SWAMP Surface Water Ambient Monitoring Program

| SWAMP Assessment Report for the Central Coast Region | 2001-02 |
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# Central Coast Ambient Monitoring Program Hydrologic Unit Report for the 2001-02 Santa Ynez Watershed Rotation Area

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# 1 Introduction

## 1.1 Overview of the Surface Water Ambient Monitoring Program in California

California Assembly Bill 982 (Water Code Section 13192; Statutes of 1999) required that the State Water Resources Control Board (SWRCB) assess and report on State water monitoring programs and prepare a proposal for a comprehensive surface water quality monitoring program. In the SWRCB Report to the Legislature from November 2000, entitled "Proposal for a comprehensive ambient surface water quality monitoring program", the SWRCB proposed to restructure existing water quality monitoring programs into a new program, the Surface Water Ambient Monitoring Program (SWAMP). The SWAMP program is intended to provide comprehensive statewide environmental monitoring focused on information necessary to effectively manage the State's water resources. The program is designed to be consistent, cooperative, adaptable, scientifically sound, and to meet clear monitoring objectives. The program focuses on spatial and temporal trends in water quality statewide. It will facilitate reporting and categorizing of the State's water quality under Sections 305 (b) and 303 (d) of the Federal Clean Water Act. A Comprehensive Monitoring and Assessment Strategy (October, 2005), also know as the Ten-Point Strategy, elaborates on SWAMP goals, objectives, design, indicators, data management, quality control, and other program information. Specific program details can be found in the SWAMP Quality Assurance Management Plan (QAMP) (Puckett 2002).

Specifically, the statewide SWAMP is designed to meet four goals:

1. Create an ambient monitoring program that addresses all hydrologic units of the State.

2. Document ambient water quality conditions in potentially clean and polluted areas.

3. Identify specific water quality problems preventing the realization of beneficial uses of water in targeted watersheds.

4. Provide the data to evaluate the overall effectiveness of water quality regulatory programs in protecting beneficial uses of waters of the State.

## 1.2 Central Coast Ambient Monitoring Program

The Central Coast Regional Water Quality Control Board is responsible for water quality issues along the central coast of California. The region extends from southern San Mateo County in the north to northern Ventura County in the south, and includes Monterey, Santa Cruz, San Benito, San Luis Obispo, Santa Barbara and portions of Santa Clara counties. The Central Coast Ambient Monitoring Program (CCAMP) is the Central Coast Regional Water Quality Control Board's ambient monitoring program, and a major portion of its funding comes from SWAMP**.** The goal of monitoring in the Central Coast region is to provide a screening level assessment of water quality in all Hydrologic Units, based on a variety of chemical, physical and biological indicators. Monitoring data is used to evaluate beneficial use support in the surface waters of the Region. Monitoring approaches include conventional water quality, water toxicity, sediment chemistry and toxicity, tissue chemistry, rapid bioassessment for benthic invertebrates, and habitat assessment. CCAMP uses a rotating basin approach where conventional water quality monitoring is conducted monthly at all sites, and at a subset of the sites other monitoring approaches are conducted annually or biannually. Coastal confluence sites, just above salt water influence, are monitored monthly on an ongoing basis, and serve for long-term trend monitoring and as "integrators" of upstream impacts.

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.

## 1.3 Program Questions, Objectives and Decision-Making Criteria

General programmatic objectives of CCAMP are to:

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

The following sections address questions posed in the SWAMP Monitoring Guidance related to beneficial use support. The monitoring approach and the water quality criteria that address these beneficial uses are discussed.

**Is there evidence that it is unsafe to swim?**
**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. 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); compilation of other data sources
**Assessment Limitations:** CCAMP sampling for fecal and total coliform only; assessments are based on these parameters
**Criteria:**

- 10% of samples over 400 MPN/100 ml fecal coliform
- Geometric mean of fecal coliform samples greater than 200 MPN/100mL
- 10% of samples over 235 MPN/100 ml *E. coli*

**Interpretation:** Minimum of five exceedances is required to determine impairment. If fewer than five exceedances, site is considered partially impaired. At least 10% of samples or the geomean must exceed the respective criterion to determine impairment.

**Is there evidence that it is unsafe to drink the water?**
**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 presence of chemical effects which may cause detrimental physiological response in humans using multi-species toxicity testing.
**Monitoring Approach:** Monthly sampling for nitrate and pH.
**Assessment Limitations:** CCAMP does not typically sample for metals or organic chemicals in water; assessment is based only on conventional parameters that have drinking water standards.
**Criteria:**

- 10% of nitrate samples over 10 mg/L (as N)
- 10% of pH samples under 6.5 or over 8.3

**Interpretation:** For nitrate and pH<6.5, a minimum of five exceedances is required to determine impairment. At least 10% of samples must exceed criterion for a site to be considered impaired. If fewer than five exceedances, site is considered partially impaired. Because of the naturally high pH levels in Region 3, no site will be listed as impaired based on high end pH exceedance alone.

**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 bivalve tissue collection and chemical analysis
**Assessment Limitations:** CCAMP is not routinely collecting bioaccumulation samples due to loss of funding.
**Criteria:**

- Exceedance of Office of Environmental Health Hazard Assessment Criteria for fish and shellfish tissue. In the absence of OEHHA criteria, use U. S. Food and Drug Administration Action Levels, or Median International Standards, in that order.

Interpretation: If there are two or more exceedances of a chemical criterion, from two or more separate samples site is considered impaired. If there is one exceedance, site is considered partially impaired.

**Is there evidence that aquatic life uses are not supported?**
**Beneficial Uses:** Cold Freshwater Habitat (COLD); Preservation of Biological Habitats (BIOL); Warm Freshwater Habitat (WARM); Wildlife Habitat (WILD); Rare and Endangered Species (RARE); 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-up 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 does not have the funding to sample all sites for benthic invertebrates, sediment chemistry or water and sediment toxicity. When sediment chemistry is analyzed, an array of metals and organic chemicals is sampled that 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.
**Critera:**

- Sediment or water toxicity effects significantly greater than reference tests and survival, growth, or reproduction less than 80% of control
- Sediment concentrations over Probable Effects Levels (MacDonald, et al, 1996) for chemicals with available criteria. Sediment concentrations of other 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.
- 10% of dissolved oxygen samples below 7.0 mg/L (cold water streams) or 5.0 mg/L (warm water streams)
- 10% of pH samples under 7.0 or above 8.5
- 10% of un-ionized ammonia samples over 0.025 mg/L $NH_3$ as N
- Biostimulatory risk rank falls within scoring range of lower quality sites (above 0.4)

- Index of Biotic Integrity falls within scoring range of lower quality sites (below 3.0)

**Interpretation**: For toxicity, sediment chemistry or tissue chemistry**,** if there are two or more exceedances of any analyte criterion, site is considered impaired. If there is one exceedance, site is considered partially impaired. For ammonia, pH (<7.0) and dissolved oxygen, if there are five or more exceedances of any analyte criterion, site is considered impaired. If there are fewer than five exceedances, site is considered partially impaired. Because of the naturally high pH levels in Region 3, no site will be listed as impaired based on high end pH exceedance alone. Sites that fall within the scoring range of lower quality sites for Biostimulatory Risk or Index of Biotic Integrity are considered partially impaired. Professional judgment is used to determine whether multiple lines of evidence of partial impairment justify a determination of full impairment.

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

- 10% of pH samples below 6.5 or above 8.3
- 10% of chloride samples over 106 mg/L
- 10% of electrical conductivity results over 3000 uS/cm
- 10% of boron samples over 0.75 mg/L
- 10% of sodium samples over 69 mg/L
- 10% of nitrate samples over 30 mg/L as $NO_3$ as N

**Interpretation:** Minimum of five exceedances of any analyte criterion are required to determine impairment. If there are fewer than five exceedances, site is considered partially impaired.

**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, etc.
**Assessment Limitations:** CCAMP does not currently conduct an assessment for trash. *E. coli* was not sampled in the Santa Maria watershed.
**Criteria:**

- 10% of pH samples under 7.0 or over 8.3

- 10% of samples over 400 MPN/100 ml fecal coliform
- 10% of samples over 409 MPN/100 ml *E. coli*
- Dry weather turbidity persistently over 10 NTU
- Filamentous algal cover persistently over 25%
- Scum, odor, trash, oil films persistently present

**Interpretation:** Minimum of five exceedances of any analyte criterion are required to determine impairment. If there are fewer than five exceedances, site is considered partially impaired. Because of the naturally high pH levels in Region 3, no site will be listed as impaired based on high end pH exceedance (>8.3) alone. Professional judgment is used to determine whether scum, odor, trash, or oil films are present at levels sufficient to represent a nuisance or hazard.

### 1.4 Overview of the CCAMP Approach

The CCAMP mission statement is to collect, assess and disseminate water quality information to aide decision makers and the public in maintaining, restoring and enhancing water quality and associated beneficial uses in the Central Coast Region. The CCAMP monitoring strategy calls for dividing the Region into five watershed rotation areas and conducting synoptic, tributary based sampling in one of the areas each year. Approximately thirty sites are monitored in each watershed rotation area. Over a five-year period all of the Hydrologic Units in the Region are monitored and evaluated. In addition to the rotational approach, thirty-one of the Region's coastal creeks and rivers are monitored continuously just upstream of their confluence with the Pacific Ocean.

The CCAMP strategy of establishing and maintaining permanent long term monitoring sites provides a framework for trend analysis and detection of emergent water quality problems and maintenance of high quality waters. CCAMP uses a variety of monitoring approaches to characterize status and trends of coastal watersheds, including conventional water quality analysis, benthic invertebrate bioassessment, analysis of tissue and sediment for organic chemicals and metals, and toxicity evaluation.

In order to develop a broad picture of the overall health of waters in the Central Coast Region, a similar monitoring approach is applied in each watershed area. This provides compatibility across the Region and allows for prioritization of problems across a relatively large spatial scale. However, additional watershed specific knowledge is incorporated into the study design, so that questions which are narrower in focus can also be addressed. For example, in watersheds where Total Maximum Daily Load assessments are being undertaken, other program funds can be applied to support additional monitoring for TMDL development. Special studies are undertaken as funding and staffing permits to further focus monitoring on questions of interest in individual watersheds.

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. 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, STORET, NPDES discharge data, and other sources. Data from County, City, and other selected programs are also acquired. Selected data is compiled into the CCAMP data base format and used along with data collected by CCAMP to evaluate standard exceedances, pollutant levels which warrant attention, beneficial use impairment, and other pertinent information. Basic GIS data layers, where available, describing land use, geology, soils, discharge locations, etc. are used in analysis and display of data, to further understanding of probable sources and causes of identified problems.

### 1.5 Scope of the Report

This report provides a data summary for watershed monitoring completed during the first two fiscal years of the SWAMP Program (2000-01 and 2001-02). This includes CCAMP watershed rotation monitoring of the Santa Ynez River Hydrologic Unit (314) between January 2001 and March 2002, as well as coastal confluences monitoring at one site in this Hydrologic Unit that is continuous to March 2003. The 2001 rotation area includes five sites on the Santa Ynez River and one site on each of two tributaries. The report provides an analysis of beneficial use support and determination of impairment for monitored water bodies.

## 2 Sampling Design

Watershed rotation area monitoring sites are placed at safe access locations along the main stem of each major creek and river, typically upstream of each major tributary input, and also at the lower end of each major tributary. Sampling locations frequently are located at public bridge crossings because of all-weather public access. Care is taken to ensure that samples are not influenced by the bridge structure itself. Approximately thirty sites are allocated within the sampling area; in addition, long-term coastal confluence sites are monitored continuously on a monthly basis at thirty-three creek mouths throughout the Region.

The CCAMP program design includes monthly monitoring for conventional water quality (CWQ) at all selected sites. At a subset of sites, generally selected based on hydrogeomorphological considerations or local issues of concern, other monitoring approaches are applied. These include sediment chemistry and toxicity, fish and freshwater clam tissue chemistry, benthic macroinvertebrate assessment and habitat assessment.

## 3 Methods

### 3.1 Conventional Water Quality

CCAMP staff collects monthly grab samples and field measurements for conventional parameters at all watershed rotation area and coastal confluence sites. Sampling is conducted following the protocols outlined in CCAMP Standard Operating Procedures (Puckett, 2002).

Field measurements are taken using a multi-analyte Hydrolab DS4a. Measured values are stored in a Surveyor 4a and subsequently downloaded into the CCAMP data management system. Data are also recorded on field data sheets, and are used to verify electronically recorded values. Probes are lowered into flowing water, at least two inches but no more than eight inches below the water's surface. Probes are held at this depth and allowed to equilibrate for at least one minute prior to recording measurements. Field measurements include dissolved oxygen, pH, conductivity, salinity, water temperature, and turbidity. In addition, air temperature, percent algal cover, percent shading from canopy, presence of scum, trash, and foam, and several other field observations are noted.

Samples are collected for laboratory analysis at the Central Coast Region's contract laboratory, BC Laboratories in Bakersfield, California (Table 3.1a). Samples are collected in pre-cleaned bottles provided by the contract laboratory. Pre-cleaned 1-L plastic bottles are used to collect samples for nutrients, salts, dissolved and suspended solids analyses. Sterile and sealed 120ml plastic bottles containing sodium thiosulfate preservative are used to collect total and fecal coliform samples. Sample bottles are rinsed three times with stream water and then filled facing upstream. Once collected, samples are stored in ice chests at 4° C until they are transferred to the contract laboratory. Proper chain of custody documentation is maintained for all samples as described in the SWAMP QAMP (Puckett, 2002).

Table 3.1a. Laboratory analytes and typical 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 CaCO3 | 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 |

Three times during the summer months (July-September) CCAMP staff collect pre-dawn dissolved oxygen measurements to characterize oxygen sags, should they exist. CCAMP staff visit each site with safe 24 hour access between 3 a.m. and 30 minutes before sunrise to collect in-situ dissolved oxygen measurements using the Hydrolab DS4a.

Quality Assurance

Hydrolab probes (DS4a) are calibrated prior to and following each sampling event. Probes are calibrated using laboratory certified standards for pH, conductivity and turbidity, and are air calibrated for dissolved oxygen. Calibration data is recorded in an Excel spreadsheet and is used to evaluate instrument performance. The SWAMP QAMP has defined +/- 20% difference as the maximum allowable variation between the calibration standard and post calibration measurement of the standard (Puckett, 2002, Appendix C).

A blind field duplicate sample is collected once per sampling trip, resulting in 10% total field duplicates. For duplicates samples, two bottles are filled side-by-side and labeled with a unique site tag to remain anonymous to the contract laboratory. Data from duplicates is compared to original samples and evaluated using the SWAMP maximum for relative percent difference of 25% (Puckett 2002, Appendix C).

The quality control measures employed by the contract laboratory are also evaluated using SWAMP criteria. These measures include but are not limited to matrix spike recovery, laboratory control samples, calibration control samples, method blanks and lab duplicates.

## 3.2 CCAMP Biostimulatory Risk Index

CCAMP has developed a “Biostimulatory Risk Index” to serve as a screening tool to evaluate sites for risk of problems associated with eutrophication. A more complete description of the index and its use is found in Appendix A; however, it is briefly summarized in this section.

The Biostimulatory Risk Index simultaneously considers factors which serve as stimuli (nutrient concentrations), in parallel with those which act as responders (pH, dissolved oxygen, algal and plant cover, water column chlorophyll concentrations). The index is intended to characterize both in-situ monitoring site response to biostimulatory substances and the capacity of monitoring site water quality parameters to induce adverse biostimulatory responses in downstream areas. The index currently has no provision for addressing nutrient-poor waters, nor waters impacted by toxic effects associated with several of its components.

The Biostimulatory Risk Index is a combination of several different measures, or “metrics” of stimuli or response, which have been percentile ranked and combined to form a single value. CCAMP collects data on a number of parameters that serve as measures of biostimulation or response. Some of these measures, such as nutrient or chlorophyll concentrations, serve as metrics based on magnitude alone (where higher concentrations are considered “worse” than lower concentrations and are ranked accordingly). Others are more complex, particularly “double-ended” parameters such as dissolved oxygen and pH. For example, both supersaturated and depressed concentrations of dissolved oxygen can be indicative of eutrophication. For such parameters the departure of the measurement from the Regional median value is used to calculate the metric (where a larger departure ranks worse than a smaller departure). Various forms of plant cover are stimulated by nutrients and can create nuisance conditions. The Index utilizes the maximum value from three qualitative estimates of percent cover for rooted plants, filamentous algae and periphyton, to calculate a plant cover metric.

CCAMP staff has evaluated performance of the Index using data from the entire Region. Above an average Index score of 0.40, sites begin to commonly show signs of impairment, including algal blooms, widely ranging dissolved oxygen concentrations, and elevated nutrient concentrations. We are using this value as a threshold to screen monitoring data for biostimulatory risk. In Appendix A, we discuss the regional evaluation and determination of the risk threshold.

### 3.3 Rapid Bioassessment

CCAMP staff collected benthic macroinvertebrates (BMIs) following California Stream Bioassessment Protocols (Harrington 1999 as cited in Puckett 2002, Appendix G) in two consecutive spring seasons at each site. All BMI samples are processed and identified to the lowest possible taxon at the California Department of Fish and Game Aquatic Bioassessment Laboratory (DFG-ABL).

Samples are collected during base-flow conditions. Sampling reaches are always selected in association with conventional water quality monitoring sites. When riffle habitat is present, a reach of stream containing riffles is selected for sampling. Riffles are typically the most taxonomically diverse microhabitats within streams, and are targeted for BMI sample collection. Three riffles within each stream reach are randomly selected for sampling. At each riffle, a transect location is randomly chosen from all possible meter marks along the upper third of the riffle. Three samples are collected along the transect, which is perpendicular to the direction of flow, using a D-shaped kick net. A 1x1 foot area of substrate upstream of the kick-net is disturbed for 1 minute at each site. The three samples from each transect are composited into a single sample. Each sample is preserved in 95% ethanol until analyzed.

When riffle habitat is not present, a representative 100m reach is measured out and three transect locations are chosen randomly from the 100 possible meter marks in the reach. At each transect location the two margins and thalweg are sampled by disturbing a 1 x 2-foot portion of substrate upstream of the kick-net to approximately 4-6 inches in depth. The three site collections per transect are composited to create one sample that is sieved to 0.5 mm and preserved in 95% ethanol. All samples are stored at the Central Coast Regional Board until they are transferred with the appropriate chain of custody forms to the DFG laboratory at Rancho Cordova for identification.

At the laboratory, BMI samples are randomly sub-sampled and sorted to obtain 300 individuals per sample. These individuals are stored in an ethanol-glycerin solution, identified to genus or the lowest possible taxonomic unit, and enumerated. Metrics calculated from individual count data include abundance, taxa richness and composition, taxa tolerant or intolerant of impaired conditions, and relative dominance of functional feeding groups. All organisms identified and included in the individual taxa list for each site are labeled with scientific name, date and location collected, and are returned to CCAMP for archiving.

Physical and habitat characteristics are estimated at each site based on visual observations, which score the following habitat parameters on a 1-20 scale: epifaunal substrate, embeddedness, velocity/depth regimes, sediment deposition, channel flow, channel alteration, riffle frequency, bank vegetation, bank stability, and riparian zone width. Field samplers are trained by CDFG staff to conduct this assessment, and scores are inter-calibrated for consistency prior to start of sampling.

CCAMP Index of Biotic Integrity

The CCAMP Index of Biotic Integrity (CCAMP-IBI) is a sum of several ranked metric scores, including taxonomic richness, number of *Ephemeroptera* taxa, number of *Trichoptera* taxa, number of *Plecoptera* taxa, percentage of intolerant individuals (with tolerance scores of 0, 1, or 2), percentage of tolerant individuals (with tolerance scores of 8, 9 or 10), percent dominant taxon, and percent predators. This index includes all metrics utilized by Karr and Chu (1999) in their Index of Biotic Integrity, with the exception of "clinger taxa count" and "long-lived taxa count." CCAMP-IBI scores range from 0 to 10. Sites in the lowest quartile of all CCAMP bioassessment data score below approximately 3.0, as a site average. Sites in the highest quartile score above 6.0. This index is described in more detail in Appendix B.

## 3.5 Water Toxicity

Sampling for toxicity to fathead minnow larvae (*Pimephales promelas*) and water fleas (*Ceriodaphnia dubia*) is conducted at a subset of watershed rotation area sites. Samples are collected in four 1-gallon amber glass bottles and are maintained at 4° C until delivery to the laboratory within 48 hours. Toxicity testing is performed at the University of California Davis Marine Pollution Studies Laboratory at Granite Canyon (UCD-GC). All tests are conducted for seven days, at 25ºC according to US EPA (1994) protocols. Water quality parameters including conductivity, hardness, alkalinity, pH, dissolved oxygen, and ammonia are measured at the beginning of each test. Test solutions are renewed daily; dissolved oxygen and pH are measured on the old solution and replacement solution. Temperature is monitored continuously by a temperature probe in an additional test solution placed in the controlled temperature room. Details of toxicity testing methods can be found in the SWAMP QAMP (Puckett 2002, Appendix F).

Larvae of the fathead minnow are purchased from an organism supplier and received on test initiation day (less than 24 hours old). Ten fish are randomly distributed to each of five test containers containing 250 mL of sample. Test containers are checked daily, and the number of living fish recorded; immobile fish that do not respond to a stimulus are considered dead. Survival and growth endpoints (as dry weight) are recorded for each test container at the end of seven days.

Water flea neonate individuals (<24 h old) are introduced singly into small cups containing 15 mL sample. Each sample includes ten replicates. Survival and reproduction are monitored daily in each replicate. Survival and reproduction endpoints (number of neonates and broods) were recorded for each test container at the end of seven days.

Samples are tested for chlorpyrifos and diazinon using Enzyme-Linked Immunosorbent Assay (ELISA). All ELISA analyses are performed at UCD-GC with kits from Strategic Diagnostics Inc. (Newark, DE). The lowest detectable doses are 30 ng/L for diazinon and 50 ng/L for chlorpyrifos (Sullivan and Goh 2000).

Quality Assurance

Field duplicate samples are tested to estimate the variability in results associated with sampling and laboratory procedures. All toxicity tests include both positive and negative controls. Positive control tests are conducted monthly at the laboratory and concurrently with test samples. See the UCD-GC SOP document included in Puckett 2002 for more detailed QAQC information.

To verify accuracy of the ELISA method, an external standard is quantified with each batch. Accuracy of these measurements is considered acceptable if the measured value is within 20% of the known concentration. In addition, 5% of the samples measured using the ELISA method are also measured using an EPA analytical method for comparison. The measurement is considered acceptable if the relative percent difference between the results using the two methods is less than 50%. The SWAMP QAPP allows the program manager to determine control limits for external QA assessments (Puckett 2002).

### 3.6 Sediment Chemistry and Toxicity

Bed sediment samples are collected by CCAMP staff at a subset of watershed rotation area sites targeting fine-grained sediments within the wetted creek channel. A pre-cleaned Teflon™ scoop is used to collect the top 2 cm of sediment from five or more sub-sites into a pre-cleaned glass composite jar. After an adequate amount of sediment is collected, it is homogenized thoroughly and aliquoted into pre-cleaned, pre-labeled sample jars (glass or polyethylene, as appropriate) for organic chemical, metal or toxicological analysis. Once collected, samples are stored at 4°C and shipped with appropriate chain-of-custody and handling procedures to the analytical laboratories (MPSL-DFG, Rancho Cordova-DFG and UCD-GC). Field data sheets are completed for each sampling event to document conditions and sampling notes. Details on sediment sampling are described in the bed sediment procedures outlined in the SWAMP QAMP (Puckett 2002, Appendix D).

In sediment samples, analyses for metals, organic chemicals, polynuclear aromatic hydrocarbons, total organic carbon, and grain size were conducted at BC Laboratories in Bakersfield. Analysis and QC procedures used by BC Laboratories are outlined in their QAPP (BC Labs 1999).

Toxicity and ELISA analyses are conducted at UCD-GC. Ten-day sediment toxicity testing using *Hyalella azteca* (EPA 2000) is conducted using eight 100-mL replicates, each with 10 *Hyalella* individuals. Water quality parameters, including conductivity, hardness, alkalinity, pH, dissolved oxygen, and ammonia are measured in overlying water from one replicate of each sample at the beginning and end of each test. Dissolved oxygen is measured daily in one replicate of each sample. Temperature is monitored continuously by placing a probe in an additional test solution in the controlled temperature room. Endpoints recorded after ten days are survival and growth (as dry weight).

<u>Quality Assurance</u>
Sediment toxicity QA procedures such as field duplicates, and positive and negative controls are similar to those discussed in the section on water toxicity. See Puckett (2002) for a complete discussion on QAQC procedures. In sediment toxicity tests the positive control test consists of a dilution series of cadmium (from cadmium chloride). The negative control for *Hyalella* consists of reference sediment subjected to the same well-water renewals as the samples.

### 3.7 Tissue Bioaccumulation

Resident fish and transplanted freshwater clams (*Corbicula fluminea*) are used to assess bioaccumulation of organic chemicals and metals in streams and lakes throughout the watershed rotation areas.

MPSL-DFG staff performs deployment, collection and preparation of fresh water clams at a subset of watershed rotation sites. Clams are collected from Big Break Lake near the Sacramento River Delta, and tested for contamination prior to deployment. Clams are deployed for one month in anchored polypropylene mesh bags, approximately 15 cm above the streambed. Approximately 25 to 50 clams, 20 to 30 mm in diameter, are deployed at each site for each analysis (organics and metals). After a month-long deployment, clams are collected and sent to the laboratory for analysis. Clams intended for metals analysis are transported in plastic bags; clams intended for organic analysis are bagged in aluminum, then plastic. All sample handling is performed with methods designed to minimize contamination. Details of clam collection, handling, deployment and retrieval can be found in the SWAMP QAMP (Puckett 2002, Appendix D).

Fish sampling in reservoirs and at watershed rotation area sites is conducted by the DFG-ABL through the Toxic Substances Monitoring Program (TSMP). Two to four composite samples containing four fish each are collected for each species. Within each composite the smallest fish is at least 75% the length of the largest fish. Larger, older fish are targeted. When the target species is a food fish, the minimum size is set at the legal angling size or practical eating size for that species.

Fish collection techniques include boat and backpack electro-fishing, gill netting and seine netting. Fish species and length are recorded. Fish are sacrificed and wrapped in aluminum foil or Teflon®. The heads and tails of fish larger than the wrapping material are removed prior to wrapping (gut contents are kept intact). Fish are kept on dry ice in the field, and then frozen at -20º C prior to analysis. Details of fish sampling methods used in the TSMP can be found in the CDFG-MPSL Standard Operating Procedure document, Method 102 (CDFG-MPSL 2001).

## 4 Santa Ynez River Hydrologic Unit Description

The Santa Ynez River watershed drains approximately 574,885 acres (Cal Water v. 2.2) 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 Air Force Base 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 (WWTP) discharges to the River below the City, and at times the flows in the vicinity are effluent-dominated.

Water quality data has been collected by several entities in this watershed. Vandenberg Air Force Base (VAFB) staff monitor the river at the 13th 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 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 Heal the Bay report card shows that in dry weather the beach water quality is good (grade A+); no grade is reported for wet weather.

## 5 Santa Ynez Hydrologic Unit Assessment

In this section, the Santa Ynez Hydrologic Unit is evaluated according to questions posed in the SWAMP report to the Legislature (2000) and described in detail in Section 1.2. It is only possible to address these questions in terms of analytes actually evaluated, for the given sampling period and sampling frequency. For example, from the standpoint of assessing whether water is of adequate quality to drink, only a few of the many chemicals with drinking water standards have been evaluated. However, when violations of standards and criteria are found, they support conclusions of water quality impairment.

## 5.1 Summary of monitoring

Monitoring sites are listed and types of monitoring activities conducted at each site are identified in Table 5.1a. A map of the Santa Ynez Hydrologic Unit and the location of the CCAMP monitoring sites is shown in Figure 5.1a. The following text describes in detail the assessments made for each beneficial use at all CCAMP monitoring sites in the Hydrologic Unit. An overall summary of findings is shown in Table 5.1b. Evidence of impairment is determined by comparing data to criteria listed in Section 1.2.

Table 5.1a. Specific monitoring activities conducted at sites in the Santa Ynez Hydrologic Unit (HU 314). **CWQ** - Conventional Water Quality; **BMI** - Benthic Macroinvertebrate Assessment; **Sed Chem & Tox** - Sediment Chemistry and Toxicity; **Tissue Chem** - Tissue Chemistry analysis.

| Site Tag | Monitoring Site | CWQ | BMI | Sed Chem & Toxi | Tissue Bioaccumulation |
|---|---|---|---|---|---|
| 314SYN | Santa Ynez River at 13th Street | X | X | X | X |
| 314SYF | Santa Ynez River at Floradale | X | X | X | |
| 314MIG | San Miguelito Creek at West North Avenue | X | X | X | |
| 314SYL | Santa Ynez River at Highway 246 | X | X | X | |
| 314SAL | Salsipuedes Creek at Santa Rosa Road | X | X | X | |
| 314SYI | Santa Ynez River at Old Highway 101 bridge | X | X | X | |
| 314SYC | Santa Ynez River at Highway 154 | X | X | X | |
| 314SYP | Santa Ynez River at Paradise Road | X | X | X | |
| 314CHL | Lake Cachuma | | | | X |

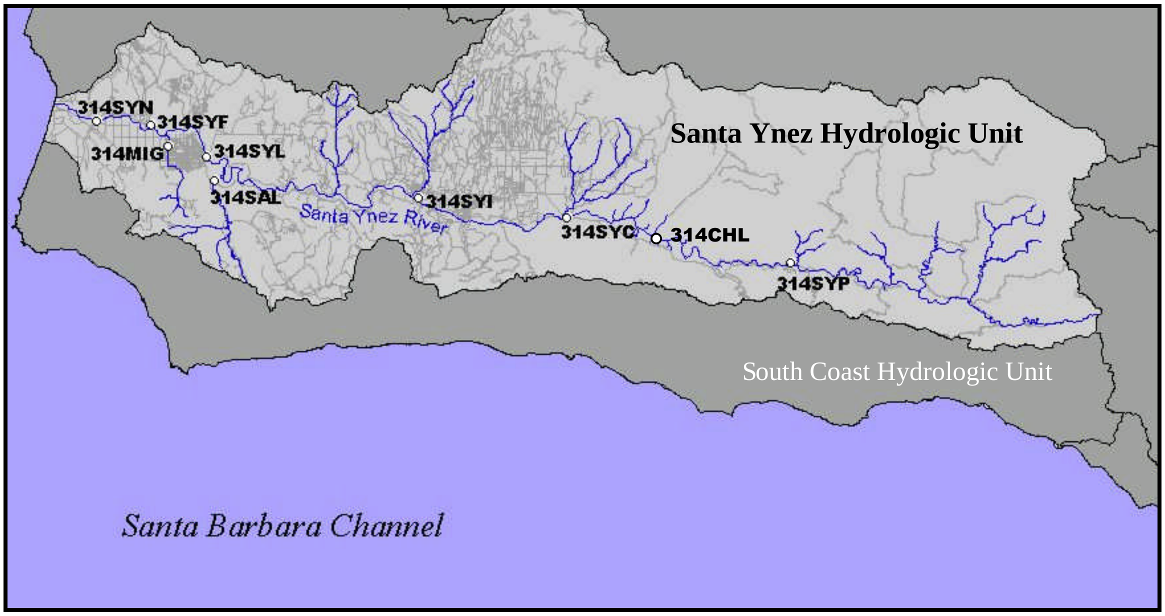


Figure 5.1a. CCAMP monitoring sites in the Santa Ynez Hydrologic Unit.

Table 5.1b. Summary of findings related to monitoring questions for sites in the Santa Ynez Hydrologic Unit (HU314). **Yes** – evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, dash symbol **(-)** - not assessed

| Site Tag | Monitoring site | Unsafe to Swim? | Unsafe to drink? | Are aquatic life uses impaired? | Unsafe to eat fish? | Are agriculture uses impaired? | Are non-contact recreation activities impaired? |
|---|---|---|---|---|---|---|---|
| **314SYN** | Santa Ynez River at 13th Street | No | **Yes** | **Yes** | No | **Yes** | **S** |
| **314SYF** | Santa Ynez River at Floradale | **S** | **Yes** | **Yes** | **-** | **Yes** | **S** |
| **314MIG** | San Miguelito Creek at West North Avenue | **S** | **S** | **S** | **-** | **Yes** | **S** |
| **314SYL** | Santa Ynez River at Highway 246 | **S** | No | **S** | **-** | **Yes** | **S** |
| **314SAL** | Salsipuedes Creek at Santa Rosa Road | **S** | **S** | **S** | **-** | **Yes** | **S** |
| **314SYI** | Santa Ynez River at Old Highway 101 bridge | **S** | No | No | **-** | **S** | **S** |
| **314SYC** | Santa Ynez River at Highway 154 | No | No | No | **-** | No | **S** |
| **314SYP** | Santa Ynez River at Paradise Road | No | No | **S** | **-** | No | **S** |
| **314CHL** | Lake Cachuma | **-** | **-** | **S** | **S** | **-** | **-** |

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

Fecal coliform levels ranged between 2 MPN/100 ml and 30,000 MPN/100 ml in the Santa Ynez Hydrologic Unit. Two of the eight sites in the Hydrologic Unit never exceeded Basin Plan criteria. Those sites are the two upper watershed sites on the Santa Ynez River at Paradise Road (314SYP) and at Highway 154 (314SYC). At all other sites in the Hydrologic Unit at lease one sample exceeded 400 MPN/100mL. However, no site had more than four exceedances of this criterion. The highest levels were observed at San Miguelito Creek (314MIG) and Santa Ynez River at Floradale (314SYF) (Figure 5.1.1a). At San Miguelito Creek (314MIG) the geomean was also elevated, at 206 MPN/100 ml (Table 5.1.1a).

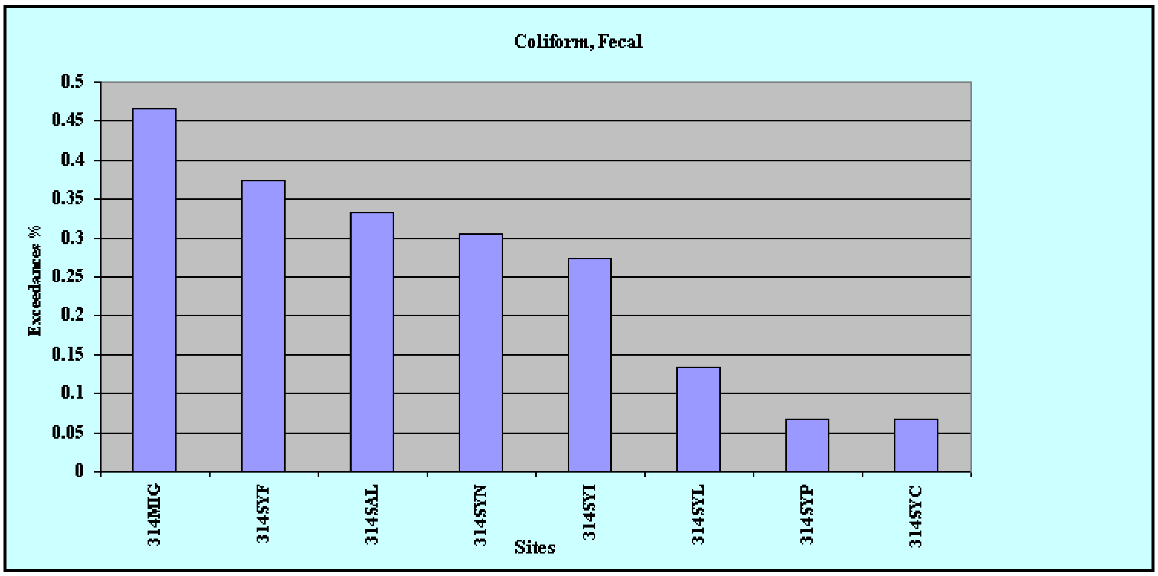


Figure 5.1.1a. Percent exceedance of the Basin Plan objective (400 MPN/100 ml) for fecal coliform at sites in the Santa Ynez Hydrologic Unit.

Table 5.1.1a. Site specific assessment of data used to assess impairment of water contact recreational uses in the Santa Ynez River Hydrologic Unit (HU314). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, dash symbol **(-)** - not assessed.

| | Fecal Coliform | Fecal Coliform | **Evidence of Impairment** |
|---|---|---|---|
| **Units** | MPN/100 ml | MPN/100 ml | |
| **Matrix** | H20 | H20 | |
| **Water Contact Recreation Assessment Threshold** | More than 10% of samples >400 | Geometric mean > 200 | |
| **Sites** | | | |
| **314SYN** | No | No | No |
| **314SYF** | **S** | No | **S** |
| **314MIG** | **S** | **S** | **S** |
| **314SYL** | **S** | No | **S** |
| **314SAL** | **S** | No | **S** |
| **314SYI** | **S** | No | **S** |
| **314SYC** | No | No | No |
| **314SYP** | No | No | No |
| **314CHL** | - | - | - |

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

Nitrate concentrations at most sites in the Santa Ynez Hydrologic Unit were below 1.0 mg/L (Table 5.1.2a). However, at the two Santa Ynez River sites below the city of Lompoc (at Floradale (314SYF) and at 13th Street (314SYN)) nitrate levels were elevated above the drinking water standard (10 mg/L NO3 as N) in more than 75% of samples (Figure 5.1.2a). Two sites in the lower Santa Ynez watershed showed elevated pH levels. Most sample measurements (82%) from San Miguelito Creek (314MIG) exceeded the Basin Plan upper limit for pH in drinking water. At this site the average pH level also exceeded 8.3 pH units. However, at this location the creek is contained within a cement box channel and therefore is not recharging to groundwater above the confluence with the River. Downstream of the confluence with the Santa Ynez River (at the 13th Street site (314SYN)) pH levels exceeded the upper limit for pH in 5 of 27 samples. All other sites in the Santa Ynez Hydrologic Unit had pH levels within the Basin Plan objectives for municipal and domestic supply.

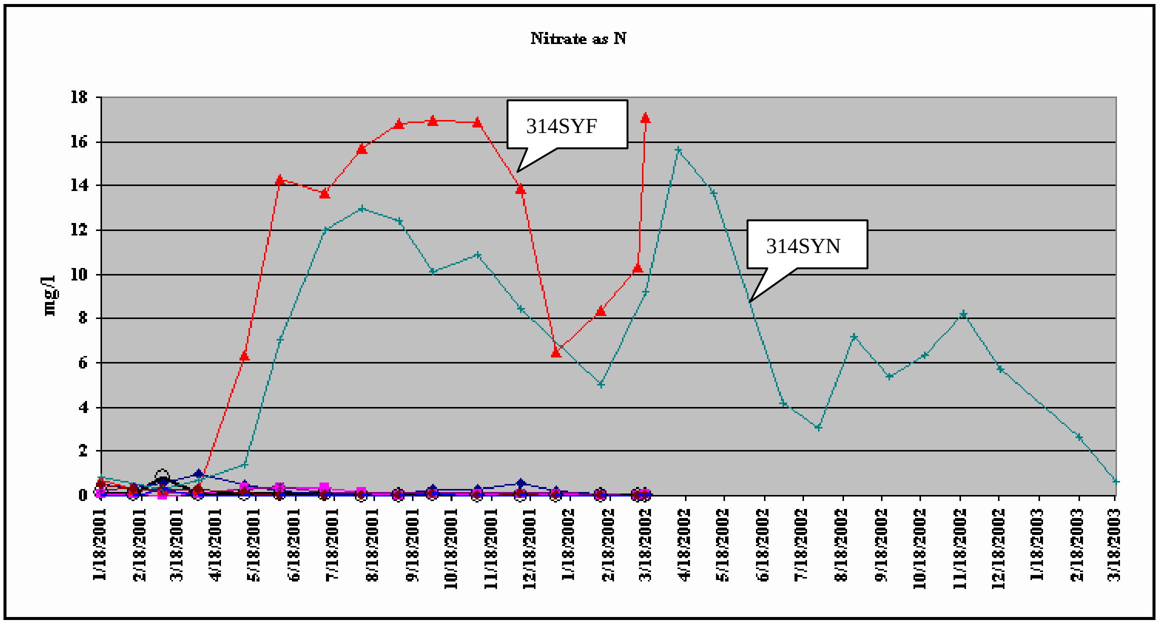


Figure 5.1.2a. Time series of nitrate levels at all sites in the Santa Ynez Hydrologic Unit between January 2001 and March 2003.

Table 5.1.2a. Determining if the water is unsafe to drink in the Santa Ynez River Hydrologic Unit (HU314). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, dash symbol **(-)** - not assessed.

| **Constituent** | Nitrate as N | pH | **Evidence of Impairment** |
|---|---|---|---|
| **Units** | ppm | pH units | |
| **Matrix** | H20 | H20 | |
| **Municipal and Domestic Supply Assessment Threshold** | 10 | <6.5 or >8.3 | |
| **Sites** | | | |
| **314SYN** | **Yes** | No | **Yes** |
| **314SYF** | **Yes** | **S** | **Yes** |
| **314MIG** | No | **Yes** | **S** |
| **314SYL** | No | No | No |
| **314SAL** | No | **S** | **S** |
| **314SYI** | No | No | No |
| **314SYC** | No | No | No |
| **314SYP** | No | No | No |
| **314CHL** | **-** | **-** | **-** |

### 5.1.3 Is there evidence that it is unsafe to eat the fish?

California Department of Fish and Game staff, working through the Toxic Substances Monitoring Program (TSM), collected resident largemouth bass (*Micropterus salmoides*) in Lake Cachuma (314CHL) in August 2000. Both liver and fillet tissues were analyzed at the lab. Mercury was measured at 0.666 ppm in fillet, which exceeds the Median International Standard (MIS). However, no mercury was detected in liver tissue. All other metals were measured at levels below the MIS. No organic chemicals were detected (Table 5.1.3a).

TSM staff collected Starry flounder (*Platichthys stellatus*) from Santa Ynez River Lagoon (near 314SYN) in both 1999 and 2000. Both liver and fillet tissues were analyzed at the lab. Metal concentrations did not exceed Median International Standards. Liver tissues in both samples showed low levels of mercury. Low levels of DDT, at 3.9 ppb and 2.2 ppb, were reported in samples from 1999 and 2000, respectively. In the 1999 sample, lindane (a component of the pesticide chlordane) was also detected at low levels. These levels do not exceed levels of concern for human safety (Table 5.1.3a).

Table 5.1.3a. Site specific assessment of data used to assess impairment of fish consumption beneficial uses in the Santa Ynez River Hydrologic Unit (HU314).
**Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, dash symbol **(-)** - not assessed

| **Constituent** | Arsenic [1] | Cadmium [1] | Chromium [3] | Copper [3] | Lead [3] | Mercury [1] | Selenium [1] | Zinc [3] | Aldrin [2] | DDT, Total [1] | Dieldrin [1] | Endrin [1] | Heptachlor Epoxide [1] | PCB, Total [1] | **Evidence of Impairment** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fish Consumption Use Assessment Threshold** | 1.0 | 3.0 | 1.0 | 20.0 | 2.0 | 0.3 | 2.0 | 45 | 300 | 100 | 2.0 | 1000 | 4.0 | 20 | |
| **Units** | ppm | ppm | ppm | ppm | ppm | ppb | ppb | ppm | ppb | ppb | ppb | ppb | ppb | ppb | |
| **Matrix** | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Tis | |
| **Sites** | | | | | | | | | | | | | | | |
| **314SYN** | No | No | No | No | No | No | No | No | No | **No** | No | No | No | No | **No** |
| **314SYF** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **314MIG** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **314SYL** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **314SAL** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **314SYI** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **314SYC** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **314SYP** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **314CHL** | No | No | No | No | No | **S** | No | No | No | No | No | No | No | No | **S** |

### 5.1.4 Is there evidence that aquatic life uses are not supported?

Water toxicity samples were collected at all sites in the Hydrologic Unit and tested using water fleas (*Ceriodaphnia dubia*) and larval fathead minnows (*Pimephales promelas*). At a subset of these sites, sediment samples were also collected and tested for toxicity using the amphipod *Hyallela azteca* (Table 5.1.4a). Sediment samples were analyzed for organic chemicals, polycyclic aromatic hydrocarbons and metals (Table 5.1.4b).

Significant reduction in survival of larval fish was reported from the toxicity sample collected at Paradise Road (312SYP). In addition, adverse biological effects (significantly reduced growth or reproduction relative to the control) were observed in four of the tests. At the Highway 246 site (314SYL), reproduction was significantly lower relative to the control for *C. dubia* tests. The *P. promelas* test conducted on the water sample from San Miguelito Creek (314MIG) resulted in significantly reduced growth. At this site the chlorpyrifos concentration was 0.15 ppb. No significant toxicity was reported for the amphipod *H. azteca* in sediment samples at sites in the Unit. However, because of a failed control in the sediment toxicity test at the laboratory, these data were reanalyzed past the holding time and are qualified as estimated data. These data are not included in the assessment of impairment.

Sediment samples were collected at the Santa Ynez River site at 13$^{th}$ Street (314SYN) in 1999 and upstream at Floradale (314SYF and Highway 246 (314SYL) in 2002. In sediment collected from the River at 13$^{th}$ Street, DDT was the only organic chemical detected. It measured 2.85 ug/Kg, far below the ERM value. In sediment samples collected in 2002, DDD, DDE and dieldrin were detected at the Floradale site (314SYF) at low levels. At the Highway 246 site (314SYL) DDE was also detected at low levels, relative to NOAA and Florida criteria (Table 5.1.4b).

In 2002 sediment samples were collected from two Santa Ynez River sites, Floradale (314SYF) and Highway 246 (314SYL). At the Floradale site (413SAF) two metals, chromium and nickel, had sediment concentrations that exceeded criteria. Chromium concentration exceeded the PEL value and neared the UET value; measuring 94.7 mg/Kg. Nickel levels exceeded the UET criteria, measuring 61.1 mg/Kg.

Several individual PCB congeners were detected in sediment samples collected at the Highway 246 site (314SYL) and at the Floradale site (314SYF). However, total PCB concentrations did not exceed the UET threshold value.

Table 5.1.4a. Site specific assessment of data used to assess impairment of aquatic life uses in the Santa Ynez River Hydrologic Unit (HU314). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist (ie a non threshold value is exceeded or only one exceedances observed, dash symbol **(-)** - not assessed.

| **Constituent** | Ammonia as N, Unionized | Oxygen, Dissolved | Oxygen, Saturation | pH | Toxicity | Bio-stimulatory Risk | CCAMP IBI | Arsenic [1] | Chromium [1] | Copper [1] | Lead [1] | Mercury [1] | Selenium [1] | Zinc [1] | DDT, Total [2] | Dieldrin [2] | Endrin [2] | PCB,Total [2] | DDT, Total [3] | Dieldrin [3] | Organic Chemicals without criteria | **Evidence of impairment** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Aquatic Life Use Assessment Threshold** | 0.03 | <7 or <5 | Median <85 | <7 >8.5 | <80% and significantly different than control | 0.4 | <3.0 | 1.5 | 1 | 20 | 2 | 0.5 | 2 | 45 | 1000 | 100 | 100 | 500 | 46 | 8 | > RL | |
| **Units** | ppm | ppm | % | pH | % survival | | | ppm | ppm | ppm | ppm | ppb | ppb | ppm | ppb | ppb | ppb | ppb | ppb | ppb | ppm | |
| **Matrix** | H20 | H20 | H20 | H20 | H20 or Sed | NA | NA | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Tis | Sed | Sed | Sed | |
| **Sites** | | | | | | | | | | | | | | | | | | | | | | |
| **314SYN** | No | **S** | **Yes** | No | No | **Yes** | - | No | No | No | No | No | No | No | No | No | No | No | No | No | No | **Yes** |
| **314SYF** | **S** | **Yes** | **Yes** | **S** | No | **Yes** | **S** | - | - | - | - | - | - | - | - | - | - | - | No | No | No | **Yes** |
| **314MIG** | No | No | No | **Yes** | No | **Yes** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **S** |
| **314SYL** | No | No | No | No | No | No | **Yes** | - | - | - | - | - | - | - | - | - | - | - | No | No | No | **S** |
| **314SAL** | No | **S** | **S** | **S** | - | **Yes** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **S** |
| **314SYI** | No | No | No | No | No | No | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | No |
| **314SYC** | No | No | No | No | No | No | No | - | - | - | - | - | - | - | - | - | - | - | - | - | - | No |
| **314SYP** | No | **S** | **S** | No | **S** | No | No | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **S** |
| **314CHL** | - | - | - | - | - | - | - | No | No | No | No | No | **S** | No | No | No | No | No | - | - | - | **S** |

Table 5.1.4b. Organic chemicals detected in sediment samples collected at sites in the Santa Ynez Hydrologic Unit, 2002 and 1999.

| Site Tag | Chlordane, Total | Chlorpyrifos | DDD(o,p') | DDD(p,p') | DDE(p,p') | DDT, Total | Dieldrin | Heptachlor epoxide | Nonachlor, cis | Nonachlor, trans | Total PCB |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 314SYF 2002 | 1.29 | 2.35 | 6.11 | 2.52 | 3.09 | 11.72 | 0.675 | 1.57 | 4.22 | 0.661 | 11.329 |
| 314SYL 2002 | | | | | 0.813 | 0.813 | | | | | 7.41 |
| 314SYN 1999 | | | | | | 2.85 | | | | | |
| **NOAAERM marine** | **6** | | | | | **46.1** | **8** | | | | |
| **Flordia PEL** | **8.9** | | | | | **4450** | **6.67** | | | | |
| **Flordia TEL** | **4.5** | | | | | **6.98** | **2.87** | | | | |

Most sites in the Hydrologic Unit had depressed dissolved oxygen levels in at least one sample (Figure 5.1.4a). The two sites that are the exception to this statement are Santa Ynez River at Highway 1 (314SYI) and at Highway 246 (314SYL). In contrast, the Santa Ynez River site at Floradale (314SYF) had oxygen levels below 7.0 mg/L (the cold water habitat objective) in 50% of all samples. Dissolved oxygen at this site was measured below 5.0 mg/L (the warm water habitat objective) in both pre-dawn monitoring events during summer 2001. Downstream at 13$^{th}$ Street (314SYN), two late fall season samples measured below 7.0 mg/L.  Two Salsipuedes Creek measurements (314SAL) and three Santa Ynez River measurements (314SYP) were below 7.0 mg/L.

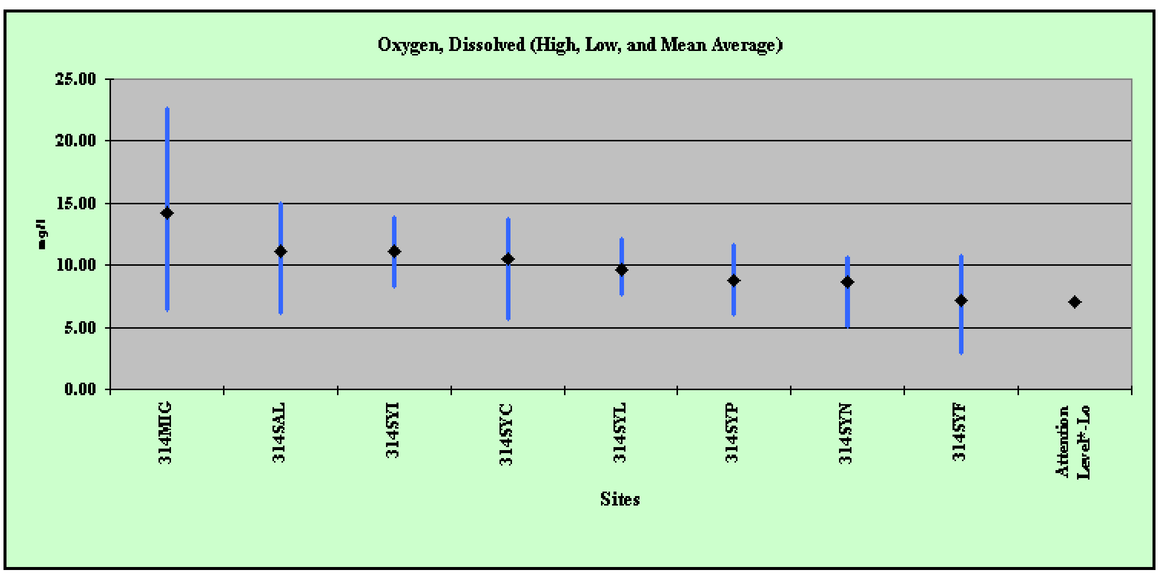


Figure 5.1.4a. Mean and range of dissolved oxygen levels (mg/L DO) at sites in the Santa Ynez River Hydrologic Unit between January 2001 and March 2002.

Two sites in the Hydrologic Unit had elevated pH levels. San Miguelito Creek (314MIG) exceeded the Basin Plan upper limit for aquatic life (8.5) in 82% of the samples. The Santa Ynez River site located at 13$^{th}$ Street (314SYN) exceeded the upper limit for pH in 5 of 27 samples (19%). The lowest pH levels were observed at the Santa Ynez River site at Floradale (314SYF) and were as low as 6.82 pH units. These pH measurements are coincident with low dissolved oxygen levels. This site is located downstream of the City of Lompoc and the City's wastewater treatment plant discharge point to the river. The change in pH between the CCAMP sites above and below City of Lompoc (314SYL at Highway 246 and 314SYF at Floradale) is often as much as one pH unit. Data collected by the wastewater treatment plant upstream and downstream of the effluent discharge to the River are consistent with these findings, implying that the discharge is significantly affecting pH in the River.

The Basin Plan objective for unionized ammonia (0.025 mg/L) was exceeded on three occasions in the lower Santa Ynez River, including twice at the Floradale site (314SYF) where it reached as high as 0.51 mg/L (unionized $NH_3$ as N) in May of 2001. Elevated unionized ammonia was also measured on the same date downstream at the 13$^{th}$ Street site (314SYN). Sources of this ammonia should be further investigated, with initial focus on the wastewater treatment plant, as these levels are directly toxic to aquatic life.

*Biostimulatory risk*

CCAMP has evaluated biostimulatory risk for all monitored sites in the Central Coast Region and has identified a threshold score of 0.40 for determining risk for eutrophic conditions (Appendix A). Biostimulatory Risk Index scores for the Santa Ynez Hydrologic Unit ranged from 0.16 (low risk) at the Paradise Road site (314SYP) to 0.81 (high risk) at the Floradale site (314SYF). As shown in Figure 5.1.4b, the Floradale site (314SYF) and the 13$^{th}$ Street site (314SYN) are in the upper 25$^{th}$ percentile for all sites in the Region, indicating elevated risk for eutrophication. The risk index rankings for both of these sites are most heavily influenced by nutrient levels, but also by pH and dissolved oxygen. During the summer months, the wastewater treatment plant effluent discharge can be the primary water source at the Floradale site (314SYF), and consequently also contributes to flow at the 13$^{th}$ Street site (314SYN). Elevated orthophosphate levels in the effluent discharge are of concern, as this is often the limiting nutrient in Central Coast waters. Compared to other CCAMP monitoring sites, the average orthophosphate level at the Floradale site (314SYF) is the third highest in the Region. Other sites in the watershed with high Biostimulatory Risk Index scores include San Miguelito Creek (314MIG) and Salsipuedes Creek (314SAL) (Figure 5.1.4.b). These sites had widely ranging levels of dissolved oxygen and pH, and elevated levels of chlorophyll *a*.

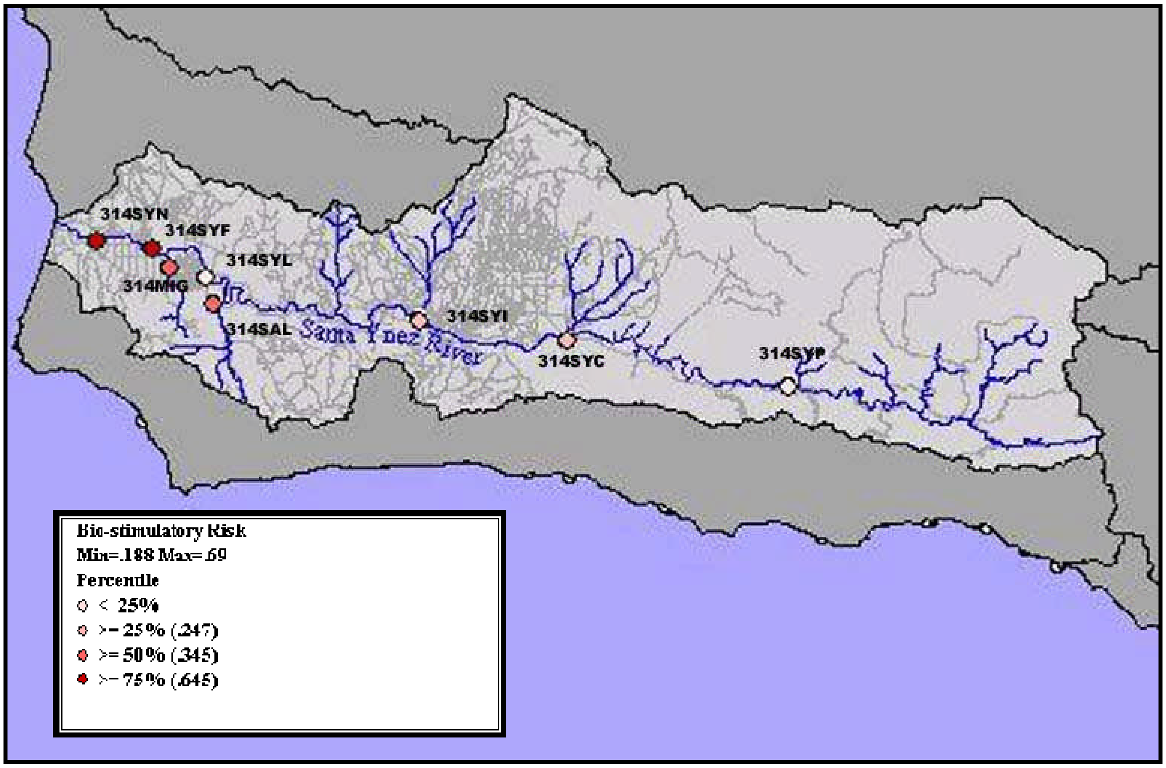


Figure 5.1.4b. Biostimulatory risk rankings at sites in the Santa Ynez Hydrologic Unit based on data collected between April 2001 and March 2002.

*CCAMP Index of Biotic Integrity (CCAMP IBI)*

CCAMP IBI scores are a relative ranking and sites scoring less than 3.0 on the CCAMP IBI are considered to be in poor condition, based on macroinvertebrate assemblages. Because samples were collected in two consecutive years at each site and each year the sampling effort consists of 3 composite samples per site (as specified by the CSPB protocol, Harrington 1999), the mean CCAMP IBI score for a site represents six samples. Although this index may indicate impairment of aquatic life uses at some sites it is not used alone as an assessment threshold.

Benthic invertebrate community assemblage data was collected at four sites in the Santa Ynez River in 2001 and in 2002. CCAMP Index of Biotic Integrity (IBI) scores are highest at the upstream-most site at Paradise Road (314SYP). At this site IBI scores ranged from 4.0 (fair) to 6.5 (good). The average IBI scores decrease at each downstream site and are in the poor range (<3.0) for both sites located below the city of Lompoc (314SYF and 314SYN). Lowest scores in the watershed were at the Floradale site (314SYF) in the second year (2002), and a strong odor of chlorine was noted in the river on that day. This site is directly downstream of the Lompoc wastewater treatment plant discharge point, which is assumed to be the source of this odor.

### 5.1.5 Is there evidence that agricultural uses are not supported?

For the protection of agricultures uses the Central Coast Basin Plan includes water quality objectives for conductivity and some salts, including sodium, chloride and boron. Table 5.1.5a summarizes threshold exceedances of these criteria. No sites exceeded the objective for conductivity or for boron. However, several sites had elevated chloride and sodium levels relative to Basin Plan agricultural irrigation objectives. In most samples collected from the Santa Ynez River at 13$^{th}$ Street (314SYN), Floradale (314SYF) and Highway 246 (314SYL) and from San Miguelito Creek (314MIG) and Salsipuedes Creek (314SAL) chloride and sodium levels exceeded the objective. There were no samples exceeding the objective for chloride at Santa Ynez River sites at Highway 101 (314SYI), Highway 154 (314SYC) or at Paradise Road (314SYP). Sources of elevated chloride and sodium in the lower watershed are unknown. Primary land uses are a mixture of agriculture and the urban area of Lompoc.

Nitrate concentration above 30 mg/L as N is also of concern for the protection of water quality for agriculture uses. The Basin Plan objective for agriculture use was not exceeded at any site in the Hydrologic Unit.

See the section discussing aquatic life beneficial uses for information on pH in the Hydrologic Unit.

Table 5.1.5a. Site specific assessment of data used to assess impairment of agricultural beneficial uses in the Santa Ynez River Hydrologic Unit (HU314). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist (i.e. a non threshold value is exceeded or only one exceedance observed, dash symbol **(-)** - not assessed.

| **Constituent** | Boron | Chloride | Conductivity (Us) | Nitrate as N | pH | Sodium | **Evidence of Impairment** |
|---|---|---|---|---|---|---|---|
| **Matrix** | H20 | H20 | H20 | H20 | H20 | H20 | |
| **Units** | mg/L | mg/L | mg/L | mg/L | pH Units | mg/L | |
| **Agricultural Use Assessment Threshold** | 0.75 | 106 | 3000 | 30 | or >8.4 | 69 | |
| **Sites** | | | | | | | |
| **314SYN** | No | **Yes** | No | No | No | **Yes** | **Yes** |
| **314SYF** | No | **Yes** | No | No | **S** | **Yes** | **Yes** |
| **314MIG** | No | **Yes** | No | No | **Yes** | **Yes** | **Yes** |
| **314SYL** | No | **Yes** | No | No | No | **Yes** | **Yes** |
| **314SAL** | No | **Yes** | No | No | **S** | **Yes** | **Yes** |
| **314SYI** | No | No | No | No | No | **S** | **S** |
| **314SYC** | No | No | No | No | No | No | No |
| **314SYP** | No | No | No | No | No | No | No |
| **314CHL** | - | - | - | - | - | - | - |

### 5.1.6 Is there evidence that aesthetic and non-contact recreation uses are not supported?

There are two Basin Plan objectives for fecal coliform to protect for non-contact recreation uses: no more than 10% of samples can exceed 4000 MPN/100mL and geomean shall not exceed 2000 MPN/100mL. Three sites has single sample exceedances of 3000 MPN/100ML; however, the geomean at all sites was below 2000 MPN/100mL (Table 5.1.6a).

Turbidity was generally low during dry weather flows in the Hydrologic Unit. However, turbidity was observed as high as 20 NTU at the San Miguelito Creek site (314MIG) during summer months.

Growth of algae and emergent vegetation can cause nuisance conditions and adversely affect aquatic life beneficial uses. Persistent algal cover greater than 25% was observed at several sites through the watershed at sites where attachable substrate was available. Santa Ynez River sites at Paradise Road (4314SYP) and at Highway 154 (314SYC) had nuisance algal conditions, with thick algal coverage on all cobble and boulder substrate. Downstream at Highway 1 (314SYI), Highway 246 (314SYL) and at Floradale (314SYF), algal density was low but present where attachable substrate was in place. Sites where sand is the dominant substrate (i.e. lower Santa Ynez River) did not have persistent algae. In the lower watershed at Floradale (314SYF) and at 13$^{th}$ Street (314SYN) emergent vegetation in the summer months became dense and overgrown. On multiple occasions watercress completely filled the wetted channel at these locations. Tributary sites at San Miguelito Creek (314MIG) and Salsipuedes Creek (314SAL) also had persistent algal cover above 25%. Site photographs can be viewed at the CCAMP web site.

Trash, litter and odors can also cause nuisance conditions and adversely affect aquatic life beneficial uses. Litter in the channel at San Miguelito Creek (314MIG) was noted each time the site was visited. This site is located in the storm water canal adjacent to V Street in Lompoc. Foul odors were also recorded at this site. CCAMP staff observed chlorine and laundry detergent odors on multiple site visits the Santa Ynez River site at Floradale (314SYF). These odors are assumed to be from the WWTP discharge to the River, just upstream of this site.

See the section discussing aquatic life beneficial uses for information on pH in the Hydrologic Unit.

Table 5.1.6a. Site specific assessment of data used to assess impairment of water contact recreational uses in the Santa Ynez River Hydrologic Unit (HU314).

BPJ is Best Professional Judgment. **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist (i.e. a non threshold value is exceeded or only one exceedances observed, dash symbol **(-)** - not assessed.

| Constituent | Emergent vegetation nusiance condition | % algal Cover, filamentous | Coliform, Fecal | Coliform, Fecal | Litter, odor or other | pH | Turbidity (NTU) | **Evidence of Impairment** |
|---|---|---|---|---|---|---|---|---|
| **Units** | | % | MPN/100 ml | MPN/100 ml | | pH units | NTU | |
| **Matrix** | | NA | H20 | H20 | | H20 | H20 | |
| **Non-Contact Recreation Assessment Threshold** | BPJ | 25% | More than 10% of samples >4000 | Geometric mean > 2000 | BPJ | <6.5 or >8.3 | 10 | |
| **Sites** | | | | | | | | |
| **314SYN** | **Yes** | No | No | No | - | No | No | **S** |
| **314SYF** | **Yes** | No | **S** | No | **Yes** | **Yes** | **S** | **S** |
| **314MIG** | No | **Yes** | **S** | No | **Yes** | **Yes** | **S** | **S** |
| **314SYL** | No | No | **S** | No | - | **Yes** | No | **S** |
| **314SAL** | No | **Yes** | No | No | - | No | No | **S** |
| **314SYI** | No | **Yes** | No | No | - | No | No | **S** |
| **314SYC** | No | **Yes** | No | No | - | No | No | **S** |
| **314SYP** | No | **Yes** | No | No | - | No | No | **S** |
| **314CHL** | - | - | - | - | - | - | - | - |

## 5.2 Discussion

Monitoring data from the upper watershed (above Lake Cachuma) shows some evidence of impairment. The Santa Ynez River at Paradise Road (314SYP) is the uppermost location where public roads allow access. At this location the River is more than 100m wide and is composed of exposed gravel and cobble habitats with mature riparian vegetation along the banks. Dissolved oxygen levels as low as 6.1 mg/L in summer months and Index of Biotic Integrity (IBI) scores ranging from “good” to “poor” provide evidence that aquatic life beneficial uses may be impaired, at least part of the year at this site. Periphyton cover on cobble and gravel substrate was persistent throughout the year and filamentous algae cover increased as flows declined in late summer months.

Instream habitat below Lake Cachuma is similar and is dominated by cobble and gravel. However, at the CCAMP monitoring site at Highway 154 (314SYC) the River is narrower and the riparian vegetation provides more instream habitat. In 2001, year-round flows were maintained at this location by controlled releases from the Lake. IBI scores at this location ranged from 4.0 to 4.6, indicating fair benthic community composition. Algal communities were persistent throughout the year at this location with densities peaking in the summer months. However, dissolved oxygen levels do not indicate that these alga are causing diurnal fluctuations below levels of concern.

Monitoring data from middle watershed sites (at Highway 101 and at Highway 246) showed some evidence of impairment to several beneficial uses discussed in this report. Instream habitats at these locations are dominated by sand and some gravels. These sites also tend to dry up in the summer months and are frequently used for off-road recreation. Bacteria data from these middle watershed sites show that elevated levels are occurring during wet weather flows. Nitrate and pH levels are within Basin Plan Objectives at these sites. There is no evidence of impairment to aquatic life or municipal and domestic supply beneficial uses these sites. However, at Salsipuedes Creek, a tributary to the River just above the City of Lompoc, depressed dissolved oxygen levels and elevated pH are a potential concern for aquatic life. Chloride, TDS and sodium levels exceed the Basin Plan waterbody specific objective at the Santa Ynez River site at Highway 246 (314SYL).

Monitoring data from the lower watershed sites (Santa Ynez River at Floordale, 13$^{th}$ Street and San Miguelito Creek at W. North Avenue) showed evidence of some impairment to all beneficial uses discussed in this report. The CCAMP monitoring site on San Miguelito Creek (314MIG) is located within the channelized portion of this creek just before its confluence with the River. At this location, the substrate is cement and instream habitat is dominated by trash and discarded objects such as shopping carts. In summer months, algae covered the cement channel and supersaturated dissolved oxygen conditions were common. Biostimulation risk at this site was very high due to algal conditions and wide ranges of dissolved oxygen and pH. Lower Santa Ynez River sites receive year-round discharge from the Lompoc Waste Water Treatment Plant. In the dry summer months this discharge is the primary source of water at the Floradale (314SYF) and 13$^{th}$ Street (314SYN) sites. Elevated nitrate and phosphate, depressed dissolved oxygen, and nuisance conditions with respect to emergent vegetation are evidence of impairment to aquatic life, agriculture and aesthetic beneficial uses. Waterbody specific objectives for the lower Santa Ynez River were exceeded on multiple occasions for TDS, chloride, boron and sodium.

## 5.3 Conclusions

Based on relatively high percent exceedence of the Basin Plan coliform objective (400 MPN/100 ml), we recommend that the Santa Ynez River be listed as impaired by fecal coliform from Highway 101 downstream to the lagoon, and that two of its tributaries, San Miguelito and Salsipuedes, also be considered for listing.

Many of the water quality problems identified in the Santa Ynez River occur in the reaches below the wastewater treatment plant discharge upstream of Floradale Avenue. Identified problems included violations of the unionized ammonia objective, the drinking water objective for nitrate, and several site specific salts objectives, as well as large changes in pH and dissolved oxygen from upstream sampling locations.

It is apparent that the effluent discharge to the river from the City of Lompoc is having a significant affect on the river, especially during the dry season when this discharge is the primary source of flow. The Floradale Street bridge is approximately 100m downstream of the WWTP discharge confluence with the river. Regional Board staff is currently working with the WWTP facility to upgrade the system and improve the quality of the effluent discharge to the River. At this time, the lower Santa Ynez River (below the City of Lompoc) is listed on the Clean Water Act 303(d) List of Impaired Waters for nutrients. CCAMP monitoring supports this listing based on exceedances of Basin Plan objectives for unionized ammonia and nitrate, and for elevated orthophosphate levels.

Photo-documentation of trash and litter as well, as field notes documenting odors at the San Miguelito Creek site, warrant recommendation for listing due to impairment of several beneficial uses. Beneficial uses impacted by trash and odors at this site include contact recreation (REC-1) and non-contact recreation (REC-2). This site is located adjacent to homes and field crews have observed children playing in and around the water. The lack of riparian corridor at this site results in direct sunlight, warmer water conditions, algal blooms and therefore widely ranging dissolved oxygen and pH levels. Staff recommends listing of San Miguelito Creek for trash, dissolved oxygen and pH.

Several violations of Central Coast Basin Plan Objectives have been identified. In addition to 303(d) listing recommendations, we recommend the following to address these issues:

- Follow up Monitoring
    - Evaluate mercury levels in sediment and tissues collected from Lake Cachuma

- Basin Planning
    - Consider appropriateness of site-specific objectives for salts in Santa Ynez River

- Nonpoint Source Management
    - Manage for increasing impairment by nutrients for lower Santa Ynez River (below the City of Lompoc).

  - Manage to prevent biostimulatory risk in the lower end of Santa Ynez River (below the City of Lompoc) and in San Miguelito Creek.
  - Manage to reduce trash impairment in San Miguelito Creek.
  - Manage to prevent and reduce impairment by fecal coliform downstream of Buellton in the Santa Ynez River and its tributaries.

- Orders
  - Revise National Pollutant Discharge Elimination System permits, Waste Discharge Requirements, Water Quality Certifications, etc. to:
    - Add monitoring for phosphorus (total and orthophosphate) as P, nitrogen ( add total, $NO_3$, $NO_2$ ) as N, total suspended solids, sulfate, sodium and chloride. Also add benthic invertebrate monitoring in WWTP discharge permits upstream and downstream of discharge. Currently, monitoring includes monthly reporting of unionized ammonia, pH, dissolved oxygen temperature, total dissolved solids, turbidity and toxicity to water fleas and fathead minnows)
    - Manage nutrient sources/discharges
    - Manage for dissolved oxygen and temperature levels
    - Manage for total solids (dissolved and suspended) and salts.

## 6 Quality Assurance

<u>Evaluating field data</u>

Field equipment is calibrated according to manufacturers specifications (Hydrolab Inc, 2002) prior to and following each sampling event. Field data is qualified with a flag and disabled from use in data calculations and determination of beneficial use impairment if the following is true:

- Post calibration measurements differ from the calibration standard values by more than 20% as identified in the SWAMP Quality Assurance Management Plan (QAMP) (Puckett 2002, Appendix C).

<u>Evaluating laboratory data</u>

Data is qualified with a flag if it meets one of the following criteria:

- Analyte of interest is not detected (non-detect), the minimum detection limit (MDL) and/or practical quantifiable limit (PQL) is higher than the SWAMP target reporting limit (TRL), and the MDL does not exceed levels of concern or Basin Plan objectives.
- The result is between the MDL and the PQL and these values are below the appropriate water quality criterion.
- The difference between the results from a blind field duplicate and an original sample exceeds the allowable relative percent difference (RPD) defined in the SWAMP QAMP (Puckett 2002, Appendix C). The maximum RPD for conventional parameters, synthetic organics and metals is 25%.
- Blind field duplicates for coliforms exceed the 95% confidence interval values.
- Holding time requirements are not met.

Data is qualified with a flag and disabled from use in calculations and determination of beneficial use impairment if it meets one of the following criteria.

- Analyte of interest is not detected (non-detect), MDL and/or PQL is higher than the SWAMP target reporting limit (TRL), and the non-detect value is near or exceeding a criterion.
- The surrogate spike recovery levels exceed the allowable range of acceptance as identified by the contract laboratory's quality assurance program (BC Labs, 2002). The acceptable levels vary between analytes.
- Matrix spike recovery values exceed the allowable recovery (percent recovery) as defined in the SWAMP QAMP (Puckett 2002, Appendix C). The maximum variation in percent recovery for conventional parameters and metal in sediment is 25%. For synthetic organics in sediment the required recovery is at least 50%.
- The batch precision violates the precision requirements defined in the SWAMP QAMP (Puckett 2002, Appendix C). These requirements are 80-120% precision for conventional parameters and 50-150% precision for organic chemicals in sediment and tissue.
- The method blank results exceed the MDL.
- The relative percent difference (RPD) between the blind field duplicate result and the original sample exceeds the allowable defined in the SWAMP QAMP

(Puckett 2002, Appendix C) and the difference between the two results is greater than twice the analyte's SWAMP TRL.

All data was evaluated relative to SWAMP QA criteria. Flags that have been accepted are included in the database as qualifiers. These data are used by CCAMP in analyses but can be excluded by other users if desired. Data which are rejected because they are outside of the QA criteria defined in the SWAMP QAMP are disabled from all analyses.

CCAMP field and laboratory data was evaluated using the SWAMP QAMP and CCAMP acceptability criteria outlined above. The contract laboratory submitted electronic QA/QC data for all results discussed in this report. They submitted data for twenty analytes per site sample, and attached flags to a number of sample analytes. These flags were reevaluated using the SWAMP measurement quality objectives (MQOs) where appropriate.

SWAMP acceptability criteria were generally less strict than that of the contract laboratory. Therefore, several of the data were flagged by the contract laboratory and remained flagged in the CCAMP database but are acceptable for use in some data analyses using SWAMP criteria. Data that did not meet SWAMP acceptability criteria were flagged with the appropriate code and the term "reject". Rejected data was not included in any of the analyses discussed in this document.

There were a total of 223 flags generated during QA analysis of data collected from the Santa Ynez Hydrologic Unit. Flags include those generated by the Region 3 contract laboratory, such as matrix spike and continuing calibration exceedances, as well as for field duplicates and field equipment calibration. Of these 223 flags, 66 were outside the MQOs identified in the SWAMP QAMP (Puckett 2002). Rejected data are maintained in the database with a flag identifying the data as disabled. These data are not used in any assessments.

<u>Field Duplicates</u>

Blind field duplicate results were compared to original sample data. Data pairs were compared in terms of relative percent difference and determined to be unacceptable if the difference between duplicate pairs exceeded the analyte's specific MQOs and was greater than twice the TRL, as defined in the SWAMP QAMP (Puckett 2002). For each blind field duplicate pair, there are several different analytes.

We identified forty-seven sample analytes that did not meet the QA criteria defined above. All five field duplicate samples failed both the SWAMP MQO and the "twice the TRL" criteria.

The contract lab also analyzed blind field duplicate samples for total and fecal coliform on all occasions. Because analysis of these data is not discussed in the SWAMP QAMP, we compared the duplicate result to the original sample using the 95% confidence interval table from Standard Methods (1999) for multiple tube dilutions. For these data, there were no exceedances of the abovementioned criteria.

MDLs / PQLs

Comparison of reported MDLs and PQLs relative to the target values defined in the SWAMP QAMP (Puckett 2002) can result in several flags including the following: result between MDL and PQL, MDL above TRL and PQL above TRL. Additional qualifying flags related to MDL and PQL results include the following: elevated MDL/PQL due to matrix interference and elevated MDL/PQL due to sample dilution. In the Santa Ynez Hydrologic Unit the following flags were assigned to data collected between January 2001 and March 2003.

- Results were reported between the MDL and PQL for 111 analyte results. These results are considered estimated as they are detected but not quantified.
- Eighteen analyte results had elevated MDLs. Elevated MDLs were reported for six samples as a result of matrix interference. Seven of the eighteen analyte results had MDLs elevated above SWAMP TRLs; however, none were of consequence or were disqualified.

Matrix Spikes

The contract laboratory identified a total of twenty-eight analyte results for which there was a matrix spike recovery problem (being outside of the laboratory's quality control (QC) criteria. Reevaluation of these data using the SWAMP MQOs resulted in the rejection of eighteen analyte results.

Method Blanks

Six method blank flags were reported by the contract laboratory.

Precision

Sample and batch precision flags were not reported for any analyte results by the contract laboratory.

Field Data

Field data collected using a Hydrolab DS4a were evaluated using calibration records. Data are evaluated to determine if measurements are outside of the calibration range. In the Santa Ynez watershed, field measurements consist of conductivity, pH, turbidity, dissolved oxygen, water temperature, salinity and chlorophyll a. Four pH measurements were below the calibration range (< 7 pH units), Forty nine conductivity measurements and eight turbidity measurements were above the upper calibration range (1413 uS and 500 NTU respectively). Calibration records were also used to identify accuracy of the probes by comparing pre- and post-calibration data to identify drift. No measurements have been disqualified because of calibration drift.

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## Appendix A. CCAMP Biostimulatory Risk Index

### Introduction

Nutrients, such as nitrate, ammonia and phosphate, are often found at elevated concentrations in waterbodies of the Central Coast Region, and elsewhere in the State of California. Some nutrients have numeric objectives associated with particular beneficial uses. Specifically, to protect for municipal and domestic water supply, nitrate as N cannot exceed 10 mg/L. To protect against general toxicity, ammonia concentrations cannot exceed 0.025 mg/L. However, there are no numeric objectives that protect surface waters from the biostimulatory effects of excessive nutrients. Eutrophication results from a complex interaction of multiple nutrients, sunlight, substrate, water velocity, and other factors. It is difficult to identify specific nitrate or phosphate concentrations that represent thresholds over which problems will certainly occur. Consequently, the Central Coast Basin Plan narrative objective for biostimulatory substances is as follows:

> "Waters shall not contain bio-stimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses."

Understanding how to manage surface waters for biostimulation is complex, as interactions and effects of excessive nutrients are not always readily apparent. For example, a site that has excessive concentrations of phytoplankton or other algae may not display elevated concentrations of dissolved nutrients, as the nutrients may have already been taken up by plant material. This interplay of chemical, physical, and biological factors complicates assessment of overall water quality.

The Central Coast Ambient Monitoring Program has developed a "Biostimulatory Risk Index" to serve as a screening tool to simultaneously consider factors which serve as stimuli (nutrients), in parallel with those which act as responders (algal and plant cover, pH, dissolved oxygen and water column chlorophyll concentrations). The index is intended to characterize both in-situ monitoring site response to biostimulatory substances and the capacity of monitoring site water quality parameters to induce adverse biostimulatory responses in downstream areas. The index currently has no provision for addressing nutrient-poor waters, nor waters impacted by toxic effects associated with several of its components.

The Biostimulatory Risk Index is a combination of several different measures, or "metrics" of stimuli or response, which have then been ranked and combined to form a single value. The Central Coast Ambient Monitoring Program collects data on a number of parameters that are used in developing the preliminary Index, and serve as metrics. Some of these measures, such as nitrate concentration, may serve as metrics based on magnitude alone (where higher concentrations are considered "worse" than lower concentrations and are ranked accordingly). Others are more complex, particularly "double-ended" parameters such as dissolved oxygen and pH. For example, both supersaturated and depressed concentrations of dissolved oxygen can be indicative of eutrophication. Thus, one possible indicator of dissolved oxygen impairment is the departure of the measurement from the median value (where a larger departure ranks worse than a smaller departure).

**Biostimulatory Risk Index Development**

Index development included testing of a number of metrics that reflect various measures of nutrient stimulus and response. Candidate components included ranked concentrations of individual nutrient forms (such as unionized ammonia, orthophosphate, etc.), measures of dissolved solids, turbidity, various characterizations of percent vegetative cover and other measures. A subset of these candidates was selected for use.

**Selected Components**

- Chemical composite
  - Nitrate as N
  - Ammonia as N
  - Nitrite as N
  - Ortho-Phosphate as P
- Oxygen Saturation
- pH
- Chlorophyll *a*
- Plant Cover composite
  - Algal cover
  - Algal cover periphyton
  - Algal cover filamentous
  - Instream plant cover

Five metrics were developed and were calculated as follows:

1) c = Chemical composite metric = Sample percentile rank of summed concentrations (mg/L) of NO2-N + NO3-N + NH3-N + (PO4-P * 10)

This metric assumes that dissolved nutrients of various forms can all contribute to biostimulation, either at the site or downstream from it, and that they can be summed to represent overall nutrient availability, once adjustments have been made for the typical uptake ratio of phosphorus to nitrogen in plant tissue (1:10).

2) p = pH metric = Sample percentile rank departure from median of entire CCAMP dataset (8.2)

This metric reflects fluctuations in pH levels in response to photosynthetic and respiration activity by plants. Photosynthetic activity uses up carbon dioxide, causing bicarbonate ions to dissociate to create more CO2 and $OH^-$; this process increases alkalinity. The opposite is true during respiration and decay. This process assumes that pH that diverges widely from the median can be a measure of excessive plant activity, either as photosynthesis or respiration, and thus an indicator of biostimulation.

3) o = Oxygen metric = Sample percentile rank departure from median of entire CCAMP dataset for percent saturation (92.6)

The assumption driving this metric is that both depressed and supersaturated oxygen levels are indications of biostimulation. Samples taken in association with significant amounts of aquatic plant and algae growth may be supersaturated in late afternoon, and depressed in pre-dawn samples. Oxygen levels may remain depressed throughout the day when plant decay is prevalent. Percent saturation is used instead of dissolved oxygen concentration because it takes into account the confounding effects of water temperature and salinity.

4) a = Chlorophyll *a* component = Sample percentile rank of water column concentration of chlorophyll *a* (ug/L)

This metric assumes that higher concentrations of water column chlorophyll *a* are indications of phytoplankton abundance and hence of biostimulatory activity.

5) f = Flora component = Sample percentile rank of the maximum of one of the following: (Filamentous, Periphyton, or total Algal cover, instream plant cover)

This metric assumes that various forms of plant and algal cover represent uptake of nutrients from the stream system and hence indicate biostimulatory activity. Light availability, substrate and other factors affect which form of plant predominates; therefore this metric calculates rank based on the maximum value of the various forms quantified. This metric is not weighted highly because the quantified values are extremely subjective in nature and are highly variable.

Metrics are weighted and summed for each sampling event at each site, as follows:

$$a = 2^{(f1*c \ + \ f2*p \ + \ f3*o + f4*a \ + \ f5*f)}$$

Where:

f1=chemical composite weight = 6
f2= pH weight = 7
f3=oxygen weight = 5
f4=chlorophyll *a* weight = 9
f5=flora weight = 1

The mean percentile rank of 'a' for each site is utilized as the Biostimulatory Index for that site.

CCAMP staff evaluated performance of the index using data from the entire Region. Weighting factors f1, f2, f3, f4, and f5 were initially determined by confining the database under consideration to several hydrologic units well known to staff, and setting weighting factors to values that ranked sites in a sequence that was consistent with staff knowledge of the sites. Performance of the index was then examined in other hydrologic units not used to develop the weighting factors, using different staff, knowledgeable of site and waterbody characteristics in the new set of hydrologic units. Through iterative adjustment of weighting factors, index performance was tested until all staff agreed that site rankings best reflected overall staff knowledge of the sites.

Staff evaluated the final site ranking for evidence of threshold values at which sites begin to show overall impairment or cause downstream problems. Staff agreed that above an average index score of 0.40, sites begin to commonly show signs of impairment, including algal blooms, widely ranging dissolved oxygen concentrations, and elevated nutrient concentrations. We are using this value as a threshold for screening monitoring data for biostimulatory risk. Figure A.1. shows the mean and range of nitrate concentrations at sites scored for biostimulatory risk. Sites whose scores fall below the threshold of 0.40 virtually never exceed the drinking water standard for nitrate. 89% of these samples have site nitrate averages under 1.0 mg/L-N. Also, sites with a risk score of 0.40 or greater never have benthic invertebrate community index scores in the highest quartile (over 6.0) (Figure A.2.).

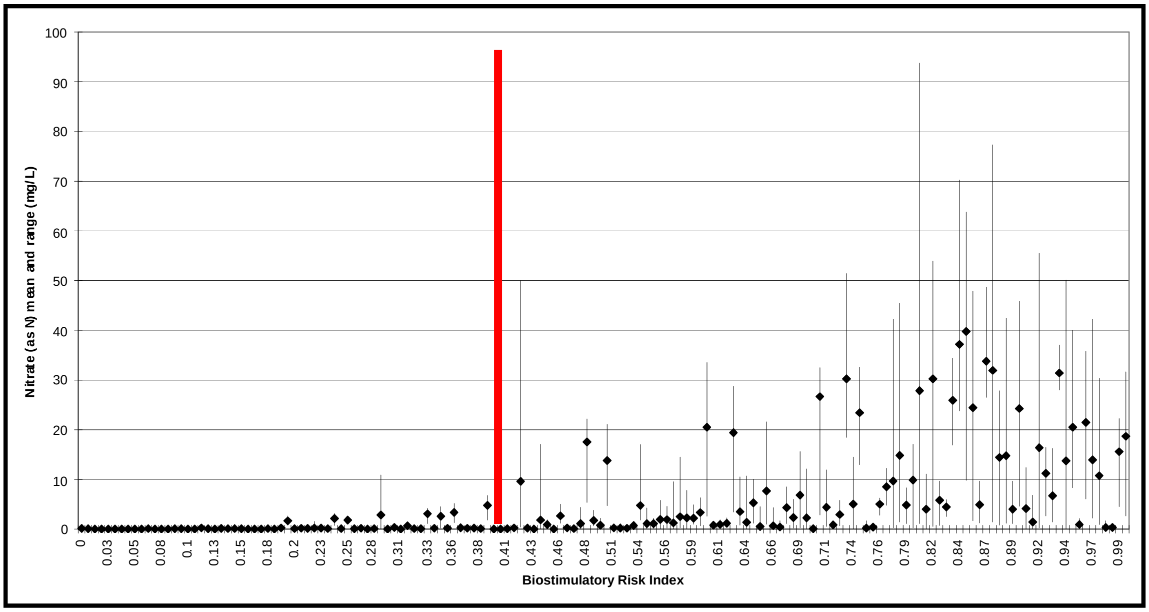



Figure A.1. Range and mean of Nitrate-N concentrations (mg/L) at sites scored for biostimulatory risk in the Central Coast Region. Biostimulatory risk threshold (0.40) indicated by red line.

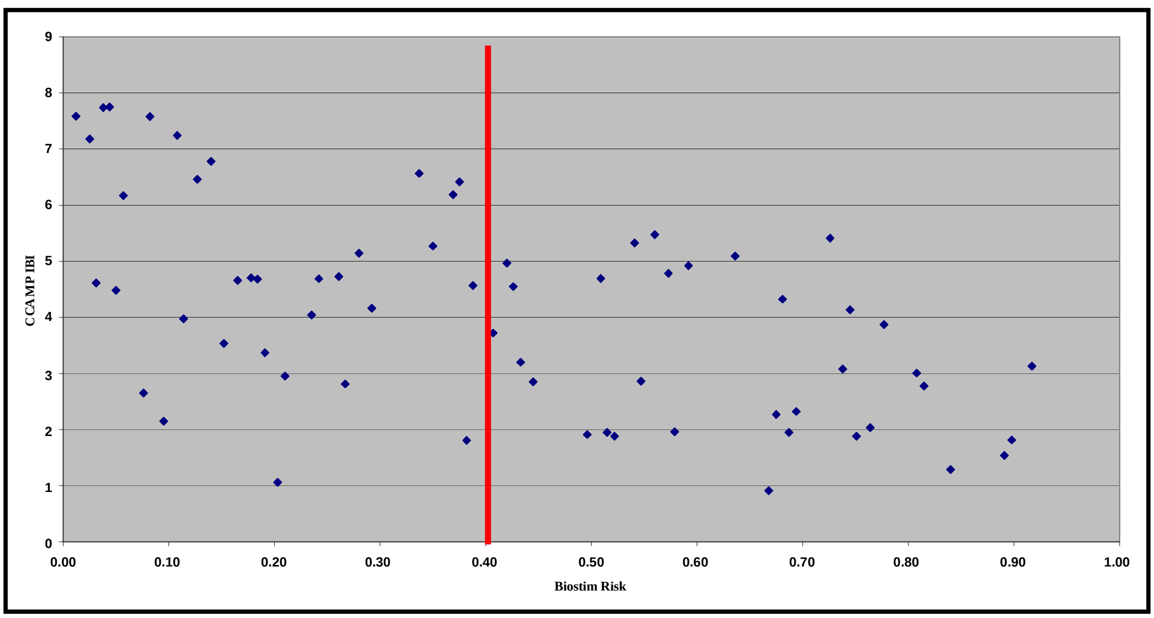



Figure A.2. Scatter plot of CCAMP-IBI scores against the Biostimulatory Risk Index for CCAMP sites. Biostimulatory risk threshold (0.40) indicated by red line.

**Index development assumptions**

The Bioassessment Risk Index is not based on bio-chemical process modeling. The only component of the index that deals with plant uptake of nutrients is the chemical composite component that assumes that phosphate concentration impacts occur at levels 10 times lower than nitrogenous compounds. The factor of ten was selected based on the typical ratio of these two nutrients in plant tissue. Freshwater systems tend to be limited by phosphorus. If the N:P ration is above 10:1 N:P a system will likely experience an algal bloom, the severity of which will be dictated by the amount of available phosphorus. (Schindler 1978 and Jaworski 1981). Examination of the data indicates that nitrogen is rarely the limiting nutrient in streams and rivers that exhibit problems with bio-stimulatory substances on the Central Coast of California. For this reason we selected a multiplier on the high end of literature values.

Since the Index is intended for use in moving water, it does not rely upon the assumption that effects will be located at the same place or time as causes.

Ranking of nutrient concentrations assumes that oligotropic conditions do not exist in the Central Coast Region and that a straight ranking of nutrient concentration from low to high reflects conditions moving from “good” (i.e. low concentrations) to “bad” (i.e. high concentrations). We have not documented conditions which appeared to be nutrient-poor in this Region.

The Index does not rely upon mass loading calculations (e.g. total pounds of a stressor delivered to a monitoring site). Biostimulatory impacts in stream and river systems are more related to concentrations found within a given reach than to nutrient loads moving through the reach. For example, during storm events very large quantities of nutrients move rapidly through river and stream systems with little or no impact on the streams and rivers. The true impacts of these nutrients are not manifest until they reach a ‘terminal water body’ such as a lake or the near shore ocean.

**Biostimulatory Risk in the Central Coast Region**

Figure A.3. shows the quartile rank of BioStim scores for all sites monitored by the Central Coast Ambient Monitoring Program. In general, Biostimulatory Risk Index scores are highest in areas of the Central Coast Region already known to suffer from very high levels of nutrients. Most of these areas are associated with intensive irrigated agricultural activity. Sites in the upper quartile of ranked scores are primarily in watersheds that have already been 303(d) listed as impaired by nutrients. Many are smaller tributaries that enter impaired rivers, such as Quail Creek (tributary to Salinas River), Little Oso Flaco Creek (tributary to Oso Flaco Creek), Main Street Canal, Orcutt-Solomon Creek and Blosser Channel (tributary to Santa Maria River), and Salsipuedes and Llagas Creeks (tributary to Pajaro River). Many of these tributaries have exceptionally high concentrations of nutrients and serve as major nutrients sources to the main stem systems. For example, Quail Creek concentrations have ranged as high as 94.7 mg/L for nitrate (as N) and 2.8 mg/L for orthophosphate (as P). Other waterbodies scoring in the top quartile are slow moving terminal waterbodies, such as Tembladero Slough, Moro Cojo Slough, and the Old Salinas River. These types of systems tend to have relatively high scores for pH, oxygen, and chlorophyll *a*, in addition to chemistry. Though much less common, some chemical scores are driven more by elevated phosphate concentrations than by nitrate. These include San Antonio and Carneros Creek sites. Santa Ynez River, Chorro Creek and San Luis Obispo Creek also have relatively high phosphate levels downstream of their respective wastewater treatment plant discharges. A few waterbodies not currently 303(d) listed for nutrients also scored in the top quartile. These include Franklin Creek, Arroyo Paradon Creek, Los Berros Creek and San Antonio Creek. They will be considered for 303(d) listing in the next listing cycle.

Waterbodies which fall in the lowest risk quartile include all of the Carmel River watershed, all creeks in the Santa Lucia Hydrologic Unit (along the Big Sur coast), most creeks in northern San Luis Obispo County (excluding San Simeon Creek), and small creeks in relatively undisturbed watersheds, such as Scott Creek (Santa Cruz County), Toro Creek, Old Creek above the reservoir, and Coon Creek (San Luis Obispo County), and El Capitan Creek and Gaviota Creek (Santa Barbara County). Several waterbodies which do not score in the lowest quartile overall have upper watershed sites with scores in the lowest quartile. These include San Luis Obispo Creek, Santa Ynez River, and San Simeon Creeks above their respective wastewater treatment plants.

Several of the creeks that score in the lowest quartile are dry in the summer, so scoring is calculated only from wet weather samples, which do not typically represent the worst case conditions relative to biostimulation. These include Montecito and San Ysidro Creeks in Santa Barbara County, both of which are channelized drainages passing through urban and agricultural land uses, and Villa Creek in San Luis Obispo County, which supports upstream irrigated agriculture.

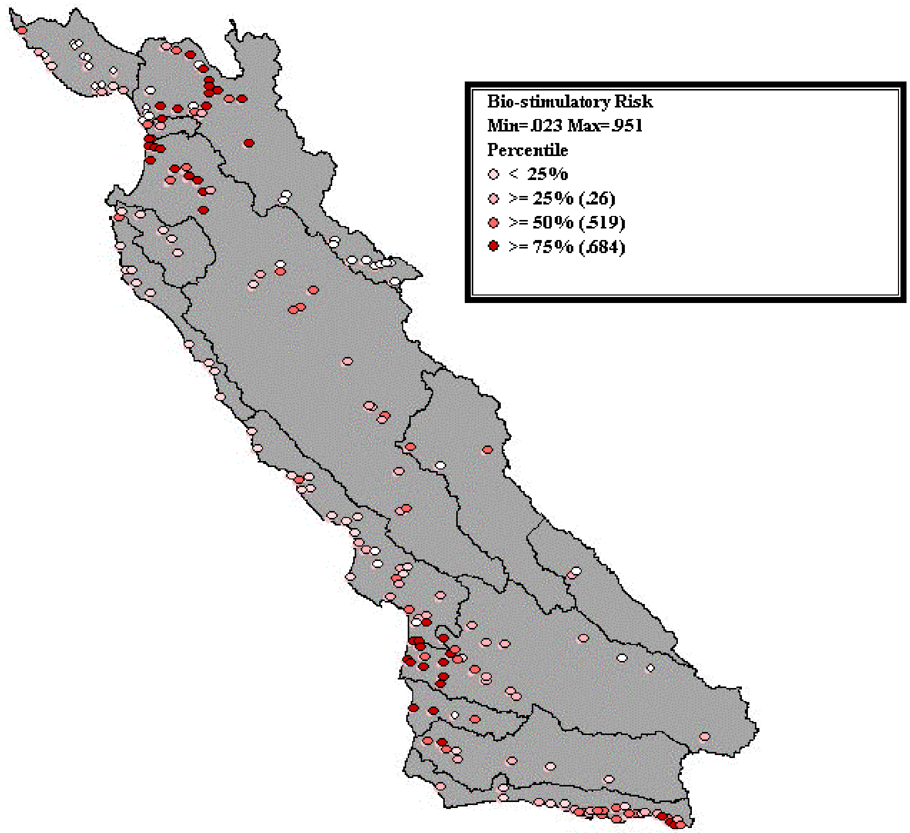



Figure A.3. Biostimulatory Risk Index scores for all sites monitored by CCAMP in the Central Coast Region between January 1998 and July 2005. Site scores are shown in quartiles, with sites ranked in the 75th quartile and above having the highest risk for eutrophic conditions.

**Biostimulatory Risk Index and Waterbody Impairment**

RWQCB staff have evaluated sites rankings alongside water quality and habitat data and subjectively made a determination of the Index score for creeks beginning to show "impairment". 0.40 was selected, as a site average. Sites in this range begin to show somewhat elevated nutrient concentrations, occasional algal blooms, and depressed dissolved oxygen concentrations.

## Appendix B. CCAMP Index of Biotic Integrity

The CCAMP Index of Biotic Integrity (CCAMP-IBI) is a sum of several ranked metric scores, including taxonomic richness, number of Ephemeroptera taxa, number of Trichoptera taxa, number of Plecoptera taxa, percentage of intolerant individuals (with tolerance scores of 0, 1, or 2), percentage of tolerant individuals (with tolerance scores of 8, 9 or 10), percent dominant taxon, and percent predators. This index includes all metrics utilized by Karr and Chu (1999) in their Index of Biotic Integrity, with the exception of "clinger taxa count" and "long-lived taxa count". The CCAMP program has been utilizing this index for a number of years for evaluating benthic invertebrate data in the Central Coast.

CCAMP-IBI scores range from 0 to 10. Sites in the lowest quartile of all CCAMP bioassessment data score below approximately 3.0, as a site average. Sites in the highest quartile score above 6.0. We have examined these quartile break points relative to other indices of water quality as shown in the following figures.

Pie charts in Figure B.2. show that at 60% of all sites in the lowest IBI quartile, multiple measures of toxicity were present; only 20% of these sites had no evidence of toxicity. At sites in the highest quartile, 60% were free of toxicity and the remaining sites showed only a single indication of toxicity (such as reduced growth or reproduction).

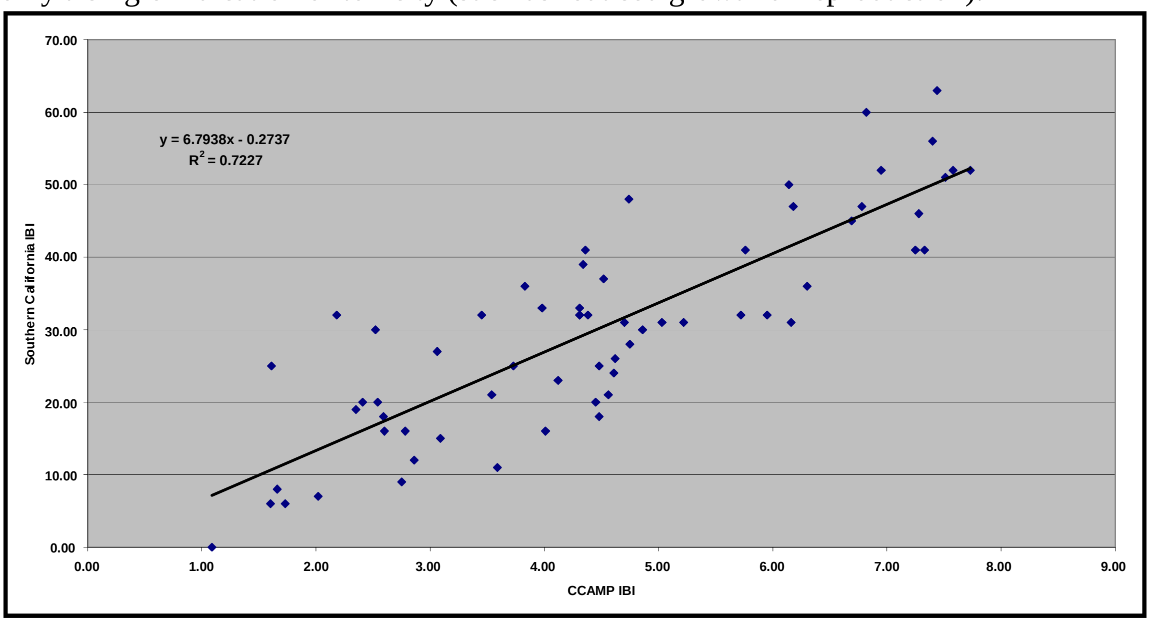
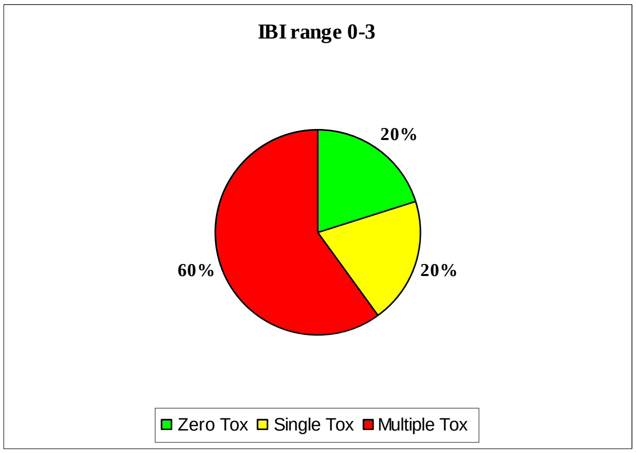
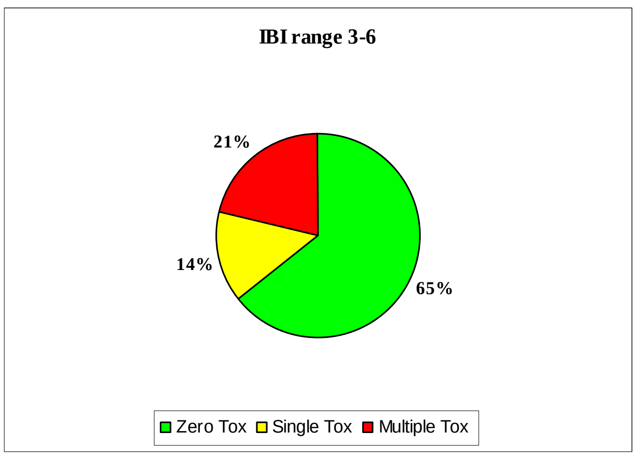
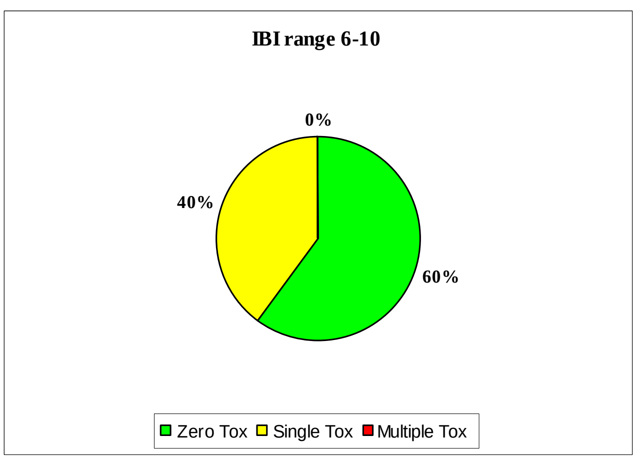



Figure B.1. Regression of Southern California Index of Biotic Integrity scores against Central Coast Ambient Monitoring Program Index of Biotic Integrity scores for the Central Coast Region.




Lowest IBI quartile scores




Highest IBI quartile scores

Figure B.2. Percent of sites showing zero toxicity, a single toxic result or multiple toxic results, according to CCAMP-IBI quartile scores.