\$5,448			
<b>Watershed Characterization subtotal</b>						<b>\$121,709</b>		<b>\$0</b>	<b>\$86,423</b>	<b>\$40,734</b>	<b>\$0</b>	<b>\$0</b>
<b>Misc</b>												
SWAMP Overhead			flat fee			\$3,900			\$3,900			
Pacific EcoRisk Admin Costs						\$15,540						\$15,540
Lab Overruns from 05-06						\$75,604						\$75,604
Misc Hardware (field equipment)						\$5,000		\$5,000				
<b>Misc Subtotal</b>						<b>\$95,044</b>		<b>\$0</b>	<b>\$3,900</b>	<b>\$0</b>	<b>\$0</b>	<b>\$91,144</b>
<b>Support Staff</b>												
Field team leader	#	Wks	\$/Hr	Hrs/Wk		\$32,000						\$32,000

Field Team staff	1	50	\$14	30	\$21,000					\$21,000	
Field Team Travel					\$3,000					\$3,000	
Web site and Mastermon Support					\$30,000		\$30,000				
<b>Support Staff Subtotal</b>					<b>\$86,000</b>		<b>\$30,000</b>	<b>\$0</b>	<b>\$0</b>	<b>\$56,000</b>	
<b>Table 8, cont. - CCAMP Budget FY 2006-07</b>											
	Sites	Duplicate samples/event	\$/Sample	Sample events/yr	Total Samples	Total	Funding	CCAMP Endowment	SWAMP Master Contract	R3 Lab Contract	Monterey County Foundation Endowment
						\$574,087	\$35,000	\$111,123	\$180,000	\$243,158	\$5
<b>Sources of Funding</b>											
SWAMP funding (06-07) held at MLML for BC Labs						\$30,000				\$30,000	
SWAMP Funding (06-07)						\$230,100		\$80,100	\$150,000		
SWAMP Funding (0405 carryover allocated to ATL for water Tox)						\$31,043		\$31,043			
CCAMP Endowment(NFWF)						\$35,000	\$35,000				
State Mussel Watch Endowment						\$10,254					
Monterey County Foundation Endowment						\$200,000					\$200,000
San Jose State Foundation											
<b>Total Sources of Funding</b>						<b>\$506,397</b>	<b>\$35,000</b>	<b>\$111,143</b>	<b>\$180,000</b>	<b>\$200,000</b>	<b>\$</b>
<b>Total Costs</b>						<b>\$579,535</b>	<b>\$35,000</b>	<b>\$111,123</b>	<b>\$180,000</b>	<b>\$243,158</b>	<b>\$</b>
<b>Net</b>						<b>-\$73,138</b>	<b>\$0</b>	<b>\$20</b>	<b>\$0</b>	<b>-\$43,158</b>	<b>\$</b>
<b>Contract allocations</b>											
RB3 Lab Contract						\$280,948				\$180,000	\$100,948
SWAMP master contract						-\$19,805		\$111,143			
Student contract						\$0		\$0			
								<b>\$111,143</b>	<b>\$180,000</b>	<b>\$100,948</b>	<b>\$</b>



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## Appendix A. Summary of Central Coast Watershed Characteristics and Conditions

### Big Basin Hydrologic Area 304

The Big Basin Hydrologic Area is characterized by smaller coastal watersheds draining out of the Santa Cruz mountains directly to the ocean. In most areas the creeks drain through a coastal plain area that is relatively narrow. For some of the watersheds, particularly in the southern portion of this area, this coastal plain is heavily developed (around the towns of Santa Cruz, Aptos, and Soquel). In the northern portion of the region, the plain is narrower and development is minimal. Irrigated agriculture is relatively limited in this area.

Major issues in the Big Basin area include siltation, water diversions, migration barriers and loss of riparian habitat. The SCCPD has gathered data at various locations in the smaller watersheds of this area for a number of years. In addition, several volunteer monitoring programs are collecting data in various watersheds. CCAMP data for most of the other smaller watersheds along the coast indicate few water quality problems. However, the CCAMP program is not currently geared to assess instream sediment impacts, which are some of the more likely impacts in these watersheds. Several waterbodies in the Big Basin Hydrologic Unit (304) are on the 303(d) list of impaired waterbodies due to specific pollutants and or stressors. These waterbodies are listed below:

#### Big Basin Hydrologic Unit waters currently identified as impaired on the 303(d) list.

<u>Waterbody</u>	<u>Pollutant/stressor</u>	<u>Pollutant/stressor</u>	<u>Pollutant/stressor</u>
<b>San Lorenzo Watershed</b>			
Branciforte Creek	Siltation		
Carbonera Creek	Nutrients	Pathogens	Siltation
Boulder Creek	Siltation		
Bear Creek	Siltation		
Fall Creek	Siltation		
Kings Creek	Siltation		
Lompico Creek	Nutrients	Pathogens	Siltation
Love Creek	Siltation		
Mountain Charlie Gulch	Siltation		
Newell Creek	Siltation		
Shingle Mill Creek	Nutrients	Siltation	
San Lorenzo Lagoon	Boron	Fecal Coliform	
San Lorenzo River	Nutrients	Pathogens	Siltation
<b>Aptos Watershed</b>			
Aptos Creek	Pathogens	Siltation	
Valencia Creek	Pathogens	Siltation	
<b>Other watersheds</b>			
Soquel Lagoon	Nutrients	Pathogens	Siltation
Waddell Creek East Branch	Pathogens	Siltation	

### **Aptos Creek – Hydrologic SubArea 304.13**

Aptos Creek is located in southern Santa Cruz County and is approximately 24.5 square miles in size. It drains to Monterey Bay south of the City of Santa Cruz. Its main tributaries are Valencia Creek, Mangles Gulch, and Bridge Creek. Both Aptos and Valencia Creeks are listed on the 303(d) impaired waterbodies list for siltation and pathogens, and are the subject of a Total Maximum Daily Load analysis.

The entire upper watershed was logged during the late 1800s, and 140 million board feet of first-growth redwood was removed. The California Department of Fish and Game (1977) conducted inventories of fisheries resources and found that factors limiting steelhead populations in the creek include temperature, sedimentation, barriers to fish passage, inadequate woody debris, and inadequate canopy cover. Titus et al. (1994) indicate that declining fish populations are primarily caused by sedimentation in Aptos Creek. He indicated that a disastrous flood in 1982 created landslides and mass wasting, as well as debris jams, which blocked fish passage. The 1982 steelhead year-class was essentially eliminated. Surveys in 1999 (Nelson 2000) documented a number of steelhead once again present in the creek

The SCCPD has monitored sites on Aptos and Valencia Creek since 1975. Their data shows that both creeks are fairly alkaline compared to other creeks they monitor, averaging 242 and 229 mg/L, respectively. Conductivity is also higher than on many of the other coastal streams monitored.

One of the County's sites, at the Spreckels Drive bridge, had elevated fecal coliform 57% of the time relative to the Basin Plan objective of 200MPN/100mL (a criteria which is applied to 5 samples collected within a 30 day period). Other sites in the watershed were relatively clean. CCAMP coastal confluence monitoring data for fecal coliform at the Aptos Creek site had a geomean which exceeded the Central Coast Basin Plan objective of 400 MPN/100 ml. Nitrate levels were relatively low, averaging less than 0.2 mg/L (NO<sub>3</sub> as N). Orthophosphate (as P) levels were slightly elevated, averaging somewhat less than 0.2 mg/L. This compares well with the County's data. Oxygen levels were fully saturated with a relatively narrow range of values.

Conventional water quality has been monitored by volunteer monitors from the Coastal Watershed Council. Findings from the spring and summer of 2000 indicate that most parameters met water quality standards. However, turbidity was elevated on Valencia Creek, and flow was low at the confluence of Valencia Creek with Aptos Creek.

Mussel Watch data shows no exceedances of FDA action levels for metals or organic chemicals in fish tissue collected from Aptos Creek.

### **Soquel Creek – Hydrologic SubArea 304.13**

The Soquel Creek Lagoon is listed on the 303(d) impaired waterbodies list for pathogens, nutrients, and siltation. Montgomery (1979) indicated that water quality influences on the watershed are primarily from urban runoff and residential development in the upper watershed with associated septic system use. Forestry activities in the upper watershed contribute to the sedimentation problem. Cafferata and Poole (1993) completed a watershed assessment of sediment impacts to the East Branch of Soquel Creek.

USGS conducted water sampling at their gaging station between 1953 and 1966, which gives an indication of general mineral composition of Soquel Creek water; hardness and dissolved solids are relatively high, but are comparable to ground water supply in the area. SCCPD data show that Soquel Creek, along with Aptos and Valencia, have among the highest alkalinity levels of all creeks sampled by their program, averaging 210 mg/L in Soquel Creek.

Past CCAMP monitoring for fecal coliform at the Soquel Creek coastal confluence site has showed a geomean of all samples of 401 MPN/100 ml, with 33% of measurements exceeding the Central Coast Basin Plan single sample maximum of 400 MPN/100 ml. Nitrate levels were very low, averaging less than 0.1 mg/L (NO<sub>3</sub> as N). Orthophosphate (as P) averaged 0.11 mg/L. Dissolved oxygen levels showed no signs of depression. However, the maximum value was 13.88, which may indicate super-saturation. pH occasionally exceeded 8.3 (the Basin Plan criteria for domestic supply), but averaged 8.17. Multiple years of data collected by Santa Cruz County generally supports these findings.

Mussel Watch data shows no exceedances of FDA action levels for metals or organic chemicals in bivalve tissue collected from Soquel Creek.

### **San Lorenzo River Watershed – Hydrologic Subarea 304.12**

The San Lorenzo River is listed on the 1998 303(d) list as impaired by nutrients, pathogens and sedimentation. The San Lorenzo River estuary is also listed for pathogens and sedimentation. Carbonera and Lompico Creeks, tributaries to the San Lorenzo River, are also listed for pathogens, nutrients and sedimentation. Shingle Mill Creek is listed for nutrients and siltation. Schwan Lake, which is also in the watershed, is listed for nutrients and pathogens. Revisions to the list currently under consideration would add a number of the tributaries specifically for sediment, but would delist the San Lorenzo for nutrients.

General Watershed Description – The San Lorenzo River is a 25-mile long river that drains to the Pacific Ocean at the northern end of Monterey Bay. It drains a 115 square mile watershed, which is mostly a steep, heavily forested landscape on the west slope of the central Santa Cruz mountains. Average rainfall is about 47 inches, most of which falls between December and April (SCCPD 1979; Phillip Williams & Assoc. 1989).

The San Lorenzo River is a perennial stream with average summer flows typically under 10 cfs but flood flows recorded as high as 35,000 cfs. The lower 2.2 miles of the stream have been channelized and levied for flood control purposes, as the stream flows through downtown Santa Cruz. This reach of stream does not have a well-shaded canopy, though vegetation restoration projects have begun to improve bank vegetation along the levees. The San Lorenzo River lagoon provides critical summer habitat for juvenile steelhead. Breaching of the lagoon to prevent flooding is an ongoing management concern for protection of steelhead habitat.

As of 1970, 23.2% of the watershed was in urban and suburban land use. Besides the City of Santa Cruz, the San Lorenzo River and its tributaries flow past the communities of Boulder Creek, Ben Lomond, Felton, Lompico, Zayante, Mount Hermon, and the City of Scotts Valley (SCCPD 1979). In addition to urban, suburban and timber harvest uses, others include recreation (including golf courses), range and pasture land, and small animal holding facilities.

The main tributaries to San Lorenzo River include Carbonera Creek (7.4 sq. mi.), Zayante Creek (13.8 sq. mi.), Bear Creek (16.2 sq. mi.), Boulder Creek (10.2 sq. mi.), Newell Creek (9.7 sq. mi.), and Branciforte Creek (18.1 sq. mi.). Branciforte Creek is channelized in its lowest mile before it joins the San Lorenzo River. Loch Lomond is an impoundment on Newell Creek, formed in 1961 (SCCPD 1979).

Conventional Water Quality Findings - Though nitrate levels in the San Lorenzo system are relatively low compared to other agriculture dominated watersheds in the area (such as the Pajaro River), the river was listed as impaired by nitrate based on impacts to taste and odor in the municipal water supply.

CCAMP coastal confluences monitoring rank the San Lorenzo River among the lowest in the Region for nitrate concentrations; it averaged 0.19 mg/L (NO<sub>3</sub> as N) and never exceeded 0.8 mg/L. The San Lorenzo watershed has relatively rich natural sources of phosphorus (SCCPD 1979); coastal confluence monitoring indicated an average value of 0.45 mg/L phosphorus as P. The low nitrogen to phosphorus ratio indicates that the watershed is nitrate limited. Therefore, controls on nitrate are important in the watershed to reduce taste and odor problems originating from algal growth.

The CCAMP program has acquired and reviewed the extensive water quality data collected by the Santa Cruz County Environmental Health Department. Virtually no indications of problems from nitrite or ammonia were found. An examination of dissolved oxygen levels over a twenty-year period of record showed only three excursions below 7.0 mg/L (the Basin Plan criteria for cold water fish) on tributaries. Violations were on Bear Creek, Gold Gulch and Kings Creek. No measurements were recorded below 6.4 mg/L. On the main stem of the San Lorenzo violations were more common, with measurements dropping below 7.0 mg/L 10.3% of the time. However, most violations were from one of the 18 sites monitored on the San Lorenzo; this was Station 1-01-002 below Boulder Creek, which violated 52% of the time, but never

dropped below 5.3. Two violations were recorded at Waterman Gap and one at Irwin Way check dam. Overall, dissolved oxygen levels in the watershed appear to be in good condition.

CCAMP data show the San Lorenzo River to have the highest fecal coliform levels of all coastal confluences measured, which include 33 major watershed systems of the Central Coast. The fecal coliform geomean at the lower end of the river was 953 MPN/100 ml, with single sample maximums ranging as high as 92,000. This site violated the Central Coast Basin Plan objective (single sample maximum of 400 MPN/100ml) in 71% of the 17 samples taken (between April 2001 and March 2003). Fecal coliform appears to be a significant problem in almost all tributaries, according to data collected by the SCCPD Environmental Health Department. Fall Creek and Clear Creek rarely or never exceeded 200 MPN/100 ml, the basin plan objective for the geomean of all samples. All other tributaries and the San Lorenzo River itself exceeded this value regularly. For example, of the 100 samples taken along the main stem over the twenty-five year period of record, 49 samples exceeded 200 MPN/100 ml and the geometric mean of all samples was 6749 MPN/100 ml. The worst site on the San Lorenzo River main stem was at Big Trees, where 67% of all samples violated the standard. Branciforte Creek, Carbonera Creek, Camp Evers tributary, and Schwann Lake also had relatively high percent violations. High fecal coliform levels are attributable at least in part to old and failing septic systems in the upper watershed.

Metals - State Mussel Watch Program data indicates that some metals may exceed Median International Standards (MIS) in mussel tissue in the Santa Cruz area (Rasmussen, ). Samples have been collected from a number of locations in the San Lorenzo watershed and in the Santa Cruz Harbor. The MIS for copper was exceeded on the San Lorenzo River at Big Trees in the early 1980's. Santa Cruz Harbor exceeded MIS standards in shellfish on several occasions for cadmium, chromium, copper, and zinc. Fish tissue samples from Corcoran Lagoon and Moran Lake also had elevated levels of cadmium and chromium. In freshwater clam and fish tissue samples collected by Department of Fish and Game staff throughout the watershed, cadmium and copper levels did exceed the MIS levels on occasion.

The SCCPD sampled for metals in water throughout the San Lorenzo watershed on a number of occasions. The Basin Plan standard in cold water fish habitat for both cadmium and chromium is 0.03 ppm and 0.05 ppm respectively. These values were exceeded on several occasions in urban runoff. Sediment chemistry data collected at the CCAMP coastal confluences site in 1998 did not show levels of these or any other metals elevated above the effects range medium (ERM) value.

Habitat – Sediment is a problem in a number of locations in the watershed and is the subject of several TMDL analyses. Fine sediment in spawning gravels results in reduction in carrying capacity for anadromous fish, and can severely reduce fish populations. Several studies describe the problem in detail (Leonard 1972, SCCPD 1979, Swanson Hydrology 2001, and Soil Conservation Service 1990) and Regional 3 staff has

compiled a literature review of studies related to the problem (Jagger et al. 1993). Sedimentation sources are various and the problem is a complex one. The major sources of erosion defined in the Zayante Creek sedimentation study (Swanson Hydrology 2001) are from roads (from timber harvest, private, and public purposes), active timber harvest, mass wasting, channel erosion and other urban and rural land uses. This study estimated that the Zayante watershed yielded 115,116 tons per year of sediment, of which 23% is potentially controllable. Hecht (1998) indicates that stream conditions have not improved since the Watershed Management Plan, developed in 1979 by the SCCPD, was written. The proportion of bed material composed by baserock used for road surfacing has increased over the years, indicating significant wasting of roads in the upper watershed. The bed material is generally composed of finer material, with proportionally less material originating in the upper watershed, and more from the lower, sandier areas.

Algal growth has been documented in excessive amounts in the lower San Lorenzo River. Studies have been done to assess the extent of the algal growth problem in the watershed. Species found at Boulder Creek and Ben Lomond were particularly indicative of a nutrient enrichment problem. Relatively low dissolved oxygen levels at Boulder Creek support this finding. As the river moves downstream through Henry Cowell State Park this condition improves substantially (SCCPD 1979).

Fish and Game surveys (CDFG 1996) indicate that water diversions by the City Water Department and by riparian users significantly impact summer stream flow, to the point that dewatering occurs at times. Water impoundment by Loch Lomond Reservoir also results in a reduction of flows to the lagoon. Channelization, riparian habitat removal, and lack of wood debris greatly reduce habitat quality in the lower reaches of the river. The same surveys describe numerous problems in tributary streams, including siltation, degradation of stream flow from water diversion, removal of riparian vegetation, improper placement of culverts, and degradation of water quality from septic systems.

### **Pajaro River Hydrologic Unit 305**

The Pajaro River watershed was the focus of CCAMP watershed rotation monitoring in 1998 and 2005. Much of the following description of water quality issues stems from data collected by CCAMP in 1998.

Several waterbodies in the Pajaro watershed are listed on the CWA 303(d) list of impaired waterbodies, as follows:

<b>Water Body</b>	<b>Pollutant</b>	<b>Pollutant</b>	<b>Pollutant</b>	<b>Pollutant</b>	<b>Pollutant</b>
Pajaro River	Sedimentation	Nutrients			
Watsonville Slough	Sedimentation	Pathogens	Oil and Grease	Metals	Pesticides
Llagas Creek	Sedimentation	Nutrients			
Rider Gulch	Sedimentation				
San Benito River	Sedimentation				
Clear Creek	Mercury				
Hernandez Reservoir	Mercury				
Schwan Lake	Nutrients	Pathogens			

General Watershed Description - The Pajaro River watershed encompasses over 1,300 square miles of central California. The major direct tributaries to the Pajaro River include San Benito River, Tequisquita Slough/Santa Ana Creek, Pacheco Creek, Llagas Creek, Uvas Creek, and Corralitos Creek. The Pajaro River flows to Monterey Bay north of Moss Landing Harbor.

The Pajaro River watershed encompasses parts of four counties: San Benito County (about 65% of the watershed area), Santa Clara County (about 20% of the watershed), Santa Cruz County (about 10% of the watershed) and Monterey County (less than 5% of the watershed). There are five incorporated cities within the watershed: Watsonville, Gilroy, Morgan Hill, Hollister, and San Juan Bautista. The Pajaro River watershed contains a wide variety of land uses, including row crop agriculture, livestock grazing, forestry, industrial, and rural/urban residential. The watershed also contains significant amounts of natural vegetative cover, which provides habitat to numerous native bird and wildlife species.

Pajaro River watershed flow patterns are characteristic of a Mediterranean climate, with higher flows during the wetter, cooler winter months and low flows during the warmer, drier summer months. Principal water sources for the Pajaro River and its tributaries are surface runoff, springs, subsurface flow into the channels, and reclaimed water entering the creek through percolation from water discharged by South County Regional Wastewater Authority (SCRWA). The first three water sources are subject to large flow variations due to climatic influences, while the discharge from the SCWRA tends to influence flow year-round.

Water Quality Findings - The Pajaro River watershed was monitored (water, sediment, and tissue samples) by the Central Coast Regional Water Quality Control Board (RWQCB) and subcontract laboratories from December 1997 through January 1999 to assess the relative contributions of conventional pollutants (nutrients, sediment, etc.), toxins, metals, and other pollutants from major tributary streams to document ambient water quality.

Conventional Water Quality - CCAMP has documented levels of pH, nutrients (nitrate and ammonia), dissolved oxygen, and total dissolved solids in the Pajaro River watershed that do not meet Central Coast Water Quality Control Plan (Basin Plan) water quality criteria. CCAMP has also determined that other water quality parameters of concern include temperature, algae (attached and suspended), sediment, and bacteria.

Sedimentation has been documented as a problem in portions of the watershed in other studies (Balance Hydrologics 1990 and Golder 1997). Much of this is due to bank sloughing, land slides of sandstone and shales in headwater areas, and sheet and rill erosion from adjacent land uses. The lower portion of the San Benito River is degrading as a result of gravel mining, and is in a state of disequilibrium, which can result in



erosion of banks (Applied Science Engineering et al. 1999). CCAMP monitoring in 1998 did not address instream impacts of sedimentation in a detailed way, but did assess sediment impacts as part of bioassessment habitat analysis. That "snapshot" view indicated that lower Llagas Creek and the Pajaro River at Betabel Road were most severely impacted by sediment.

CCAMP monitoring documented specific violations of Basin Plan pH criteria (mean values greater than standard of 8.3 pH units) at two sites in the Pajaro River watershed (Tres Pinos Creek and Pajaro River at Frazier Lake Road). Limited pH data has been collected on the San Benito and Pajaro Rivers. Dynamac Corporation (1998) reported "background concentrations" of pH data collected in the San Benito River up stream and down stream of the confluence with Clear Creek (upper San Benito River) exceeded regulatory limits (pH values from 8.4 to 8.8). Similarly, Williamson (1994) documented a pH range of 7.8 to 9.3 at the Frazier Lake Road site. A report by Greenlee (1981) contained 1978 Pajaro River surface water data collected by the State Water Resources Control Board showing pH values ranging from 6.6 to 9.4. This range of pH values in the Pajaro River is supported by historical data from the Chittenden stream gauge station (USGS and DWR data summarized by Williamson (1994)).

Water samples from three stations along the southern portion of Llagas Creek exceeded the State nitrate drinking water objective of 10 mg/L ( $\text{NO}_3$  as N) on multiple occasions, and ranged as high as 31.7 mg/l at Holsclaw Road. Williamson (1994) reported similar elevated nitrate levels at two sampling stations (17.7 and 19.0 mg/L  $\text{NO}_3$  as N) on Llagas Creek. Similarly, James Montgomery Consulting Engineers (1993) documented nitrate levels on Llagas Creek between 4.5 and 17.0 mg/L  $\text{NO}_3$  as N. Historical data (1955 through 1991) from various stations on Llagas Creek show nitrate levels on Llagas Creek ranging between 0.1 and 10.3 mg/L  $\text{NO}_3$  as N (sources include USGS 1982 – 1990 Water Resources Data Reports, Regional Water Quality Control Board 1983 Staff Report). Haase (Applied Science Engineering et al., 1999) theorized that a reducing substance was infiltrating into the reach where seepage from the City of Gilroy's treatment plant is prevalent (from Holsclaw Road downstream to Bloomfield Road), because of the declining nitrate levels and sometimes increased ammonia levels across this reach.

The Basin Plan unionized ammonia objective of 0.025 mg/L  $\text{NH}_3$  as N was exceeded once at the Tequisquita Slough site reaching 0.072 mg/L  $\text{NH}_3$  as N. Limited ammonia data has been collected in the Pajaro River watershed. James Montgomery Consulting Engineers (1993) documented ammonia levels on Llagas Creek between 0.0007 and 0.0014 mg/L  $\text{NO}_3$  as N. Williamson (1994) reported similar ammonia levels (a limited review of the data revealed ammonia levels from 0.011 to 0.032 mg/L  $\text{NH}_3$  as N) at six sampling stations in the Pajaro River watershed. The levels documented are typically below the 0.025 mg/l  $\text{NH}_3$  as N limit and indicate no problem with ammonia toxicity.

Over 35 violations of Basin Plan dissolved oxygen criteria for the COLD beneficial use (minimum values less than standard of 7.0 mg/L) were observed at twelve sites in the Pajaro River watershed. Williamson (1994) reported similar dissolved oxygen levels (a

limited review of the data revealed 11 dissolved oxygen measurements below 7.0 mg/L) at six sampling stations (four on Llagas Creek and two on the Pajaro River) in the Pajaro River watershed. James Montgomery Consulting Engineers (1993) also documented 16 dissolved oxygen measurements below 7.0 mg/L on Llagas Creek, Miller Canal, and Pajaro River. The Greenlee (1981) report containing 1978 Pajaro River surface water data collected by the State Water Resources Control Board documented one instance of dissolved oxygen below 7.0 mg/L.

Three violations of Basin Plan dissolved oxygen criteria for the WARM beneficial use (minimum values less than standard of 5.0 mg/L for WARM) were observed at the Tequisquita Slough site in the Pajaro River watershed. Of the data reviewed, no others documented dissolved oxygen levels lower than this value in water bodies designated as WARM.

All but two sites sampled in the Pajaro River watershed had at least one dissolved oxygen measurement depressed below 85% saturation, however the Basin Plan objective is applied to the median dissolved oxygen saturation value of 85%. Both Tequisquita Slough and the Pajaro River sites at Betabel Road and Thurwachter Bridge violated the oxygen saturation criteria 50 percent of the time. Of other data sources reviewed, none recorded oxygen saturation levels.

Average total dissolved solids (TDS) levels, at all Llagas Creek sites, exceeded the Basin Plan waterbody specific objective of 200 mg/L. On the San Benito River, at the Y Road site, TDS levels exceeded the Basin Plan surface water quality objective of 1400 mg/L in September and October 1998. TDS values at the lower Pajaro River sites at Chittenden Gap and Murphy's Crossing reached or exceeded the Basin Plan surface water quality objective of 1000 mg/L for TDS in August, September, and October 1998.

James Montgomery Consulting Engineers (1993) documented a range of average TDS values of 736 to 848 mg/L on Llagas Creek. Only two samples out of 25 collected were below the water quality objective of 200 mg/L. James Montgomery Consulting Engineers (1993) also observed an average range of TDS values of 829 to 839 mg/L on Pajaro River. Average TDS values reported for this section of the Pajaro River were below the Basin Plan surface water quality objective of 1000 mg/L, but several individual measurements exceeded the objective.

Metals – State Mussel Watch Program tissue data collected during the 1998 CCAMP sampling from the San Benito River at Y Road had the highest values of all sites for several different metals, notably aluminum, cadmium, chromium, copper, mercury, nickel, silver, and zinc, implying metals may be a problem in this watershed. Chromium, copper and zinc levels in tissue were high throughout the watershed compared to Median International Standards. Chromium levels were also elevated throughout the watershed in sediment samples. Chromium concentrations are commonly high in areas with serpentine soils.

Manganese levels in tissue were high throughout the Pajaro watershed overall compared to the Mussel Watch EDL 95 for transplanted freshwater clams, and in Llagas Creek samples were particularly high. Historical data from the Pajaro Valley Water Management Agency has shown manganese to also be elevated in Corralitos Creek (Applied Science Engineering et al. 1999)

On the Pajaro River at Betabel Road, several metals (lead, copper, nickel and zinc) were above cold water habitat Basin Plan criteria, in a single water sample taken in March. Metals data from the Chittendon Gap site on the Pajaro River have historically been elevated for both mercury and lead. Mercury and lead are also periodically elevated on Llagas Creek (Applied Science Engineering et al. 1999).

A management plan developed for Watsonville Slough identified copper, nickel and zinc at high levels in tissue and sediment in the Slough (Questa Engineering 1995). Lead at potentially toxic levels has also been detected repeatedly over the years (Applied Science Engineering et al. 1999).

Mercury was elevated (over the California Toxics Rule water quality objective) at sites on the San Benito watershed, in water samples collected for CCAMP by the State Mussel Watch Program. Sediment samples from the upper San Benito watershed also had elevated mercury levels (exceeding the NOAA ERL). There are a number of historical references to elevated mercury levels in this watershed (Applied Science Engineering 1999). Both Clear Creek and Hernandez Reservoir are listed on the 303(d) list for mercury.

A Clear Creek study conducted for the Bureau of Land Management (Dynamac 1998) found elevated levels of chromium, nickel and copper in water quality samples. Sediment samples were high in cobalt, nickel and mercury at several sites, and antimony, chromium, cadmium, copper, and arsenic at a few sites. Some references also indicate elevated levels of barium in Clear Creek (Applied Science Engineering 1999).

Synthetic Organic Chemicals - Legacy organochlorine pesticides and several currently applied organophosphate pesticides can be found in most tributaries of the Pajaro River system. DDT compounds were widespread in CCAMP sediment and tissue samples. Several main stem sites had elevated levels of DDT, dieldrin, and chlordane compounds. The Betabel Road site had the highest values of dieldrin and toxaphene. Chittendon Gap had relatively high levels of dieldrin and toxaphene as well as chlordane compounds. Llagas Creek also had relatively high levels of chlordane compounds.

Salsipuedes Creek stands out in CCAMP data for the relatively large number of chemicals that were present in clam tissue. DDT compounds were found at levels exceeding several criteria at this site in sediment, water and tissue. Relatively low levels of diazinon and chlorpyrifos were found in sediment, water, and/or tissue. Other chemicals included dieldrin, chlordane, and oxadiazon (sediment and tissue); and toxaphene, heptachlor epoxide, and ethyl parathion (tissue only).

The most prevalent findings related to currently applied pesticides were relatively high values of diazinon in clam tissue collected in several main stem Pajaro River sites, particularly at Betabel Road. Pacheco Creek also had somewhat elevated levels of ethyl parathion, which though being phased out, is still applied to certain crops.

Toxicity Identification Evaluation studies conducted on samples from lower Pajaro watershed sites (by Granite Canyons Marine Pollution Studies Laboratory staff in 1998) suggested the toxicity found on the main stem and in some of the agricultural drains were attributable to organochlorine pesticides. 78% of samples collected from drainage ditches were acutely toxic. Sampling by M. Swanson and the Habitat Restoration Group in the winter of 91/92 identified 4'4'DDE and endosulphan sulphate in the Pajaro lagoon. The Questa Engineering study (1995) confirmed elevated levels of diazinon and DDT/DDE in water quality samples. State Mussel Watch data confirms that Watsonville Slough has had extremely high levels of organochlorine pesticides in past years, particularly DDT, chlordane, dieldrin, endosulphan, toxaphene, hexachlorobenzene and PCBs; some of these levels are the highest documented in the State.

Oil and Grease – Recent stormwater data collected from Watsonville Slough (RWQCB, 2001) indicate that oil and grease are found there at levels that are sometimes of concern. Watsonville Slough is listed as impaired by oil and grease.

**Bolsa Nueva Hydrologic Unit 306**

The Bolsa Nueva Hydrologic Unit is located in Monterey County, east of Moss Landing Harbor and consists of Moro Cojo Slough and Elkhorn Slough. These largely tidal waters enter Monterey Bay through Moss Landing Harbor. Both the Elkhorn and Moro Cojo Sloughs are listed on the CWA 303(d) list of impaired waterbodies, as follows:

Waterbody	Pollutant
Elkhorn Slough	Pathogens Pesticides Sedimentation/Siltation
Moro Cojo Slough	Low Dissolved Oxygen Pesticides Sedimentation/Siltation

Water Quality findings

Historically, water quality data in the Bolsa Nueva Hydrologic Unit is minimal. However, some data sources exist for nutrients, as summarized by Jaggeer (1981). More recently, the Elkhorn Slough Reserve employs two water quality monitoring programs. The volunteer monitoring program has been collecting monthly data since 1988 in both Elkhorn and Moro Cojo Sloughs. The National Estuarine Reserve System (NERR)

system-wide program has been collecting data since 1995, including continuous probe data at multiple stations throughout the Elkhorn Slough. CCAMP is also collecting data at one location in Moro Cojo Slough and three locations in the Elkhorn Slough and its tributaries.

#### Conventional Water Quality

Historic nutrient data from Elkhorn Slough indicated that nitrate, phosphorus, and ammonia levels in Elkhorn Slough were uniformly low. Jagger (1981) also concluded that there was little impact from agricultural return waters on Elkhorn Slough, although it was not determined if this was due more to regular tidal flushing or to a lack of nutrient inputs. Elkhorn Slough is largely tidal, with some freshwater stratification in the rainy winter months.

The data report for volunteer monitoring data in the Elkhorn Slough Reserve summarized several findings including a significant increase in nitrate concentrations over the past thirty years (Caffrey 1997). In general, volunteer monitoring data documented elevated nutrient concentrations throughout most of Elkhorn Slough, Bennett Slough and Moro during the rainy season. Volunteer data from Carneros Creek a tributary to Elkhorn Slough show nitrate concentrations in excess of 14 mg/l during the winter rainy season. The volunteer data summary report also reported relatively low concentrations of ammonium, despite potential inputs from dairy farms in watershed. Data analysis conducted by Caffrey et al (1997) show that nutrient concentrations in the slough have increased dramatically since the 1970s and when compared to historic data the authors have shown that nitrate concentrations have increased at all stations where both historic and current data exists.

Bacterial monitoring conducted in the Bolsa Nueva watershed between 1988 and 1994 for assessment of the feasibility of a commercial shellfish operation in Elkhorn Slough. The sites were largely marine and tidal, with generally low bacteria levels. Total coliform levels exceeded 10,000 MPN/100ml and fecal coliform exceeded 600 MPN/100ml in about 5 % of the samples, with the highest values occurring during rainy winter months (Cotter and Strnad 1997-secondary reference from SWRCB 1999).

Dissolved oxygen concentrations measured monthly by volunteer monitors ranged widely within Elkhorn Slough as in normal in estuaries. In addition to monthly monitoring continuous monitoring probes were deployed at several locations in the Slough. These results show that the Upper Pond becomes hypoxic or anoxic on a daily basis for several weeks in late summer or early fall, while the South Marsh does not.

#### Synthetic Organic Chemicals and Metals

Moss Landing Harbor and its tributaries are listed as a known Toxic Hot Spots for pesticides, PCBs, nickel, chromium, and tributyl tin (SWRCB 1999). Several beneficial uses for waterbodies in this Hydrologic Unit are impaired due to metal or pesticide concentrations. Data collected in Moss Landing Harbor identified multiple pollutants which exceed published criteria for sediment and tissue. These include pesticides (dieldrin, chlordane, DDT and toxaphene), PCB's and metals (tri-butyl tin and nickel). Sediment samples were also toxic to invertebrate test organisms. Moss Landing Harbor

is now on the Clean Water Act section 303(d) list (Impaired Waters List) for pesticides. In Elkhorn Slough, elevated levels of dieldrin, endosulfan and nickel were reported and the Slough was added to the Impaired Waters List in 1999 for pesticides. Moro Cojo Slough data showed elevated dieldrin, DDT, toxaphene, PCB's and nickel in tissue and sediment. Sediment samples were also toxic to invertebrate test organisms.

### **Carmel River Hydrologic Unit 307**

The Carmel River watershed is located in Monterey County just south of Monterey Bay, between the Santa Lucia mountains to the South and the Sierra del Salinas to the North and East. The river flows northwest through Carmel Valley to Carmel River lagoon and the Pacific Ocean near Carmel. The watershed drains approximately 199,570 acres. The largest tributary to the Carmel River is Tularcitos Creek. There are two major impoundments along the watercourse, Los Padres Dam and San Clemente Dam. The Carmel Valley has a mixture of urban areas, including Carmel Village and the City of Carmel by the Sea, rural residential, agriculture, rangeland and recreational areas. The Carmel River between San Clemente Dam and Los Padres Dam flows through woodland and grassland, primarily used for rangeland and rural residential purposes. The upper reaches of the Carmel River, above the Los Padres Dam, flow through the Los Padres National Forest.

CCAMP staff conducted monthly monitoring at five sites in this watershed in 2002. In general, the watershed is in good condition. One Carmel River site (near Carmel Village) had widely ranging dissolved oxygen values, with lows reaching 6.12 mg/L during summer 24 hour continuous monitoring. There were no other exceedances of Basin Plan objective at sites on the Carmel River. CCAMP staff also monitored one site on Tularcitos Creek. Elevated phosphate levels were reported and 50% of all CCAMP monthly sample exceeded the Basin Plan Objective for contact recreation (400 MPN/100mL).

### **Santa Lucia Hydrologic Unit 308**

The Santa Lucia Hydrologic Unit is located west of the Santa Lucia mountain ranges in Monterey County and is characterized by small coastal streams that flow directly to the ocean. Because this Hydrologic Unit is located along the remote Big Sur coastline, many of the watersheds have little or no disturbance by agricultural or urban activities. Upper watersheds originate in the Los Padres National Forest, on the steep northwestern slopes of the Santa Lucia mountains. Primary impacts in this forest stem primarily from roads, cattle grazing, fire management, inactive mines, and other sources of sediment. Rural residential uses are common at lower watershed elevations. Watersheds with these primary land use activities include San Jose Creek, Garrapata Creek and Little Sur River. Several of the larger creeks and rivers run through State and/or private parks at their lower ends. For example, the Big Sur River watershed, which is the largest in the Unit at 37,392 acres, includes National Forest Service land, Big Sur State Park, Andrew Molera State Park, small private parks, the community of Big Sur and scattered single family

residences. Other creeks, such as Big Creek, have far less exposure to human activities; the upper reaches of this creek are in Forest Service land and the lower reaches are within the U.C. Santa Cruz Landels-Hill Big Creek Ecological Reserve.

In 2002, CCAMP staff conducted monthly monitoring at several creeks and rivers in this Hydrologic Unit including the following: San Jose Creek, Garrapata Creek, Little Sur River, Big Sur River, Big Creek, Limeklin Creek, Mill Creek and Willow Creek. Many of these are also coastal confluence sites. No site in this Hydrologic Unit exceeded Basin Plan objectives. However, nuisance algae and emergent aquatic plant growth was documented at San Jose Creek. These conditions occurred as the creek was drying up in the summer months.

### Salinas River Hydrologic Unit 309

The 2002 303d list indicates that nutrients, pesticides, and fecal coliform bacteria are the most widespread pollutants in the lower Salinas watershed, while metals are the dominant pollutant in the upper Salinas watershed. The presence of some of these pollutants at problematic levels has been well documented for decades (Jagger 1981, Jagger et al. 1981, Cotter and Strnad 1997), and recent sampling by CCAMP and others suggests that these problems persist today (CCoWS 2003, CCAMP 2003, Rasmussen and Blethrow 1990, Downing et al. 1998).

Twenty-four water bodies within the Salinas River watershed have been listed by the Regional Board on the 2002 Clean Water Act's 303(d) list of impaired water bodies due to specific pollutants as follows:

Waterbody	Pollutant	Pollutant	Pollutant	Pollutant
<b>Lower Salinas Watershed</b>				
Alisal Creek	Fecal Coliform	Nitrate		
Gabilan Creek	Fecal Coliform			
Old Salinas River Estuary	Fecal Coliform	Nutrients	Pesticides	Dissolved Oxygen
Salinas River (Estuary to Gonzalez)	Fecal Coliform	Nutrients	Salinity/TDS/ Chlorides	Pesticides
Salinas River (upper)	Chloride	Sodium		
Salinas River Lagoon South	Nutrients	Pesticides	Salinity/TDS/ Chlorides	
Tembladero Slough	Fecal Coliform	Nutrients	Pesticides	
Blanco Drain	Pesticides			
Espinosa Slough	Nutrients	Pesticides	Organics	
Salinas Reclamation Canal	Fecal Coliform	Nitrate	Pesticides	Dissolved Oxygen
Salinas River (Gonzalez Rd to Nacimiento River)	Pesticides		Salinity/TDS/ Chlorides	Sedimentation
Salinas River Lagoon North	Nutrients	Pesticides	Sedimentation	
San Lorenzo Creek	Fecal Coliform	Boron		
<b>Upper Salinas Watershed</b>				
Atascadero Creek	Fecal Coliform			
Las Tablas Creek, N. Fork	Metals			
Nacimiento Reservoir	Metals			
Las Tablas Creek	Metals			
Las Tablas Creek, S. Fork	Metals			

### **General Watershed Description**

The watershed of the Salinas River and its tributaries covers approximately 4,600 square miles (nearly 3 million acres) and 2 Hydrologic Units, the Salinas River Hydrologic Unit (HU 309) and the Estrella River HU (317). The Salinas watershed is completely within San Luis Obispo and Monterey Counties. The Salinas River originates in San Luis Obispo County, flows northwest into Monterey County, through the entire length of the Salinas Valley and empties into Monterey Bay. The watershed's main tributaries are the Arroyo Seco, Nacimiento, San Antonio, and Estrella Rivers. The Salinas forms a large lagoon at its mouth, closed to the ocean by a sandbar much of the year.

Grazing and pasture lands and dry land farming have historically been the dominant land uses in the upper Salinas watershed; however, large areas in southern Monterey County and northern San Luis Obispo County are being converted to vineyards and grazing now primarily occurs in foothill regions of the watershed. Irrigated cropland is predominant in the lower Salinas watershed. Row crops such as lettuce, celery, broccoli and cauliflower are cultivated on the valley floor. The lower Salinas watershed is one of the most productive agricultural areas in the world, with a gross annual value of nearly \$2 billion. The rapidly expanding wine-producing region in the upper Salinas watershed around Paso Robles is also becoming a highly productive agricultural area. Urban development occurs primarily in a corridor along the Salinas River. Major cities in the lower Salinas watershed include King City, Greenfield, Soledad, Gonzalez, Salinas and Castroville. The largest city, Salinas, has more than 140,000 people and is growing rapidly. Urban development and rapid growth in the upper Salinas watershed is occurring in the small cities of Santa Margarita, Atascadero, Templeton and Paso Robles. Additional land uses include two military facilities (Fort Hunter Liggett and Camp Roberts), mineral and oil extraction in the San Ardo area and a few other locations throughout the watershed, and some public land and open space.

The watershed has three dams, one on the upper Salinas River south of Santa Margarita, one on the Nacimiento River and one on the San Antonio River. The above information is adapted from the Salinas River Watershed Management Action Plan (RWQCB, 1999a).

### **Water Quality Findings**

A general overview of Salinas watershed water quality findings follows. For the purposes of this summary the upper and lower watershed (divided at Bradley) are discussed separately.

#### **UPPER SALINAS WATERSHED, ABOVE BRADLEY:**

##### *Conventional Water Quality:*

Most of the nutrient data for the upper Salinas watershed area prior to 1999 comes from a 1981 review of Basin Plan Water Quality Standards for the Salinas River that included a significant data and literature review. The authors report that in general, nutrient levels



and associated problems with dissolved oxygen fluctuations were not a concern in the upper Salinas River as of 1981 (Jagger et al. 1981). These data show that Salinas River nitrate concentrations near Bradley averaged 0.22 to 0.45 mg/L NO<sub>3</sub> as N from 1958 to 1980, with a maximum level of 4.4 mg/L NO<sub>3</sub> as N in 1961 (Jagger et al. 1981). Neither ammonia nor dissolved oxygen levels were considered a water quality problem in the upper Salinas watershed as of 1981. Nitrate concentrations at the Bradley bridge in CCAMP data from 1999 ranged from 0.22 to 0.72 mg/L NO<sub>3</sub> as N.

TDS, sodium, boron, and chloride were within Basin Plan objectives in 1981 at Bradley Bridge (Jagger et al. (1981). During this same time period, sulfate levels were moderately higher than existing Basin Plan objectives, but the suggestion at that time was to raise the Basin Plan objective (Jagger et al. 1981). CCAMP data collected in the upper watershed in 1999 shows that site specific objectives for chloride, sodium and total dissolved solids were exceeded on multiple occasions in the upper Salinas watershed, including main stem sites in Atascadero, Paso Robles, Bradley and San Ardo. San Lorenzo Creek, which enters the Salinas River from the east side of the watershed, also has elevated boron and total dissolved solids.

A 1971 survey by the State Health Department found that fecal bacteria levels in the Salinas River near Bradley were below levels of concern (Jagger et al.1981). CCAMP data collected monthly in 1999 show that fecal coliform levels in Atascadero Creek and Salinas River at Atascadero were elevated, relative to Basin Plan Objectives, on multiple occasions.

#### Pesticides & Metals

No historic data on pesticides or metals in water or stream sediments is available for the upper Salinas watershed. In 1999, CCAMP collected sediment samples throughout the watershed. There were no exceedances of available criteria for organic chemicals or metals in sediments from upper-watershed sites.

#### LOWER SALINAS WATERSHED:

The known water quality problems and the majority of past water quality data for the lower Salinas watershed are concentrated in the area downstream of the town of Chualar (approx 10 miles upstream from the city of Salinas).

#### Conventional Water Quality

Elevated nutrient levels and associated problems with algal blooms and dissolved oxygen extremes in the lower Salinas watershed have been well documented since as early as 1965 (SWRCB 1965). Prior to the construction of the Monterey regional wastewater treatment plant (in 1990), dry season flow in the lower Salinas River was almost entirely a combination of wastewater discharge and agricultural return flows. Jagger et al. (1981) documented that nitrogen and phosphorus levels increased dramatically below the wastewater treatment plant inputs and were accompanied by large algal blooms and associated extreme diurnal swings in dissolved oxygen in the Salinas River. At these

locations unionized ammonia levels greatly exceeded levels of concern for toxicity to fish on a regular basis (Jagger et al.1981). Limited data for the Tembladero Slough prior to 1990 suggests that it had elevated nitrate and phosphate levels similar to the lower Salinas River, and increasing below wastewater treatment plant discharge points. However, ammonia levels were significantly lower (Jagger et al.1981).

The long-term water quality monitoring program for Elkhorn Slough and the tributaries to Moss Landing Harbor found that nitrate (as  $\text{NO}_3$ ) in the Old Salinas River, Tembladero Slough, and Salinas River Lagoon averaged 30 mg/l for the period 1988-1995, , with highest concentrations during the low flow dry season (Caffrey et al. 1997). A more recent analysis of nutrients in the Salinas watershed examines nitrate, ammonia, and phosphate data spanning the last decade in Salinas and Pajaro watershed areas, from Central Coast Watershed Institute (CCoWS), CCAMP, and USGS sampling stations (Anderson et al. 2003). This analysis shows that the agricultural return drains in the lower Salinas watershed, including Chualar Creek, Quail Creek, Tembladero Slough, the Salinas Reclamation Canal and Blanco Drain, have extremely high levels of ammonia, nitrate, and phosphate, with numerous sites averaging greater than 20 mg/L  $\text{NO}_3$  as N. The main stem Salinas River sites have much lower nutrient levels, but are clearly influenced by the input of the agricultural return drains, with increasing nitrate and phosphate concentrations in the sites downstream of these inputs. Nutrient levels tend to be lower during high flow events than during base flow conditions.

### Bacteria

Bacterial contamination in the lower Salinas River has been a chronic problem since at least 1969, when the Monterey County Health Department began regular sampling that led to continuous posting of the river below Spreckels as unsafe for water contact recreation. The county emphasized that the problem was worst in the summer when agricultural return flows and wastewater treatment plant outputs were the primary sources of water in the lower Salinas. Like nutrients, coliform bacteria concentrations were generally lower above the wastewater treatment plants and higher below them. Coliform levels measured in Alisal Slough and Blanco Drain (agricultural return drains) in 1980 indicated that high levels of coliform were also entering the Salinas from these drainages (Jagger et al. 1981).

More recent bacterial monitoring data from the lower Salinas Watershed show elevated fecal coliform levels year round in San Lorenzo Creek, Quail Creek, Salinas Reclamation Canal and a storm drain input at Airport Road, the Salinas Storm drain near Davis Road, and Tembladero Slough. These data are from monthly monitoring between January 1999 and March 2000. In wet weather flows the Salinas River at Chualar and David Road also had elevated fecal coliform levels during this period (CCAMP 2003).

### Minerals and Salts:

Limited data on minerals and salts in the water bodies of the lower Salinas watershed suggests that TDS, sodium, boron, and chloride in the lower Salinas were moderate to low above Spreckles, but increased significantly from Spreckles downstream. Because

no specific water quality objectives for minerals or salts were listed for the water bodies below Spreckels at the time of the analysis, only a brief discussion of TDS was presented in the report (Jagger et al. 1981). TDS was found to peak at the Blanco Drain input, and separate sampling in Blanco Drain confirmed that it had much higher conductivity and salinity than the main stem Salinas River. This suggests that agricultural return drains in the lower Salinas watershed were increasing the TDS levels in the main stem river at that time (Jagger et al. 1981).

CCAMP data collected in the lower watershed shows that site specific objectives for Boron were exceeded on multiple occasions in the Old Salinas River and Tembladero Slough. These sites are in the lower watershed and are tidally influenced.

### Pesticides

Row-crop agriculture is the dominant land use in the lower Salinas watershed. Intensive pesticide usage associated with agriculture is common throughout this area, and has probably been so since the development of pesticides for commercial agriculture in the 1940s. A wide variety of both legacy pesticides and currently used pesticides have been detected in water, sediment, and tissue samples from the lower Salinas watershed. Available data on pesticides in the Salinas Watershed begins in the early 1970s and includes tissue data from the State Mussel Watch Program (SMWP) and Toxic Substances Monitoring Program (TSM), water samples from the Department of Water Resources (DWR), sediment and toxicity testing by the Bay Protection and Toxic Cleanup Program (BPTCP), sampling by Burae (1981) taken in 1972, and sampling by the Regional Water Quality Control Board in 1980 (Jagger 1981).

Toxicity testing on numerous occasions between 1997 and 2003 has shown that the waters and sediments of numerous sites in the lower Salinas watershed are toxic to standard test organisms. Tembladero Slough and numerous agricultural return drains that flow into the Salinas have shown the highest toxicity, with some sites exhibiting 85-100% mortality from exposure to water on fifteen separate occasions across a time span of over a year. The observed toxicity was attributed to the organophosphate pesticides chlorpyrifos and diazinon in the majority of the samples where an evaluation of toxicity sources was conducted (Downing et al. 1998, Hunt et al. 2003 and Anderson et al. 2003). CCAMP sediment chemistry monitoring, conducted in 1999, identified elevated DDT in sediments (relative to ERM values) from the Salinas River Lagoon, the Old Salinas estuary and Tembladero Slough.

### Metals

Extensive sampling of stream sediments for heavy metals as described in Burae et al. (1981) was conducted in large portions of the Salinas watershed in 1972. This sampling effort identified the marine sedimentary deposits on the southwest side of the Salinas River between King City and San Ardo as naturally high in cadmium, arsenic, copper, and zinc. Metals were found at generally low levels in sediments and soil samples

throughout the sampled areas. The only criteria exceedance was for lead, in Salinas River sediments near San Ardo exceeding the Probable Effects Level at 102 ppm.

The sampling effort by Burau et al. (1981) did not include any portion of the Nacimiento River drainage. This area is naturally rich in mercury, and was commercially mined for mercury in the past. Metals concentrations in water samples from these water bodies consistently exceed narrative and numeric water quality objectives for mercury (RWQCB 1999b). In addition, a number of fish tissue samples collected from fish in Lake Nacimiento between 1981 and 1994 exceeded US Food and Drug Administration standards for human consumption (Rasmussen and Blethrow 1990). Inactive mercury mines in the Las Tablas Creek drainage are thought to be the primary source of the high mercury levels found in water, sediment, and fish tissue from these water bodies (Rice et al. 1994 and RWQCB 2002).

CCAMP sediment chemistry monitoring, conducted in 1999, identified elevated nickel concentrations in sediments from Tembladero Slough, Old Salinas River, the Salinas River at Davis Road, and the Salinas Lagoon. In addition, elevated nickel concentrations were measured in the channel that conveys storm drain water from the City of Salinas to the Salinas River above Davis Road.

### **Estero Bay Hydrologic Unit 310**

The coastal watersheds of the Estero Bay Hydrologic Unit are in western San Luis Obispo County. San Luis Obispo Creek is the largest of the watersheds in this Unit, at 54,150 acres. Steelhead trout are an important resource in most of these creeks, and the southern portion of this Unit is often considered the southern extent of their viable range. TMDL listings in this area include Morro Bay (for metals, pathogens, and sedimentation), Chorro Creek (for metals, nutrients, and sedimentation), Los Osos Creek (for nutrients, priority organics, and sedimentation), and San Luis Obispo Creek (for nutrients, pathogens, and priority organics).

Several urban areas including San Simeon, Cambria, Cayucos, Morro Bay, Los Osos, San Luis Obispo, Pismo Beach, Arroyo Grande, and Oceano are found in the area. Major land uses in the area include grazing, agriculture and residential. In the watersheds of San Simeon, Santa Rosa, Villa, Cayucos, Old, Toro and Morro Creeks the primary land uses are grazing, vineyards, avocado and orange orchards on multiple ranch properties. In recent years an increasing number of ranches are converting to vineyards and avocado orchards. Some areas include intensive agricultural cropping activities, particularly in the lower watersheds of Chorro Creek, Los Osos Creek, San Luis Obispo Creek, Pismo Creek, and Arroyo Grande Creek. There are additional land uses that have affected water quality in several of these watersheds, these are discussed in more detail in the following paragraphs.

In the San Simeon Creek watershed the creek mouth is located within the boundary of San Simeon State Park Campground. Upstream of this location there is gravel mining on the stream terraces. Also located just upstream from the campground are Cambria Community Services District wastewater percolation ponds and spray fields. The San Luis Obispo Waste Water Treatment Plant (WWTP) discharges directly to San Luis Creek, resulting in consistently elevated phosphate levels downstream. A similar situation is found in Chorro Creek downstream of the California Men's Colony WWTP discharge. During some months of drier years the lowest reaches of these creeks are dominated by effluent flows.

Impoundments in several watersheds in the Unit have significantly altered stream hydrology and are barriers to fish passage. Old Creek historically flowed to Estero Bay between Cayucos Creek and Toro Creek. Whale Rock Reservoir is located less than a mile from the ocean on this creek, creating a complete fish barrier for the majority of the watershed. Native steelhead trout populations are currently maintained in the reservoir by artificial spawning and rearing. Chorro Creek flows to Morro Bay Estuary at Morro Bay State Park. Morro Bay is recognized as both a State and National Estuary. The headwaters of Chorro Creek drain to Chorro Reservoir, which both impounds Chorro Creek water and serves as a terminal reservoir for Whale Rock Reservoir. Chorro Reservoir is located above the California Men's Colony facilities on California National Guard property. Low volume year-round releases from the reservoir are maintained. The dam at Lopez Lake divides the Arroyo Grande watershed, with more than half of the watershed above the dam. Lopez Lake maintains continuous releases to the lower Arroyo Grande Creek channel. The dam represents a complete barrier for steelhead trout and has resulted in a significant reduction in anadromous spawning in this watershed. A small dam on Prefumo Creek, a tributary to San Luis Obispo Creek, has created Laguna Lake, which provides recreation for local residents as well as habitat for wildlife. It is not a barrier to steelhead passage in higher flows.

San Luis Obispo Creek has been channelized through the downtown areas of San Luis Obispo, and in one segment flows underneath the City. Creeks in the area with extensive channelization include Pismo Creek and Arroyo Grande Creek. Pismo Creek is contained in a cement box channel between Highway 101 and the ocean through the City of Pismo Beach. Arroyo Grande Creek is completely channelized below Fair Oaks Boulevard and the channel is maintained for flood control through annual removal of vegetation. Flood control in lower Arroyo Grande Creek is an ongoing local problem.

### **Soda Lake Hydrologic Unit 311**

The Carrizo Plain Hydrologic Unit is located in the eastern portion of San Luis Obispo County. This is a geologically and biologically unique area. A large portion of the land is protected in the "Carrizo Plain Natural Area (CPNA), a cooperative effort since 1985 between the Bureau of Land Management (BLM), the California Department of Fish and Game (CDFG), and The Nature Conservancy (TNC).

The Carrizo Plain is a basin-shaped watershed with no outlet to the ocean, formed by the Temblor Mountains to the northeast and the Caliente Mountains to the Southwest. The San Andreas Fault cuts along the base of the Temblor Range, resulting in striking geological features such as displaced streambeds and sheared hillsides. The Pleistocene uplift of the Temblors resulted in capture of runoff within the central Carrizo Plain to form Soda Lake, a 3,000 acre ephemeral alkaline lake at the center of the Plains. Soda Lake provides important habitat for migratory birds and is one of the largest undisturbed alkali wetlands in California. Without an outlet, water from the lake evaporates, leaving behind residual sulphates and carbonates. The lake is currently identified as impaired by ammonia on the Clean Water Act section 303(d) list.

Erosion by southern tributaries of the Salinas River has resulted in capture of the more northerly portions of the Plain, so that this area now drains to the Salinas River.

The CPNA is 250,000 acres of cattle ranching and dryland farming, rural residential and large areas of relatively undisturbed habitat. The Carrizo Plain supports many endangered, threatened and rare plant and animal species and contains some of the last remnants of the once vast San Joaquin Valley grassland habitat.

### **Santa Maria Hydrologic Unit 312**

The Santa Maria River Hydrologic Unit includes all areas tributary to the Cuyama River, Sisquoc River, and Santa Maria River. At 1,880 square miles (1.2 million acres) the Santa Maria River watershed is one of the larger coastal drainage basins of California. The Cuyama River and Sisquoc River originate in north and south slopes of the Los Padres National Forest wilderness areas. The Santa Maria River is formed by the confluence of the Cuyama and Sisquoc approximately 7 miles southwest of Santa Maria.

The upper Sisquoc River is in a reasonably natural state with much of the watershed located in National Forest and large ranches. Within the Los Padres Forest Service boundary, the upper 33 miles of the Sisquoc is listed as a National Wild and Scenic River and is important spawning habitat to steelhead trout (*Oncorhynchus mykiss*). Major tributaries to the Sisquoc River include La Brea Creek, Horse Canyon Creek and Tepusquet Canyon Creek.

The Cuyama River headwaters are in Ventura county where it is also in reasonably natural state (above Highway 33) and National Forest areas and large ranches are the primary land use. Below Sierra Madre Road and throughout its length in San Luis Obispo County the channel of the Cuyama has been highly altered to better align with State Highway 166. Much of the upper Cuyama watershed is made up of sedimentary marine deposits that are naturally erosive. As a result, the river carries a heavy sediment load. The Twitchell reservoir (completed in 1958) is located on the Cuyama River six miles above the confluence with the Sisquoc River. The dam traps much of the sediment contained in the Cuyama flows and prevents migration of steelhead upstream to tributaries of Alamo Creek and Huasna River where they historically spawned.

The Santa Maria valley is a broad flat valley, protected from flooding by levees and a series of flood control channels and basins. The lower Santa Maria River Watershed, including the Santa Maria River, is highly altered. The river has a very sandy, braided channel and is levied along much of its length. It is a "losing" stream, meaning that surface water flow tends to rapidly infiltrate into underlying permeable layers. The river is the major source of recharge to the Santa Maria groundwater basin. Urban runoff and associated pollutants also tend to infiltrate, rather than flow to the Santa Maria River.

Nipomo Creek drains the Nipomo valley and joins the Santa Maria River just west of US Highway 101. Solomon (Orcutt) creek drains the Orcutt area and joins the Santa Maria River near its outlet to the Pacific Ocean. Oso Flaco Lake and its drainage, though not part of the Santa Maria watershed, are included in Hydrologic Unit 312.00 and will be included in this sampling rotation. Oso Flaco is north of the Santa Maria Estuary.

Major activities in the Santa Maria watershed include irrigated and dryland agriculture, oil production, and urban development. Twitchell Reservoir serves important flood control and water recharge functions. Sedimentation of this reservoir is reducing its water storage capacity, and if allowed to continue will affect the reservoir's flood control capacity. Pollutants of known concern in the watershed include nitrates and total dissolved solids in groundwater, organochlorine pesticides in the estuary, and petroleum production byproduct (diluent) in ground and surface water of the Guadalupe Dunes and nearby areas. Currently TMDLs for nitrate and coliforms are being prepared by Regional board staff for the watershed. Those waters that are identified as impaired and are included on the Clean Water Act section 303(d) list are identified below. The majority of these impairments were identified as a result of CCAMP monitoring in this watershed between January 2000 and March 2001. These data can be viewed on the CCAMP website (<http://www.ccamp.org/ca0/3/312/312BySiteProj.htm>).

**Clean Water Act section 303(d) listed waters in the Santa Maria Hydrologic Unit**

<b>Waterbody</b>	<b>Pollutant / Stressor</b>
Alamo Creek	Fecal coliform
Bradley Canyon Creek	Ammonia Nitrate Fecal coliform
Bradley Channel	Nitrate Fecal coliform
Cyuama River	Boron
Main Street Canal	Ammonia Nitrate
Nipomo Creek	Fecal coliform
Oso Flaco Creek	Ammonia Nitrate Fecal coliform

Oso Flaco Lake	Dieldrin
Orcutt Solomon Creek	Ammonia Nitrate Fecal coliform Chlorpyrifos Dieldrin DDT
Santa Maria River	Ammonia Nitrate Fecal coliform Chlorpyrifos Dieldrin Endrin DDT

**San Antonio Creek Hydrologic Unit 313**

San Antonio Creek watershed drains approximately 17,000 acres (Cal Water v. 2.2) in Santa Barbara County, and is the only watershed in the San Antonio Creek Hydrologic Unit. The creek flows to the ocean on Vandenberg Air Force Base (AFB) property, north of the Santa Ynez River. There are several small tributaries in the watershed including Canada de las Flores and Harris Canyon Creek. Primary land uses include the residential and urban areas of the towns of Los Alamos and Vandenberg village, as well as agriculture and grazing upstream of Vandenberg AFB. San Antonio Creek is on the 303(d) list of impaired waterbodies due to sedimentation. The Vandenberg AFB water quality program is monitoring several sites on this creek. However, that data is not yet available for inclusion in this report.

**Santa Ynez River Hydrologic Unit 314**

The Santa Ynez River watershed drains approximately 574,885 acres originating in the Santa Ynez Mountains of Los Padres National Forest, and is the only watershed within the Santa Ynez River Hydrologic Unit. Three reservoirs have been created along the river course. The Jamison and Gibraltar Reservoirs are both located within Los Padres National Forest. Major tributaries to the river above these reservoirs include North Fork Juncal Creek, Agua Caliente Canyon Creek, Mono Creek and Indian Creek. Cachuma Reservoir is located along Highway 154, and major tributaries to the River between Gibraltar and Cachuma dam include Santa Cruz Creek and Cachuma Creek. The lower reaches of the River flow through Vandenberg AFB property to the ocean at Surf Beach. Major tributaries below Cachuma Dam include Santa Aguenda Creek, Alamo Pintado Creek, Zaca Creek, Santa Rosa Creek and Salsipuedes Creek. Steelhead trout are historically resident throughout the watershed, although fish passage at Cachuma Dam is notoriously poor. Land uses that may impact water quality in the watershed include recreation, including the numerous campground and day use areas along the river in the National Forest and at Lake Cachuma, grazing, dry land agriculture, viticulture, rural residential (including a large number of horse facilities) and the urban and residential



areas of Solvang, Buelton and Lompoc. The City of Lompoc’s wastewater treatment plant discharges to the River below the City, and at times the flows in the vicinity are effluent-dominated.

Summary of Existing Data for Hydrologic Unit 314

Water quality data has been collected by several entities in this watershed. Vandenberg Air Force Base staff monitor the river at the 13<sup>th</sup> Street Bridge; this is also a CCAMP site. Data collected by VAFB staff is not yet available for inclusion in this report. Data is collected by Lompoc WWTP staff in Santa Ynez River at two sites above and below the effluent discharge. WWTP monitoring data shows no toxicity below the discharge. However, temperature is elevated and dissolved oxygen and pH are both depressed downstream of the discharge relative to the upstream site. Phosphate is not monitored by the WWTP staff. Santa Barbara County has collected bacteria data at Surf Beach at the mouth of the River. This data is summarized by Heal the Bay. The report card shows that in dry weather the beach water quality is good (grade A+); no grade is reported for wet weather.

**South Coast Hydrologic Unit 315**

The South Coast Hydrologic Unit is made up of small coastal watersheds originating in the southern Los Padres National Forest and draining to the Santa Barbara coast. All watersheds in this Unit are completely within Santa Barbara County. Approximate sizes of sampled watersheds are listed below.

**South Coast Hydrologic Unit watershed acreages (from Cal Water 2.2).**

<b>Waterbody Name</b>	<b>Watershed Acreage</b>
Jalama Creek	16,270
Canada de la Gaviota	10,900
Canada del Refugio	5,500
Canada del Capitan	5,200
Dos Pueblos Creek	5,375
Bell Canyon Creek	3,300
Tecelote Creek	4,350
Los Carneros Creek	4,500
Glen Annie Creek	4,500
San Pedro Creek	4,500
San Jose Creek	4,500
Atascadero Creek	13,000
Arroyo Burro	6,200
Mission Creek	7,800
Sycamore Creek	5,600
San Ysidro Creek	4,000
Romero Creek	4,300

Toro Creek	3,800
Arroyo Paradon	4,500
Santa Monica Creek	4,000
Franklin Creek	3,000
Carpinteria Creek	9,400
Rincon Creek	9,300

Most of these creeks originate in steep chaparral, southern coastal scrub and woodland habitat, flow through mid-elevations which often support estate homes and other rural residential uses, and then through flat coastal terraces to the ocean. In the northwestern part of the Unit coastal terraces are predominately used for grazing and agriculture. From Goleta southeast through the communities of Santa Barbara and Carpinteria, the terrace is largely urbanized. The lowest reaches of several of these creeks flow through County and State Park campgrounds, these include Jalama County Park, Gaviota, Refugio, El Capitan and Carpinteria State Parks.

Channelization is common in the Unit, as many of these creeks flow through the urbanized flood plains. These watersheds include Arroyo Burro, Mission, Sycamore, San Ysidro, Romero, Toro, Arroyo Paradon, Santa Monica and Franklin Creeks. In the Carpinteria area, Franklin and Santa Monica Creeks are contained in cement box channels as they flow through intensive multi-use agriculture in the form of greenhouses and nurseries, as well as residential and light commercial development. Several of the nurseries and greenhouses in these watersheds have direct discharge points to the creek channels. Arroyo Paradon Creek is located just north of the city of Carpinteria and flows primarily through rural residential and greenhouse areas. The groundwater in this watershed is known to have extremely elevated levels of nitrate and a sump pump discharges groundwater to the creek at the Highway 101 bridge. The Goleta Slough watershed includes Los Carneros, Glen Annie, San Jose, San Pedro, Atascadero and Maria Ygnacio Creeks. Each of these creeks is channelized to some extent as they flow through the urban areas of Goleta. Los Carneros, Glen Annie, San Pedro and San Jose creeks have been converted to cement box channels in the lowest reaches and sediment is mechanically removed annually. Gaviota Creek has been completely channelized as it flows along Highway 101. Several streams and beaches in the Unit have previously been identified as impaired and are listed on the 303(d) list.

**Impaired waterbody 303(d) listings in the South Coast Hydrologic Unit.**

<b>Water Body / Beach</b>	<b>Listing</b>
Arroyo Burro Creek	Pathogens
Mission Creek	Pathogens
	Toxicity
Carpinteria Creek	Pathogens
<b>Water Body / Beach</b>	<b>Listing</b>
Carpinteria Marsh	Pathogens

	Low dissolved oxygen
	Priority organics
Goleta Slough	Pathogens
	Metals
	Priority organics
	Sedimentation
Refugio Beach	Pathogens
Rincon Beach	Pathogens
Jalama Beach	Pathogens
Gaviota State Beach	Pathogens
East Beach	Pathogens
Carpinteria State Beach	Pathogens
Arroyo Burro State Beach	Pathogens

Summary of Existing Data for Hydrologic Unit 315

Santa Barbara coastal creeks have been the subject of monitoring by several agencies and researchers. California State Parks staff and volunteers monitor sites within the Gaviota, Refugio, El Capitan and Carpinteria State Parks. State Parks data for dissolved oxygen, nutrients and benthic macroinvertebrates has been collected since 1997. However, this data is not reviewed here.

The County of Santa Barbara coordinates monitoring at several beaches where there are creek mouths. As a result of known impairment and inclusion on the 303 (d) list of for pathogen indicators, the County of Santa Barbara was recently awarded a grant to install a UV treatment system at the Arroyo Burro creek mouth. Coliform data for beach water quality is summarized on the Heal the Bay web site (see the report card link at [www.healthebay.org](http://www.healthebay.org)). Heal the Bay report card grades for beaches where creeks are flowing to the ocean are summarized below.

Heal the Bay report card scores for Santa Barbara beaches. Dry weather data includes AB 411 monitoring conducted between 4/02-10/02 and wet weather grades reflect county monitoring conducted between 10/02-3/03.

<b>Beach and creek name</b>	<b>Dry 4/02-10/02</b>	<b>Wet 10/02-3/03</b>
Jalama Beach at Jalama Creek	A	F
Gaviota State Beach at Canada de las Gaviota	A	F
Refugio State beach at Canada del Refugio	A	D
El Capitan State Beach at Canada del Capitan	A	A+
Arroyo Burro Beach at Arroyo Burro Creek	C	F
East Beach at Mission Creek	C	F
East Beach at Sycamore Creek	B	F
Hammonds Beach at Montecito Creek	B	F
Carpinteria State Beach at Carpinteria Creek	A	A
Rincon Beach at Rincon Creek	A+	F

The Long Term Ecological Research (LTER) program has collected ambient water quality data from several creeks in the Unit. LTER sites on Rincon, Carpinteria, Franklin, Santa Monica, Mission and Arroyo Burro creeks are also CCAMP sites. Data collected on Mission and Arroyo Burro creeks has not yet been published. However, data from Carpinteria area creeks has shown consistently elevated nutrient levels, especially in Franklin Creek. LTER data collected as part of a study on nutrient loading estimates that Franklin Creek is contributing over 11,000 kg NO<sub>3</sub>-N/yr and over 1,000 kg PO<sub>4</sub>-P/yr to Carpinteria Marsh and the ocean (Robinson et. al. in press). This is more than four times the load estimated by the LTER program from any other creek on the Carpinteria Coast. Carpinteria Creek, at over three times the watershed area, contributes less than half the load, at over 4000 kg/yr of nitrate (as N) and 700 kg/yr of phosphate (as P) (Robinson et. al. in 2003).

The County's Project Clean Water storm water volunteer monitoring program has collected storm water samples at many coastal creek sites between 2000 and 2002. Monitoring has been conducted at many of the same sites monitored by CCAMP. Project Clean Water data shows elevated levels of total phosphorus, suspended solids, dissolved solids and turbidity in all samples. This is not unusual for storm event data. Storm water data shows elevated nitrate levels, but these are greatly reduced when compared to non-storm levels. Glyphosate concentrations are near criteria levels in all samples, and chlorpyrifos and diazinon levels are elevated in all samples.