

**SANTA ANA RIVER  
CITIZENS MONITORING PROJECT  
FINAL REPORT**

**by**

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**for**

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## **SANTA ANA RIVER CITIZENS WATER MONITORING PROJECT**

### **EXECUTIVE SUMMARY**

The Santa Ana River Citizens Water Monitoring Project was a cooperative effort to determine non-point source (NPS) water quality issues on seven streams within the Santa Ana River Watershed. This objective was accomplished by monitoring the water quality at 27 sites throughout San Bernardino, Riverside, and Orange County. The lead agency, Orange County Coastkeeper, monitored 18 sites on four streams in Orange County. The Riverside-Corona Resource Conservation District (RCRCD) monitored six sites on two streams in Riverside County. The East Valley Resource Conservation District (EVRCD) monitored three sites on one stream in San Bernardino County.

Funded by the EPA and overseen by the Santa Ana Regional Water Quality Control Board, the main goal of the project was to identify NPS pollution in the selected streams. Other goals focused on informing and educating the public about problems in their watershed and what they can do to help eliminate the problems. This task is accomplished by taking volunteers out to monitoring sites and training them to assess the health of their local creeks, streams, and rivers. These concerned citizen volunteers were crucial resources in collecting data and informing other citizens about the project and the pollution problems of water bodies throughout their neighborhood.

The main component of the project was the water quality monitoring which occurs monthly at all 27 sites. Each site was tested for pH, conductivity, temperature, dissolved oxygen, bacteria, and the nutrients ammonia, nitrate, and orthophosphate. During the rainy season, from December to March, these sites were tested twice a month. Additionally, each site was tested after major rain events. Besides chemical testing, a bio-assessment was conducted twice a year at selected sites. This combination of chemical and bioassessment test methods give an indication of whether or not the water meets standards set in the Water Quality Control Plan for the Santa Ana River Basin adopted by the Santa Ana Regional Water Quality Control Board.

As part of this project Orange County Coastkeeper was required to develop a Quality Assurance Project Plan (QAPP) that served as the written description of the procedures and testing goals for the project. The QAPP contains a full description of the sampling process, volunteer/staff training in sampling methodology, and data quality goals and requirements. Following the procedures and standards outlined in the QAPP assures that the data collected as part of this project was accurate to a degree to be useful to the Santa Ana Regional Water Quality Control Board and other agencies, groups, or individuals in their studies of the waterbodies we are monitoring.

Initial analysis of the results of the project indicates that several of the streams have poor water quality. Santa Ana River, San Diego Creek, and Silverado Canyon Creek, all had poor results. Temescal Creek and Golden Star Creek both had fair to poor water quality. Mill Creek results were good. And Santiago Canyon Creek was variable depending on site. In general, conductivity, orthophosphate, and bacteria results were high for nearly all monitoring sites.

Overall, this project went very well. We continuously refined our monitoring and quality control techniques to maintain and improve our data collection. We have achieved our goal of collecting high quality data for the Santa Ana Regional Water Control Board. Our quality control procedures identified areas where changes were needed such as our nitrate and Orthophosphate tests.

We have also reached our goal of public outreach. Over two hundred volunteers have directly participated in the project and have been trained in water monitoring techniques. Hundreds more have been educated on water quality problems through our participation in public events. Within the three county area citizens saw demonstrations of equipment, a Santa Ana River Watershed diorama, and received educational material on how to protect their watershed. The three organizations participating in the project worked well together and this led to a consistent and productive project.

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## Introduction

The Santa Ana River Citizens Water Monitoring Project is a cooperative effort to determine the water quality of selected streams in the Santa Ana River Watershed. This 4000 square mile watershed is home to over four million people and a wide variety of land uses. The area has experienced explosive growth in the last twenty years. The creeks and streams of this watershed reflect the land uses around them in the types of pollutants that are present in them.

This project is designed to determine non-point source (NPS) water quality issues on seven streams within the Santa Ana River Watershed. This objective will be accomplished by monitoring the water quality at 27 sites (See Exhibit 1 and 2 below) throughout San Bernardino, Riverside, and Orange County. The lead agency is Orange County Coastkeeper, which monitors 18 sites on four streams in Orange County. The Riverside-Corona Resource Conservation District (RCRCD) monitors six sites on two streams in Riverside County. The East Valley Resource Conservation District (EVRCD) monitors three sites on one stream in San Bernardino County.

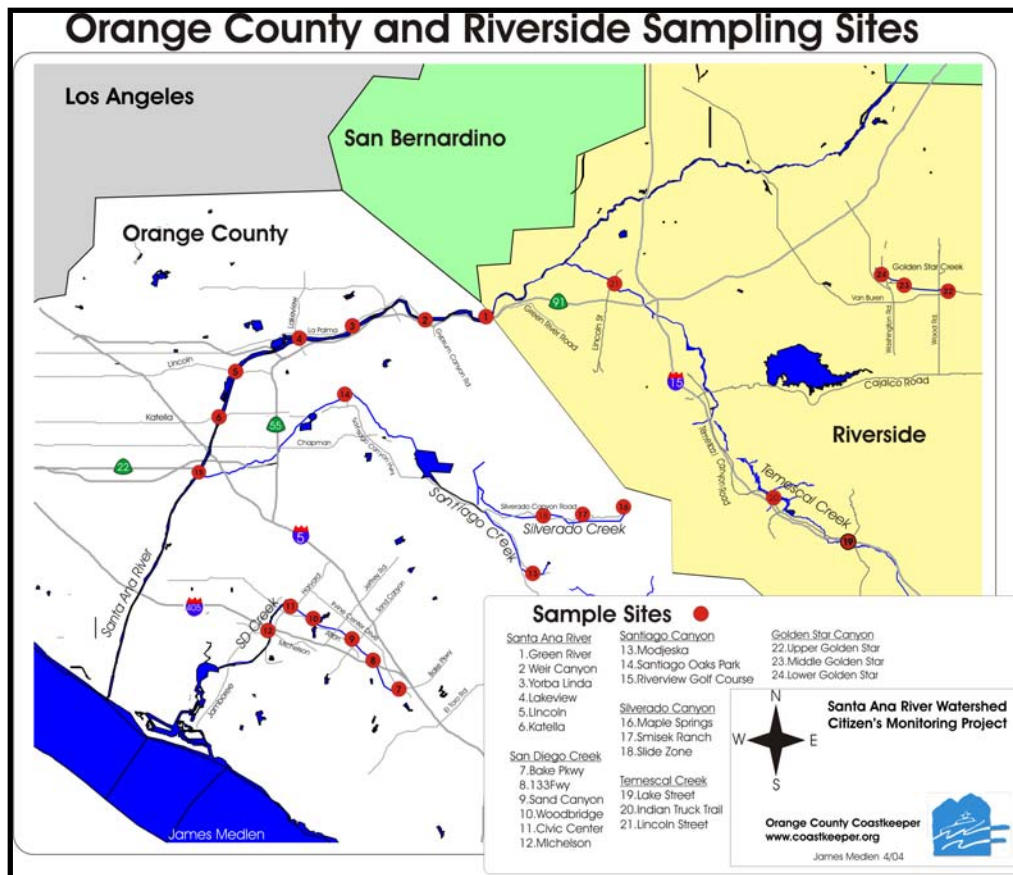


Exhibit One. Orange County and Riverside Sampling Sites. See Appendix A for Lat/Long.

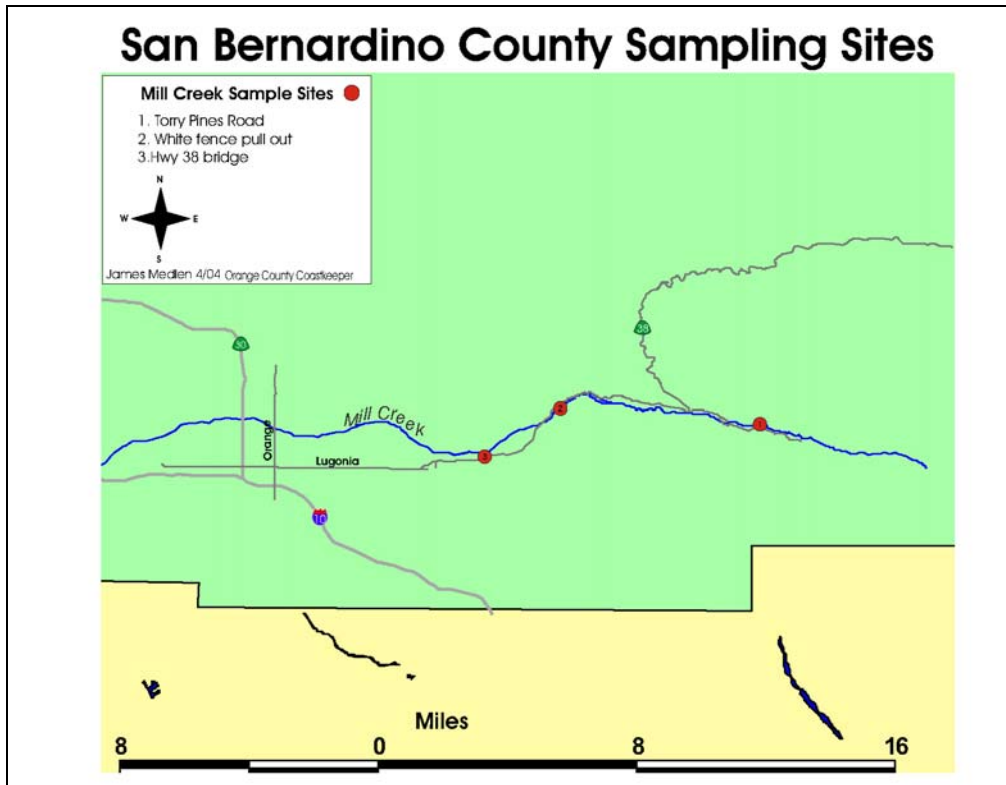


Exhibit Two: San Bernardino County Sampling Sites See Appendix A for Lat/Long.

Funded by the EPA and overseen by the Santa Ana Regional Water Quality Control Board, the main goal of the project is to identify NPS pollution in the selected streams. Other goals focus on informing and educating the public about problems in their watershed and what they can do to help eliminate the problems. This task is accomplished by taking volunteers out to monitoring sites and training them to assess the health of their local creeks, streams, and rivers. These concerned citizen volunteers are crucial resources in collecting data and informing other citizens about the project and the pollution problems of water bodies throughout their neighborhood.

The main component of the project is the water quality monitoring which occurs monthly at all 27 sites. Each site is tested for pH, conductivity, temperature, dissolved oxygen, bacteria, and the nutrients Ammonia, Nitrate, and Orthophosphate. During the rainy season, from December to March, these sites are tested twice a month. Additionally, each site is tested after major rain events. Besides chemical testing, a bio-assessment is conducted twice a year at selected sites. The bioassessment uses the diversity of aquatic life in the stream as a tool to determine stream health. This combination of chemical and bioassessment test methods give an indication of whether or not the water meets standards set in the Basin Plan for the Santa Ana River Basin adopted by the Santa Ana Regional Water Quality Control Board.

Special mention has to be made of the volunteer aspect of this project. The hundreds of people who have taken time out of their lives to participate have made this project the success it has been. People of all ages and walks of life completed the training necessary to collect the data in a professional manner. They have done a great job in the field, in the labs, and in the office to help with this project and we thank them.

## **Data Information**

All of the data discussed in this report, as well as additional data, is available upon request from Orange County Coastkeeper to any party that requests a copy. Data is stored in ACCESS 2000, which is capable of full analysis of the data. Photo documentation of each site, at each monitoring event, is also available. All the data discussed in this report is dry weather data unless otherwise noted. Wet weather data is contained in the database and available upon request.

## **Task by Task Project Description**

### **Task One: Project Management**

The project was funded by a 319h grant from the United States Environmental Protection Agency (USEPA) and administered by the Santa Ana Regional Water Quality Control Board (SARWQCB). The contract manager at the SARWQCB is Pavlova Vitale. The lead agency for the project is Orange County Coastkeeper (OCCK) with Ray Hiemstra directing the project. Two cooperating agencies also participated in the project, Riverside-Corona Resource Conservation District (RCRCD) organized the monitoring at the Riverside County sites under the guidance of Erin Snyder. East Valley Resource Conservation District (EVRCD) organized monitoring in San Bernardino County under the guidance of Keri Neal.

Task one included the requirement to produce quarterly reports to the contract manager on the projects progress, documentation of outreach to minority and women owned businesses for any project work contracted out and completion of project summary and project survey forms to the state. All of this documentation is on file with the SARWQCB.

### **Task Two: CEQA/NEPA Documentation and Permit Requirements**

No CEQA/NEPA documentation was required for the project. Permits acquired for this project include: an encroachment permits to enter the flood control channels from both Orange County and Riverside County flood control agencies; and a collection permit from the California Department of Fish and Game to collect benthic macroinvertebrates from the Santa Ana River Watershed.

### **Task Three: Quality Assurance Project Plan (QAPP)**

The QAPP details all of the objectives, training, and quality control requirements for the project. The original QAPP was approved by the SARWQCB Contract Manager in April of 2001 and was modified several times to reflect changes in the project as it evolved. The QAPP is available for review as a separate document from OCCK.

### **Task Four: Identification of Target Communities and Volunteer Outreach**

OCCK and the cooperating agencies, RCRCD and EVRCD, identified various schools, community groups, and individuals within their respective communities for outreach

opportunities. Educational outreach activities were conducted including contacting local schools and teachers to involve them in the project, giving presentations at community group meetings, and holding school assemblies to inform students on pollution issues in their local watersheds. Informational materials, such as PowerPoint presentations, water quality monitoring manuals, handbooks, and fliers were developed and distributed to schools and the community. As a result of this outreach we were able to recruit teams of volunteers for the monitoring effort from various schools and members of the community and identify individuals to lead our monitoring teams.

### **Task Five: Project Planning**

During the planning phase of this project, a Technical Advisory Committee (TAC) was assembled. The TAC was comprised of individuals with extensive water quality monitoring experience to review monitoring methods, site selection, and answer technical questions. The members come from local and state public agencies, universities, and private businesses. These include the State Water Resources Control Board, Orange County Water District, and the University of California Riverside.

In addition to assembling the TAC team, project planning included identifying the twenty-seven monitoring sites and identifying the level of testing at each site. A decision was made to monitor each site once a month during the dry season and twice a month during the wet season (December-March) for chemical and physical parameters, as well as bacteria. It was also decided that bioassessments would be conducted at each site twice a year, once in the spring and again in fall, with a required minimum of one bioassessment per stream. In an effort to guarantee accurate results, it was decided that metals analysis would be conducted at a certified laboratory. Samples for metals analysis were collected in June 2004 and were analyzed by Del Mar Laboratory in Irvine, California for selected metals.

### **Task Six: Development and Distribution of Educational Outreach Materials**

The development and distribution of educational outreach material included the creation of a special section of our website, [www.coastkeeper.org](http://www.coastkeeper.org), specifically for this project. The site contains details about the project, such as monitoring data, annual reports, and photos, as well as information on non point source pollution. O. C. Coastkeeper team members and volunteers created classroom presentation materials for use in an effort to help promote awareness at local school events. O.C. Coastkeeper produced both a water monitoring field manual for use at the sites during monitoring events and a water monitoring handbook for classroom use and as reference material. Additionally, a training video was produced for future use by staff, volunteers, and teachers.

Numerous articles in local newspapers enhanced our efforts at community outreach. Articles about the project were published in papers such as: the Daily Pilot, O.C. Register, L.A. Times and San Bernardino County Sun. PowerPoint presentations were prepared for community meetings in which local residents were informed of project details and monitoring results in their neighborhood.

### **Task Seven: Volunteer Monitoring and Training**

All volunteers completed a three-hour training course in which they participated in hands on use of all field equipment. During this training session, each volunteer received a copy of the monitoring handbook and field manual. Classroom training was scheduled after each quality assurance calibration session for any volunteers who required further training on monitoring methods.

### **Task Eight: Implementation of the Monitoring Program**

All sites were monitored as required and the data was reviewed quarterly to determine if changes in site selection or monitoring methods were needed. During the project, several site selections were changed were for safety or access reasons. Additionally, monitoring methods were changed (See Quality Control below) to increase the accuracy of the results.

### **Task Nine: Results Analysis**

Results analysis included interpreting the monitoring data and holding community meetings to inform the public of our findings. The public meetings were held at locations close to each of the monitored streams in 2004 during which details of the project were discussed. Quarterly volunteer meetings were also held to discuss the project data and monitoring methods. Although community meeting turnout was typically high, volunteer meetings were canceled several times due to lack of attendance.

### **Task Ten: Planning and Coordination of Public Forums**

Public forums were held in each county once a year to relate the findings of the study to the general public and local agencies. O.C. Coastkeeper prepared PowerPoint presentations for these public meetings. Local newspapers were informed of the meetings and articles were run to inform the public of the upcoming meetings. All monitoring data was made available to anyone in attendance who requested it

### **Task Eleven: Results Briefing**

Results briefing comprised of a quarterly meeting, with TAC, SARWQCB, and the Counties of Riverside and San Bernardino, to discuss the findings of the study. These meetings did not occur due to scheduling conflicts. However, all interested parties were apprised of monitoring results and received updated project data on a regular basis.

### **Task Twelve: Draft and Final Report**

The draft final report was received and commented on by the SARWQCB Contract Manager in early September. The final report will be completed October 15<sup>th</sup>, 2004.

## Santa Ana River

The Santa Ana River flows through and drains portions of three counties: Orange, Riverside, and San Bernardino. The Santa Ana River headwaters are located in the San Bernardino Mountains. The Santa Ana River discharges into the Pacific Ocean at Brookhurst Street in the city of Huntington Beach. The river is adjacent all land use types including but not limited to: industrial, agriculture, urban, and recreation. Orange County Coastkeeper test sites are located on Reach Two between Prado Dam in Corona and Edison Field in Anaheim. There are six test sites on this reach (SAR1-6). The Basin Plan classifies Reach Two as a MUN, AGR, GWR, REC1, REC2, WARM, WILD, and RARE area.

In general, water quality issues in this reach include agricultural areas upstream, land development, and industrial activity. Additionally, municipal water supply is a concern since most of the water in this reach infiltrates into the ground to be used as drinking water for Orange County.

### Bacterial Data

#### Total Coliform

Total coliform results at Santa Ana River were consistently high. The average percentage of exceedences was 29% of the monitoring events. Three sites, SAR1, SAR 5, and SAR6, had exceedences of 34%, 38%, and 34%, respectively.

#### E.coli

E.coli results at Santa Ana River were consistently high. The average percentage of exceedences was 20% of the monitoring events. One site, SAR5, had particularly high results with 31% exceedences.

### Chemical Data

#### Ammonia-nitrogen

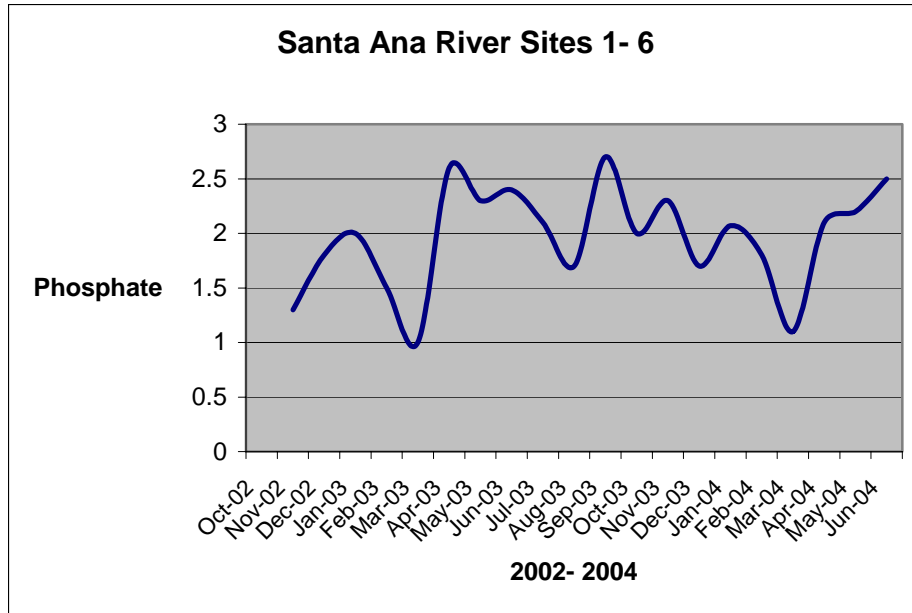
Average levels in Santa Ana River were typically low, staying below .1 mg/L during dry weather. Ammonia levels spiked to unacceptable levels during rain events.

#### Nitrate-nitrogen

Average levels in Santa Ana River were below the standard set by the regional water board during dry weather.

#### Orthophosphate

Average reading in the Santa Ana River were higher than the generally accepted value of 0.1mg/L for healthy aquatic environments during dry weather.



Graph One: Santa Ana River-OrthoPhosphate Levels Oct 02- Jun04.

pH

Data analysis shows the average pH level in Santa Ana River was 8.12. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum reading was 6.5 and the maximum was 9.44. While the average pH was acceptable at all monitoring sites, there were numerous exceedences at SAR3 through SAR6. SAR1 had only one exceedence and SAR2 had none.

Dissolved Oxygen

Dissolved oxygen (DO) levels in Santa Ana River were within acceptable the range for a warm water creek. The average DO for Santa Ana River was 10.49mg/L, with a minimum reading of 5mg/L at SAR1 on 4/Mar/04 and a maximum reading of 14.9mg/L at SAR6 on 7/Feb/03.

Conductivity/Total Dissolved Solids

Average conductivity at Santa Ana River was at an acceptable level. The average reading was 872Us. Based on this reading, the Total Dissolved Solids (\*667) average was 581mg/L.

**Bioassessment Data**

Bioassessment results showed that overall the Santa Ana River was in poor to fair condition. SAR3 had the lowest result with 2 of 3 surveys resulting a designation of poor. There were no bioassessment surveys done at SAR1, SAR2, and SAR6 due to either high flows or lack of flow during the spring/fall scheduled surveys.

**Metals Survey Data**

Metal surveys at Santa Ana River sites detected trace amounts of Chromium, Copper, Lead, Nickel, and Zinc. However, there were no exceedences of state standards at any site.

## **Santa Ana River 1-Green River**

Santa Ana River 1 (SAR1) is located off the Riverside Freeway (91), west of the Green River Drive off ramp. Access to the site is by a path through the brush just downstream of the bridge to the Green River Golf Course. The channel is earthen trapezoidal. Land use in the vicinity is recreational, some residential, and open space. Turbidity was typically high at this monitoring site, with readings as high as 174FAU. Additionally, significant amounts of debris and litter were recorded at this site.

### **Bacterial Data**

#### Total Coliform

Total Coliform levels in SAR1 exceeded standards set in the Basin Plan during 34% of the monitoring events. There were a total of 29 monitoring events with 10 exceedences. Total Coliform levels were consistently high from June 2003 to October 2003.

#### E.coli

E.coli levels in SAR1 exceeded standards during 21% of the monitoring events. There were a total of 29 monitoring events with 6 exceedences.

### **Chemical Data**

#### Ammonia-nitrogen

Ammonia levels at SAR1 were below the basin plan objectives except during rain events.

#### Nitrate-nitrogen

Nitrate levels at SAR1 met basin plan objectives.

#### OrthoPhosphate

OrthoPhosphate levels at SAR1 were higher than the generally accepted value of 0.1mg/L for healthy aquatic environments. The average level was 1.87mg/L. The minimum reading was 0mg/L and the maximum reading was 2.9mg/L.

#### pH

The average pH level at SAR1 was 7.82. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.16 and the maximum reading was 8.53. There was one exceedence. On 8/Jul/03, pH was 8.53.

#### Dissolved Oxygen

Dissolved oxygen (DO) levels at SAR1 were within acceptable the range for a warm water creek. The average DO was 9.346mg/L, with a minimum reading of 5mg/L and a maximum reading of 10.78mg/L. Although, the readings were within the acceptable range the minimum DO reading of 5mg/L indicates that there are conditions in the area that can cause low levels of DO.

Conductivity/Total Dissolved Solids

Conductivity at SAR1 was at an acceptable level with an average reading of 825us. Total Dissolved Solids average was 550mg/L.

**Santa Ana River 2-Gypsum Canyon**

Santa Ana River 2 (SD2) is located off East La Palma Avenue west of Gypsum Canyon Road in the city of Yorba Linda. Access to the site is by dirt access road and trail. The channel is trapezoidal with composite lining. SD2 is the site of an intensive non-native vegetation removal project under the direction of the County of Orange. Land use in the vicinity is recreational, with nearby residential and commercial. This site typically has monitoring results similar to SD1.

**Bacterial Data**

Total Coliform

Total Coliform levels in SAR2 exceeded standards set in the Basin Plan during 24% of the monitoring events. There were a total of 29 monitoring events with 7 exceedences. Total Coliform levels were consistently high from June 2003 to October 2003.

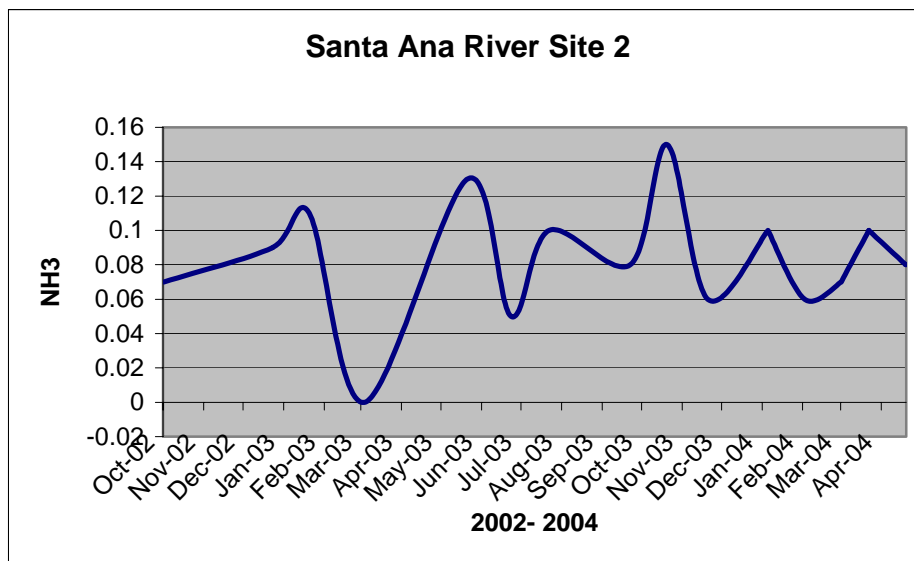
E.coli

E.coli levels in SAR2 exceeded standards during 11% of the monitoring events. There were a total of 27 monitoring events with 3 exceedences.

**Chemical Data**

Ammonia-nitrogen

Ammonia levels at SAR2 exceeded basin plan objectives several times in dry weather and on all rain events.



Graph Two: Santa Ana River2-Ammonia NH3 Oct02-Apr04.

Nitrate-nitrogen

Nitrate levels at SAR2 met basin plan objectives.

Orthophosphate

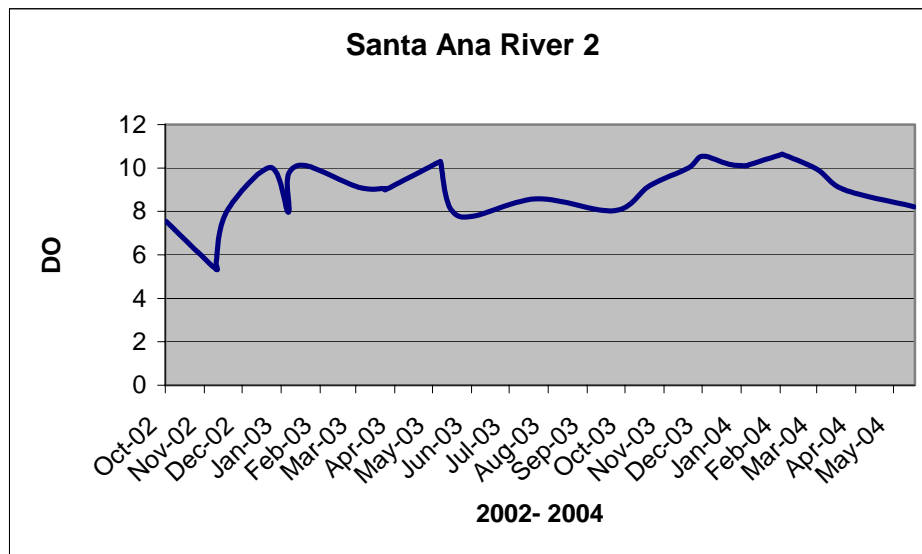
Orthophosphate levels at SAR2 were higher than the generally accepted value of 0.1mg/L for healthy aquatic environments. The average level was 2.14mg/L. The minimum reading was 0mg/L and the maximum reading was 2.75mg/L.

pH

The average pH level at SAR2 was 7.91. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.34 and the maximum was 8.47. There were no exceedences at this monitoring site.

Dissolved Oxygen

Dissolved oxygen (DO) levels at SAR2 were within acceptable the range for a warm water creek. The average DO was 9.07mg/L, with a minimum reading of 5.34mg/L and a maximum reading of 10.69mg/L. Like SAR1, SAR2 readings were within the acceptable range but several readings were near the lower end of the range and could potentially be of concern.



Graph Three: Santa Ana River2-Dissolved Oxygen Oct 02-May04.

Conductivity/Total Dissolved Solids

Conductivity at SAR2 was at an acceptable level with an average reading of 1048us. Total Dissolved Solids average was 669mg/L.

**Santa Ana River 3-Yorba Linda Park**

Santa Ana River 3 (SD3) is located off La Palma Avenue near Fairmont Boulevard in the city of Yorba Linda. Access to the site is by the Santa Ana River Bike/Pedestrian Trail. Yorba Regional Park parallels the Santa Ana River to the north at SD3. The Riverside Freeway (91) parallels the site to the south. The channel is trapezoidal with soft bottom and concrete lining. Public use of

this site is minimal and little debris/litter was reported for this site. SD3 is the site of numerous bird sightings including but not limited to: Great blue heron, Mallards, Cormorants, American crows, and Cattle egrets.

**Bacterial Data**

Total Coliform

Total Coliform levels in SAR3 exceeded standards set in the Basin Plan during 21% of the monitoring events. There were a total of 29 monitoring events with 6 exceedences. Total Coliform levels were consistently high from June 2003 to October 2003.

E.coli

E.coli levels in SAR1 exceeded standards during 17% of the monitoring events. There were a total of 29 monitoring events with 5 exceedences.

**Chemical Data**

Ammonia-nitrogen

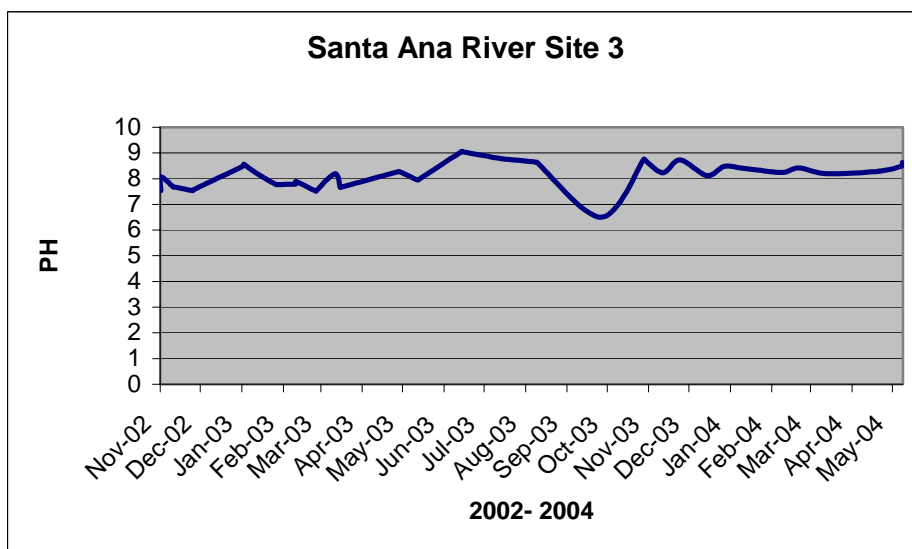
Ammonia levels at SAR3 rose over .1mg/L on three dry weather events and during rain events

Nitrate-nitrogen

Nitrate levels at SAR3 met basin plan objectives

pH

The average pH level at SAR3 was 8.17. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 6.5 and the maximum reading was 9.06. There were a total of six exceedences at this monitoring site (See Graph below).



Graph Four: Santa Ana River3-pH Levels Nov02-May04.

### Orthophosphate

Orthophosphate levels at SAR3 were higher than the generally accepted value of 0.1mg/L for healthy aquatic environments. The average level was 1.85mg/L. The minimum reading was 0.3mg/L and the maximum reading was 3mg/L.

### Dissolved Oxygen

Dissolved oxygen (DO) levels at SAR3 were within acceptable the range for a warm water creek. The average DO was 10.77mg/L, with a minimum reading of 8mg/L and a maximum reading of 14mg/L.

### Conductivity/Total Dissolved Solids

Conductivity at SAR3 was at an acceptable level with an average reading of 876us. Total Dissolved Solids average was 584mg/L.

## **Santa Ana River 4-Lakeview**

Santa Ana River 4 (SD4) is located off the Riverside Freeway (91) at Lakeview Avenue north of Riverdale Avenue. Access is through the Riverside Park. The channel is trapezoidal with soft bottom and concrete lining. This area is located in an area of the river designed as a infiltration basin to replenish Orange County's drinking water aquifer. Adjacent land use is primarily commercial. Like SD3, SD4 is the site of large avian populations. There is typically a large accumulation of trash at SD4 after storm events.

## **Bacterial Data**

### Total Coliform

Total Coliform levels in SAR4 exceeded standards set in the Basin Plan during 38% of the monitoring events. There were a total of 29 monitoring events with 11 exceedences. Total Coliform levels were consistently high from June 2003 to October 2003.

### E.coli

E.coli levels in SAR4 exceeded standards during 31% of the monitoring events. There were a total of 29 monitoring events with 9 exceedences.

## **Chemical Data**

### Ammonia-nitrogen

Ammonia levels at SAR4 exceeded .1 mg/L on three occasions.

### Nitrate-nitrogen

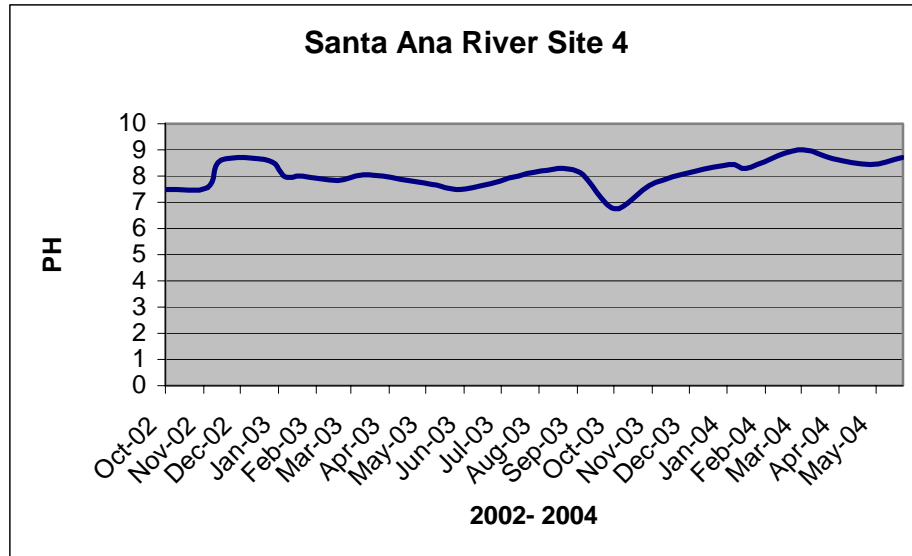
Nitrate levels at SAR4 meet basin plan objectives.

### Orthophosphate

Orthophosphate levels at SAR4 were higher than the generally accepted value of 0.1mg/L for healthy aquatic environments. The average level was 1.98mg/L. The minimum reading was 0.4mg/L and the maximum reading was 2.8mg/L.

pH

The average pH level at SAR4 was 8.134. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 6.75 and the maximum reading was 9.27. There were four exceedences at this monitoring site (See Graph below).



Graph Five: Santa Ana River4-pH Levels Oct 02-May04.

Dissolved Oxygen

Dissolved oxygen (DO) levels at SAR4 were within acceptable the range for a warm water creek. The average DO was 10.92mg/L, with a minimum reading of 7mg/L and a maximum reading of 14.76mg/L.

Conductivity/Total Dissolved Solids

Conductivity at SAR4 was at an acceptable level with an average reading of 875us. Total Dissolved Solids average was 584mg/L.

**Santa Ana River 5 –Lincoln**

Santa Ana River 5 (SD5) is located off East Lincoln Avenue at North Batavia Street in the city of Orange. Access is through Riverview Park. The channel is trapezoidal with concrete lining. SD5 is the site of an impoundment project administered by the County of Orange designed to increase bio-filtration and evaporation of channel waters. Adjacent land use is light industrial.

Additionally, this site has been the location of a homeless encampment. Large amounts of trash and debris are typically reported at this site. SD5 is also the site of heavy usage by avian species.

**Bacterial Data**

Total Coliform

Total Coliform levels in SAR5 exceeded standards set in the Basin Plan during 56% of the monitoring events. There were a total of 27 monitoring events with 15 exceedences.

E.coli

E.coli levels in SAR5 exceeded standards during 21% of the monitoring events. There were a total of 29 monitoring events with 5 exceedences.

**Chemical Data**

Ammonia-nitrogen

Ammonia levels at SAR5 were above .1mg/L on three events

Nitrate-nitrogen

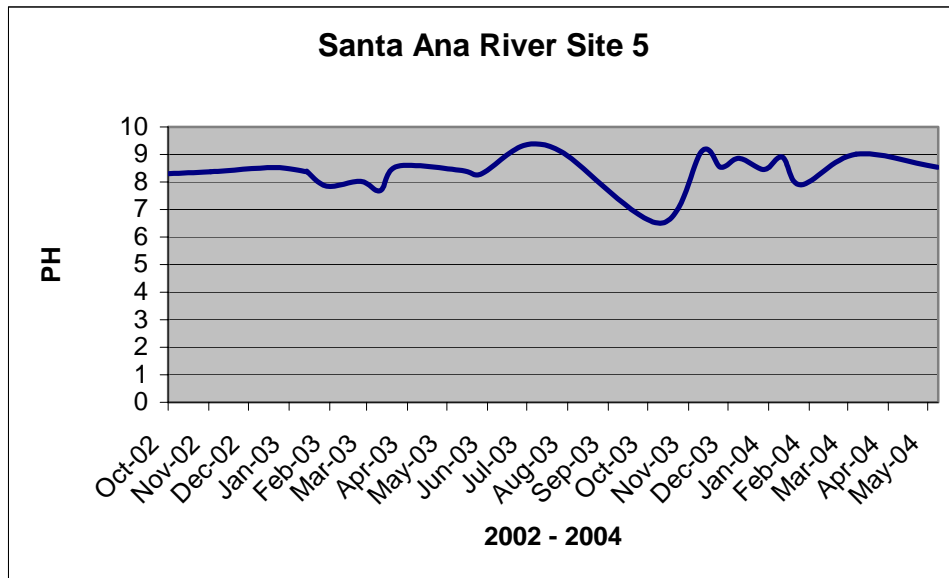
Nitrate levels at SAR5 meet basin plan objectives

Orthophosphate

Orthophosphate levels at SAR5 were higher than the generally accepted value of 0.15 for healthy aquatic environments. The average level was 1.81mg/L. The minimum reading was 0.2mg/L and the maximum reading was 2.8mg/L.

pH

The average pH level at SAR5 was 8.39. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 6.5 and the maximum reading was 9.32. SAR5 had the highest number of exceedences of any Santa Ana River site. There were nine exceedences at this monitoring site (See Graph below).



Graph Six: Santa Ana River5-pH Levels Oct02-May04.

Dissolved Oxygen

Dissolved oxygen (DO) levels at SAR5 were within acceptable the range for a warm water creek. The average DO was 11.49mg/L, with a minimum reading of 9.6mg/L and a maximum reading of 14.74mg/L.

### Conductivity/Total Dissolved Solids

Conductivity at SAR5 was at an acceptable level with an average reading of 835us. Total Dissolved Solids average was 556mg/L.

### **Santa Ana River 6-Katella**

Santa Ana River 6 (SD6) is located east of the Orange Freeway (57) off East Katella Avenue in the city of Santa Ana. Access to the site is by paved access road. The channel is concrete trapezoid. SD6 is the site of an impoundment project administered by the County of Orange designed to increase bio-filtration and evaporation of channel waters. At SD6, this project generally disrupts flow and more than 50% of monitoring events were cancelled due to no flow. Adjacent land use is recreational and light industrial. Additionally, this site has been the location of a homeless encampment. Large amounts of trash and debris are typically reported at this site.

### **Bacterial Data**

#### Total Coliform

Total Coliform levels in SAR6 exceeded standards set in the Basin Plan during 33% of the monitoring events. There were a total of 12 monitoring events with 4 exceedences.

#### E.coli

E.coli levels in SAR6 exceeded standards during 33% of the monitoring events. There were a total of 12 monitoring events with 4 exceedences.

### **Chemical Data**

#### Ammonia-nitrogen

Ammonia levels at SAR6 were at acceptable levels.

#### Nitrate-nitrogen

Nitrate levels at SAR6 meet basin plan objectives.

#### Orthophosphate

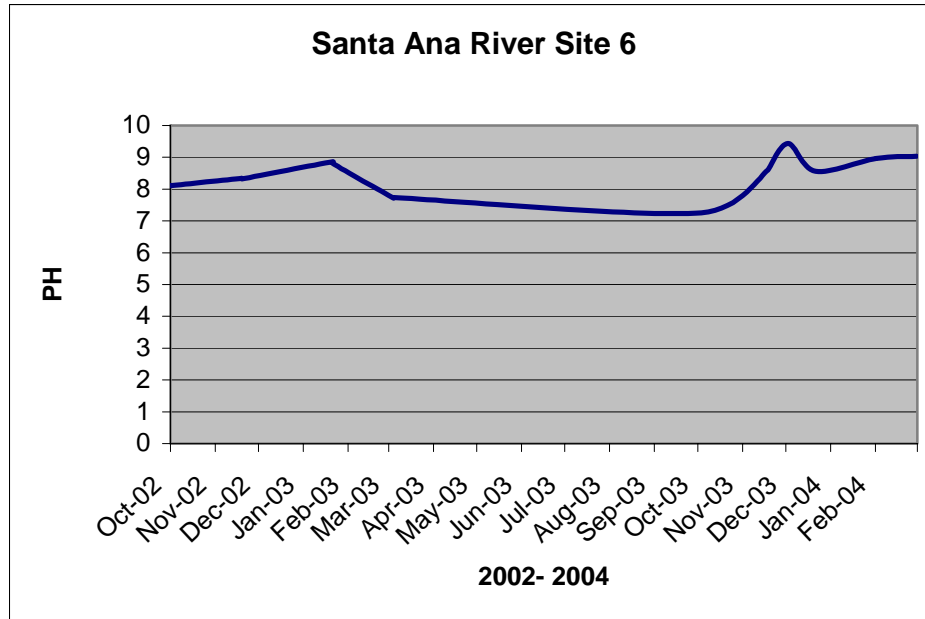
Orthophosphate levels at SAR1 were higher than the generally accepted value of 0.1mg/L for healthy aquatic environments. The average level was 1.137mg/L. The minimum reading was 0.07mg/L and the maximum reading was 2.9mg/L.

#### Dissolved Oxygen

Dissolved oxygen (DO) levels at SAR6 were within acceptable the range for a warm water creek. The average DO was 11.46mg/L, with a minimum reading of 7.92mg/L and a maximum reading of 14.9mg/L.

#### PH

The average pH level at SAR6 was 8.43. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.25 and the maximum reading was 9.44. There were a total of five exceedences at this monitoring site (See Graph below).



Graph Seven: Santa Ana River6-pH Levels Oct02-Feb04.

Conductivity/Total Dissolved Solids

Conductivity at SAR6 was at an acceptable level with an average reading of 775us. Total Dissolved Solids average was 516mg/L.

**San Diego Creek**

The San Diego Creek Watershed drains 112.2 square miles. The San Diego Creek runs through and drains the cities of Costa Mesa, Irvine, Laguna Woods, Lake Forest, Newport Beach, Orange, Santa Ana, and Tustin. The headwaters are located in the foothills of the Santa Ana Mountains. San Diego Creek discharges into Upper Newport Bay near Jamboree Road in the city of Newport Beach. The creek is adjacent all land use types but is primarily bordered by residential use. This trapezoidal channel is concrete, riprap, composite, or grass lined with soft bottom. Parks are adjacent to the channel at several places. Woodbridge Park in Irvine includes the channel bottom in its recreational area. Orange County Coastkeeper monitors six sites on San Diego Creek.

This creek is listed on the 303d List of Impaired Water Bodies (SWRCB) for bacteria, nutrients, pesticides, and metals pollution. In general, water quality issues in the San Diego Creek include: agricultural use of recycled water, which causes an increase in salinity and Total Dissolved Solids; agricultural and residential use of fertilizer; and unknown bacteria sources. Additionally, construction activities have taken place adjacent to, and in channel, during the monitoring project.

**Bacteria Data**

Total Coliform

Total Coliform levels in San Diego Creek were consistently high. The average percentage of exceedences was 48% of the monitoring events. Four sites, SD2, SD4, SD5, and SD6, had exceedences of 54%, 50%, 53%, and 59%, respectively.

E.coli

E.coli levels in San Diego Creek were consistently high. The average percentage of exceedences was 43% of the monitoring events. Four sites, SD1, SD2, and SD5, had exceedences of 57%, 46%, and 43%, respectively.

**Chemical Data**

Ammonia-nitrogen

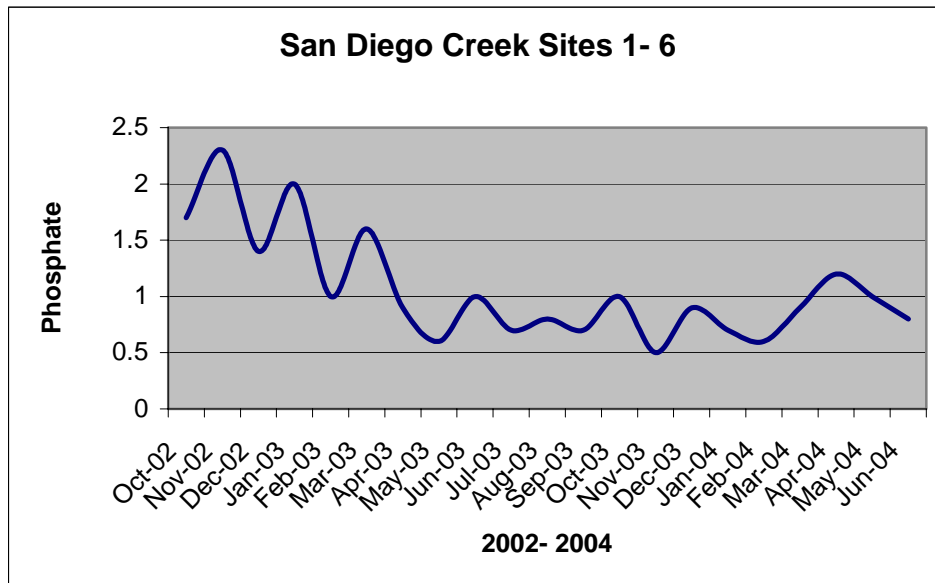
Average levels in San Diego Creek were typically low, with only one reading over .1mg/L during dry weather.

Nitrate-nitrogen

Average levels in San Diego Creek met basin plan objectives during dry weather. However, there were higher levels of nitrate-nitrogen at the lower San Diego Creek sites.

Orthophosphate

Average levels in San Diego Creek are high, measuring consistently over .5mg/L during dry weather (See Graph below).

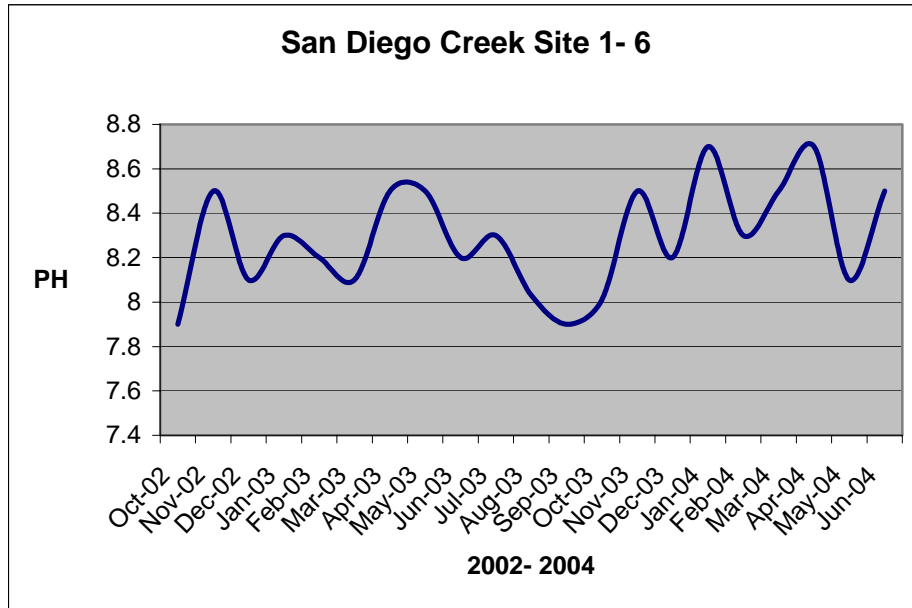


Graph Eight: San Diego Creek-OrthoPhosphates Oct02-Jun04.

pH

Data analysis shows the average pH level in San Diego Creek was 8.276. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. However, there were numerous

exceedences at several monitoring sites. Two sites, SD3 and SD5, had averages above the expected range. There were no exceedences at the low end of the range. The minimum reading was 7.4 and the maximum was 9.47.



Graph Nine: San Diego Creek-pH Oct02-Jun04.

Dissolved Oxygen

Dissolved oxygen (DO) levels in San Diego Creek were within acceptable the range for a warm water creek. The average for San Diego Creek was 10.902mg/L, with a minimum reading of 5.92mg/L at SD5 on 1/May/04 and a maximum reading of 14.75mg/L at SD6 on 8/Mar/04.

Conductivity/Total Dissolved Solids

Average conductivity at San Diego Creek was consistently high. The average reading was 1814Us. Based on this reading, Total Dissolved Solids (\*667) average was 667mg/L.

**Bioassessment Data**

Bioassessment surveys were conducted at SD4 and SD5. Survey results at SD4 showed poor water quality during every surveying event. Survey results at SD5 showed poor water quality during 2 of 3 surveying event.

**Metals Survey Data**

Metal surveys at San Diego Creek sites detected trace amounts of Chromium, Copper, Lead, Nickel, and Zinc. However, there were no exceedences of state standards at any site.

## **San Diego Creek 1-Bake Parkway**

San Diego Creek 1 (SD1) is located on Irvine Center Drive southeast of Bake Parkway in the city of Irvine. The monitoring site is located downstream the Irvine Center Drive Bridge. Access is by dirt access road. The channel is trapezoidal with soft bottom and soil-cement walls. Land use in the vicinity includes corporate, light industrial and vacant lots. Data collected/analyzed is for the months of December through July. SD1 is typically dry from August to November. This site has a large industrial development and armoring project just upstream of the monitoring site.

### **Bacterial Data**

#### Total Coliform

Total Coliform levels in SD1 exceeded standards set in the Basin Plan during 36% of the monitoring events. There were a total of 14 monitoring events with 5 exceedences.

#### E.coli

E.coli levels in SAR6 exceeded standards during 57% of the monitoring events. There were a total of 14 monitoring events with 8 exceedences.

### **Chemical Data**

#### Ammonia-nitrogen

Ammonia levels at SD1 were below .1mg/L

#### Nitrate-nitrogen

Nitrate levels at SD1 were low and met basin plan objectives.

#### Orthophosphate

Orthophosphate levels at SD1 were higher than the acceptable level of .1mg/L The average level was .902mg/L. The minimum reading was 0mg/L and the maximum reading was 1.95mg/L.

#### pH

The average pH level at SD1 was 8.301. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. However, there were several exceedences recorded: 13/Jan04 pH8.6, 11/Feb/04 pH8.61, 9/Mar/04 pH8.54, 12/Apr/04 pH9.12, 21/Jun/04 pH9.03.

#### Dissolved Oxygen

Dissolved oxygen (DO) levels at SD1 were within acceptable the range for a warm water creek. The average DO was 9.661mg/L, with a minimum reading of 7.59 mg/L and a maximum reading of 13.01mg/L.

#### Conductivity/Total Dissolved Solids

Conductivity at SD1 was high with an average reading of 1114us. Total Dissolved Solids average was 743mg/L.

**San Diego Creek 2-133 Freeway**

San Diego Creek 2 (SD2) is located near the intersection of Pacifica and Alton Parkway in the city of Irvine. The monitoring site is located upstream of the 133 (Laguna Fwy) Bridge. Access is by paved access road. The channel is trapezoidal with soft bottom and composite walls. Land use in the vicinity includes vacant lots, agriculture, corporate, and light industrial. SD2 experiences heavy vegetation growth during summer months.

**Bacterial Data**

Total Coliform

Total Coliform levels in SD2 exceeded standards set in the Basin Plan during 54% of the monitoring events. There were a total of 28 monitoring events with 15 exceedences.

E.coli

E.coli levels in SD2 exceeded standards during 46% of the monitoring events. There were a total of 28 monitoring events with 13 exceedences.

**Chemical Data**

Ammonia-nitrogen

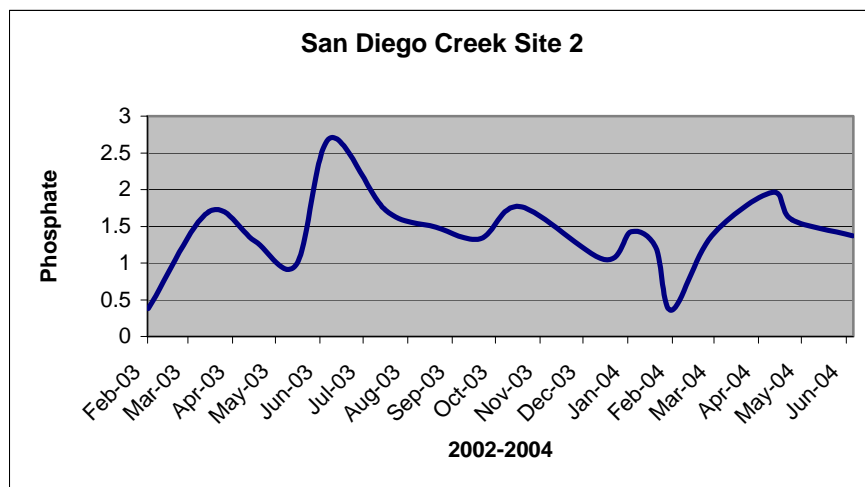
Ammonia levels at SD2 exceeded 0.1mg/L during two events.

Nitrate-nitrogen

Average nitrate levels at SD2 were 2.92mg/L.

Orthophosphate

Orthophosphate levels at SD2 were high. The average level was 1.408mg/L. The minimum reading was 0mg/L and the maximum reading was 2.7mg/L.



Graph Ten: San Diego Creek2-Orthophosphate Feb03-Jun04.

### pH

The average pH level at SD2 was 7.939. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. However, there were several exceedences recorded: 22/Dec/03 pH8.52 and 27/Jan/04 pH8.62.

### Dissolved Oxygen

Dissolved oxygen (DO) levels at SD2 were within acceptable the range for a warm water creek. The average DO was 10.184 mg/L, with a minimum reading of 7.59mg/L and a maximum reading of 13.47mg/L.

### Conductivity/Total Dissolved Solids

Conductivity at SD2 was high with an average reading of 1641us. Total Dissolved Solids average was 1094mg/L.

## **San Diego Creek 3-Sand Canyon**

San Diego Creek 3 (SD3) is located off Sand Canyon Avenue near Barranca Parkway in the city of Irvine. The monitoring site is located downstream of the Sand Canyon Bridge. Access is by stairwell located near the site. The channel is trapezoidal with soft bottom and concrete sides. Land use in the vicinity includes vacant lot, agricultural, corporate, residential, and commercial. Water levels at SD3 are variable and summer months often have no flow.

## **Bacterial Data**

### Total Coliform

Total Coliform levels in SD3 exceeded standards set in the Basin Plan during 35% of the monitoring events. There were a total of 20 monitoring events with 7 exceedences.

### E.coli

E.coli levels in SD3 exceeded standards during 42% of the monitoring events. There were a total of 19 monitoring events with 8 exceedences.

## **Chemical Data**

### Ammonia-nitrogen

Ammonia levels at SD3 never exceeded .1mg/L

### Nitrate-nitrogen

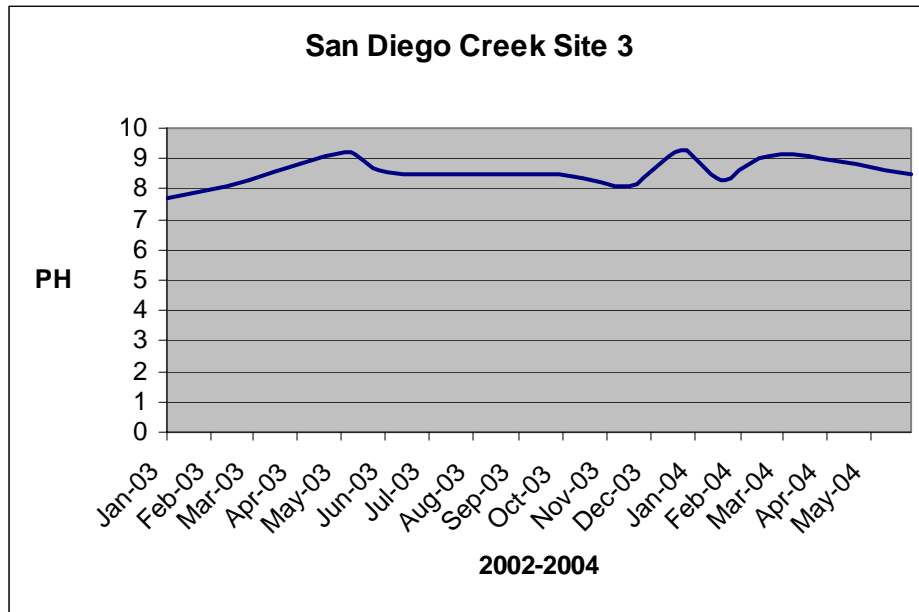
Nitrate levels at SD3 were low and met basin plan objectives.

### Orthophosphate

Orthophosphate levels at SD3 were high. The average level was .955mg/L. The minimum reading was .16mg/L and the maximum reading was 3mg/L.

pH

The average pH level at SD3 was 8.63. This finding is not within the acceptable range (6.5-8.5) as established in the Basin Plan. There were a total of 10 exceedences (See Graph below).



Graph Eleven: San Diego Creek3-pH Jan03-May04.

Dissolved Oxygen

Dissolved oxygen (DO) levels at SD3 were within acceptable the range for a warm water creek. The average DO was 11.673mg/L, with a minimum reading of 6.9mg/L and a maximum reading of 13.47mg/L.

Conductivity/Total Dissolved Solids

Conductivity at SD3 was high with an average reading of 1165us. Total Dissolved Solids average was 777mg/L.

**San Diego Creek 4-Woodbridge**

San Diego Creek 4 (SD4) is located off Lake Road between Alton Parkway and Barranca Parkway in the city of Irvine. The monitoring site is located upstream of a pedestrian bridge in Woodbridge Park. Access is by path through the park. The channel is earthen trapezoidal with landscape vegetation and grass banks. Adjacent land use is primarily recreational with some residential. SD4 experiences heavy foot traffic at this site. In addition, site visits have shown recreational use of the creek including wading.

**Bacterial Data**

Total Coliform

Total Coliform levels in SD4 exceeded standards set in the Basin Plan during 50% of the monitoring events. There were a total of 28 monitoring events with 14 exceedences.

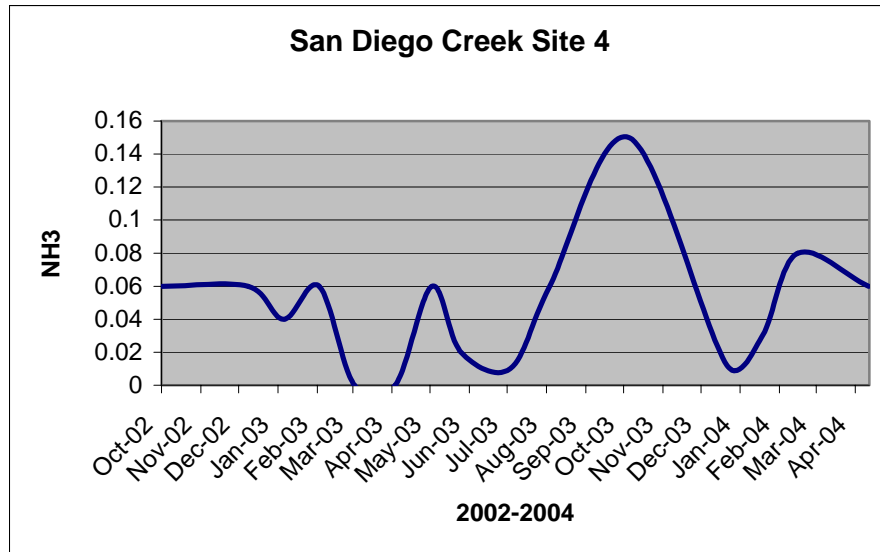
E.coli

E.coli levels in SD4 exceeded standards during 43% of the monitoring events. There were a total of 28 monitoring events with 12 exceedences.

**Chemical Data**

Ammonia-nitrogen

Ammonia levels at SD4 exceeded .1mg/L three times.



Graph Twelve: San Diego Creek4-Ammonia NH3 Oct 02-Apr04.

Nitrate-nitrogen

Nitrate levels at SD4 met basin plan objectives but were markedly higher than upstream.

pH

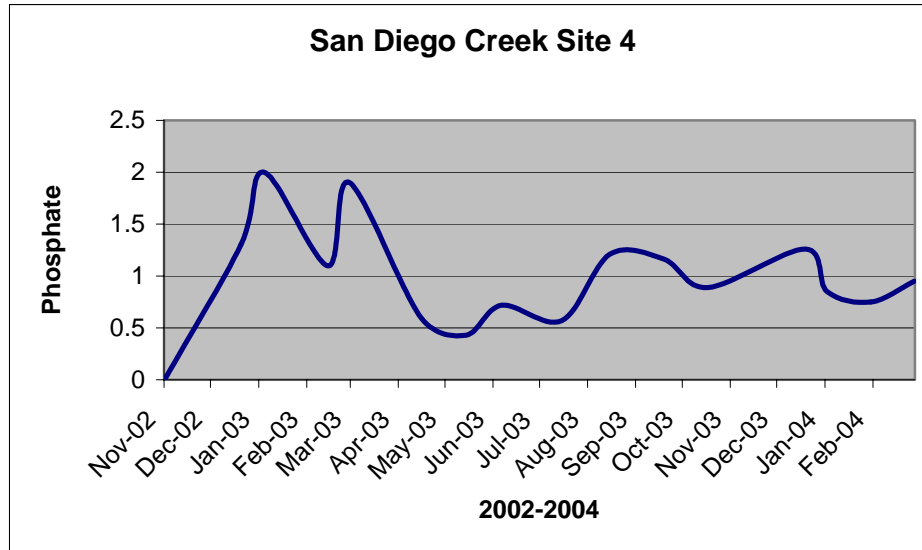
The average pH level at SD4 was 7.98. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH was 7.56 and the maximum was 8.23. This is the only monitoring site on San Diego Creek with no pH exceedences.

Dissolved Oxygen

Dissolved oxygen (DO) levels at SD4 were within acceptable the range for a warm water creek. The average DO was 11.105mg/L, with a minimum reading of 7.55mg/L and a maximum reading of 14.7mg/L.

Orthophosphate

Orthophosphate levels at SD4 were high. The average level was 1.10mg/L. The minimum reading was 0mg/L and the maximum reading was 2.3mg/L (See Graph below).



Graph Thirteen: San Diego Creek4-OrthoPhosphate Nov02-Feb04.

Conductivity/Total Dissolved Solids

Conductivity at SD4 was high with an average reading of 2115us. Total Dissolved Solids average was 1410mg/L.

**San Diego Creek 5 –Irvine Center Drive**

San Diego Creek 5 (SD5) is located off Alton Parkway between Hazard Avenue and Jamboree Boulevard. The monitoring site is located behind the Irvine Civic Center. Access is by paved access road. The channel is trapezoidal with soft bottom and riprap lining. Land use in the vicinity is residential with some commercial and corporate. This portion of SD5 is heavily utilized by birds/waterfowl. Low flow is present in the channel year around due to urban runoff. A sulfuric odor was typically present at the waters edge.

**Bacterial Data**

Total Coliform

Total Coliform levels in SD5 exceeded standards set in the Basin Plan during 53% of the monitoring events. There were a total of 30 monitoring events with 16 exceedences.

E.coli

E.coli levels in SD5 exceeded standards during 43% of the monitoring events. There were a total of 30 monitoring events with 13 exceedences.

**Chemical Data**

Ammonia-nitrogen

Ammonia levels at SD5 exceeded .1mg/L on one sampling event

Nitrate-nitrogen

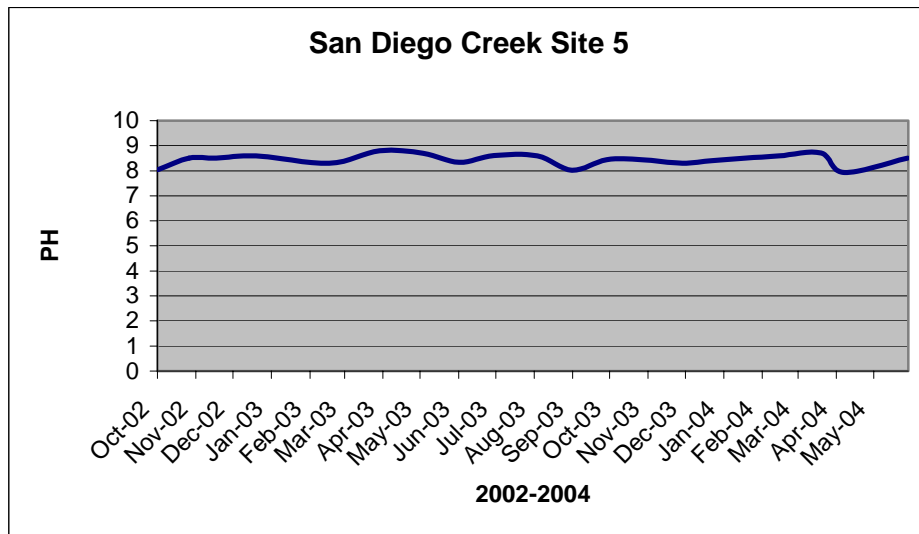
Nitrate levels at SD5 meet basin plan objectives but continued the higher levels than at the three upstream sites.

Orthophosphate

Orthophosphate levels at SD5 were high. The average level was 1.00mg/L. The minimum reading was .09mg/L and the maximum reading was 3mg/L.

pH

The average pH level at SD5 was 8.515. This finding is not within the acceptable range (6.5-8.5) as established in the Basin Plan. There were a total of 12 exceedences (See Graph below).



Graph Fourteen: San Diego Creek5-Oct02-May04.

Dissolved Oxygen

Dissolved oxygen (DO) levels at SD5 were within acceptable the range for a warm water creek. The average DO was 11.751mg/L, with a minimum reading of 5.92mg/L and a maximum reading of 13.75mg/L.

Conductivity/Total Dissolved Solids

Conductivity at SD5 was high with an average reading of 2156us. Total Dissolved Solids average was 1438mg/L.

**San Diego Creek 6-Michelson**

San Diego Creek 6 (SD6) is located off Michelson Drive at Riparian Way. The monitoring site is located upstream of Michelson Drive Bridge and upstream of the Irvine Ranch Water District Michelson Water Treatment Plant. Access is by dirt access road. The channel is earthen trapezoidal. SD6 experiences tidal influence. A stagnant, mildew odor is present at the waters edge. The site is heavily utilized by wetland/riparian species of birds and waterfowl.

## **Bacterial Data**

### Total Coliform

Total Coliform levels in SD6 exceeded standards set in the Basin Plan during 59% of the monitoring events. There were a total of 27 monitoring events with 16 exceedences.

### E.coli

E.coli levels in SD6 exceeded standards during 29% of the monitoring events. There were a total of 28 monitoring events with 8 exceedences.

## **Chemical Data**

### Ammonia-nitrogen

Ammonia levels at SD6 exceeded .1mg/L at one event.

### Nitrate-nitrogen

Nitrate levels at SD6 exceeded basin plan objectives on two occasions.

### Orthophosphate

Orthophosphate levels at SD6 were high. The average level was .955mg/L. The minimum reading was .16mg/L and the maximum reading was 2.8mg/L.

### PH

The average pH level at SD6 was 7.939. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. However, there were two exceedences recorded: 25/Apr/03 pH8.53 and 22/Nov/03 pH8.66.

### Dissolved Oxygen

Dissolved oxygen (DO) levels at SD6 were within acceptable the range for a warm water creek. The average DO was 11.125mg/L, with a minimum reading of 6.47mg/L and a maximum reading of 14.75mg/L.

### Conductivity/Total Dissolved Solids

Conductivity at SD6 was high with an average reading of 2694us. Total Dissolved Solids average was 1129mg/L.

## **Santiago Canyon Creek**

Santiago Canyon Creek is the largest tributary to the Santa Ana River. Santiago Canyon Creek runs through and drains the rural community of Modjeska, the cities Orange and Santa Ana, as well as portions of unincorporated Orange County. The headwaters are located in Cleveland National Forest. Santiago Canyon Creek flows into and through Irvine Lake /Santiago Reservoir in unincorporated Orange County. The creek discharges into the Santa Ana River in the city of Santa Ana. The confluence is located between West Memory Lane and West 17<sup>th</sup> Street. Above

Irvine Lake, Santiago Canyon Creek is a natural watercourse that flows through the city of Modjeska and open space. Below Irvine Lake, the channel is generally earthen or riprap lined, soft bottom trapezoid. It is adjacent all land use types but is primarily bordered by residential, light industrial, and recreational. Santiago Canyon Creek is listed on the 303d list of impaired water bodies for pathogens, chlorides, total dissolved solids, and salinity. Orange County Coastkeeper monitors three sites on Santiago Canyon Creek.

Water quality issues in Santiago Canyon Creek include septic systems near the creek, animal pens near the creek, and runoff from residential development.

## **Bacterial Data**

### Total Coliform

Total Coliform levels in Santiago Canyon Creek varied by site. Sant1 had very low levels and no exceedences, while Sant2 had 20% exceedences. There was no bacteria testing done at SANT3.

### E.coli

E.coli levels in Santiago Canyon Creek varied by site. Sant1 had very low levels and no exceedences, while Sant2 had 14% exceedences. There was no bacteria testing done at Sant3.

## **Chemical Data**

### Ammonia-nitrogen

Average levels at SANT1 were below .1mg/L

### Nitrate-nitrogen

Average levels at SANT1 met basin plan objectives

### Orthophosphate

Average levels at Santiago Canyon Creek were high. The average level was .351mg/L. The minimum reading was 0g/L and the maximum reading was 1.5g/L.

### PH

The average pH level in Santiago Canyon Creek was 7.92. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan.

### Dissolved Oxygen

Average Dissolved oxygen (DO) levels Santiago Canyon Creek were within acceptable the range for a warm water creek. The average DO was 10.15mg/L, with a minimum reading of 5.45mg/L and a maximum reading of 14.97mg/L.

### Conductivity/Total Dissolved Solids

Average conductivity at Santiago Creek was at an acceptable level. The average reading was 1406us. Based on this reading, the Total Dissolved Solids (\*667) average was 938mg/L. this average is above the standards set by the SARWQCB for this creek.

## **Bioassessment Data**

Bioassessment surveys were conducted only at Sant1. Sant2 and Sant3 lacked flow during spring/fall survey events. Overall, water quality at Sant1 was fair to excellent.

## **Metals Survey Data**

There were no metals survey results above the detection limit at any Santiago Creek site.

## **Santiago Canyon Creek 1- Modjeska**

Santiago Canyon Creek 1 (SANT1) is located off Modjeska Canyon Road. The monitoring site is directly east of the first bridge crossing. Access to the site is by dirt footpath. Sant1 is natural watercourse. The creek flows through the rural community of Modjeska. This community is not connected to domestic sewer lines and currently utilizes septic systems. Adjacent land use is residential, some grazing, and open space. In addition, there was evidence of recreational use including trash, additional footpaths, and a make shift bridge for pedestrian crossing.

## **Bacterial Data**

### Total Coliform

Total Coliform levels in SANT1 did not exceed standards set in the Basin Plan.

### E.coli

E.coli levels in SANT1 did not exceed standards set in the Basin Plan.

## **Chemical Data**

### Ammonia-nitrogen

Ammonia levels were very low. Only two readings, July 11, 2003 (0.26mg/L) and Jan 20, 2003 (0.13mg/L), had results above 0.1.

### Nitrate-nitrogen

Nitrate levels met Basin Plan objectives.

### Orthophosphate

Orthophosphate levels at SANT1 were high. The average level was .303mg/L. The minimum reading was 0mg/L and the maximum reading was 1.1mg/L.

### PH

The average pH level at SANT1 was 7.993. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.21 and the maximum pH reading was 9.05. There was one exceedence at this site on 6/Feb/04 with a pH reading of 9.05.

### Dissolved Oxygen

Dissolved oxygen (DO) levels at SANT1 were within acceptable the range for a warm water creek. The average DO was 10.41mg/L, with a minimum reading of 8.37mg/L and a maximum reading of 12.42mg/L.

### Conductivity/Total Dissolved Solids

Average conductivity at SANT1 was at an acceptable level. The average reading was 835us. The Total Dissolved Solids average was 556mg/L.

## **Santiago Canyon Creek 2-Santiago Oaks Regional Park**

Santiago Creek 2 (SANT 2) is located of Windes Drive, in Santiago Oaks Regional Park, in the city of Orange. The monitoring site is located just before the entrance gate to the parking area. Access is by footpath. SANT2 is a soft bottom channel with composite lining. Adjacent land use is residential and recreational. With the exception of storm events, water in SANT2 is urban runoff primarily from the newer housing developments just uphill from the park.

### **Bacterial Data**

#### Total Coliform

Total Coliform levels in SANT2 exceeded standards set in the Basin Plan during 20% of the monitoring events. There were a total of 24 monitoring events with 5 exceedences.

#### E.coli

E.coli levels in SANT2 exceeded standards during 14% of the monitoring events. There were a total of 21 monitoring events with 3 exceedences.

### **Chemical Data**

#### Ammonia-nitrogen

Ammonia never exceeded .1mg/L.

#### Nitrate-nitrogen

Nitrate levels met basin plan objectives.

#### Orthophosphate

Orthophosphate levels at Sant2 were high. The average level was .378mg/L. The minimum reading was 0mg/L and the maximum reading was 1.5mg/L.

#### PH

The average pH level at Sant2 was 7.85. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum reading was 7.39 and the maximum reading was 8.16.

### Dissolved Oxygen

Dissolved oxygen (DO) levels at Sant2 were within acceptable the range for a warm water creek. The average DO was 9.98mg/L, with a minimum reading of 5.45mg/L and a maximum reading of 14.97mg/L.

### Conductivity/Total Dissolved Solids

Average conductivity at SANT2 was high. The average reading was 1978us. The Total Dissolved Solids average was 1319mg/L. This average exceeds the standards set by the RWQCB.

## **Santiago Canyon Creek 3- Riverview**

Santiago Canyon Creek 3 (SANT3) is located at the confluence of the Santiago Canyon Creek and the Santa Ana River in the city of Santa Ana. The monitoring site is located just upstream of the Bristol St. Bridge. The site is accessed through the Riverview Golf Course located in the channel bed. This site is dry except for during rain events. Due to safety factors we could not access the site during storms, therefore, there was little data collected at this site.

### **Bacterial Data**

There is no bacterial data for Sant3.

### **Chemical Data**

There was only one OrthoPhosphate reading recorded for Sant3. This reading was 1.2mg/L, recorded on 29/Dec/02

### PH

There was only one pH reading done on SANT3. The pH recorded for 29/Dec/02 was 7.93. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan.

### Dissolved Oxygen

Dissolved oxygen (DO) levels at Sant3 were within acceptable the range for a warm water creek. The average DO was 9.03mg/L, with a minimum reading of 7.2mg/L and a maximum reading of 9.95mg/L.

### Conductivity/Total Dissolved Solids

Conductivity was acceptable at SANT3.

## **Silverado Canyon Creek**

Silverado Canyon Creek is a tributary to Santiago Canyon Creek. Silverado Canyon Creek runs through and drains the rural community of Silverado and open space in unincorporated Orange

County. The headwaters are located in Cleveland National Forest. The creek discharges into the Santiago Canyon Creek near Black Star Canyon in unincorporated Orange County. Silverado Creek is a natural watercourse. The community of Silverado is not connected to a municipal sewer system and therefore utilizes septic systems. Silverado Canyon Creek is listed on the 303d list of impaired water bodies for pathogens, chlorides, total dissolved solids, and salinity. Orange County Coastkeeper monitors three sites on Silverado Canyon Creek.

Water quality issues in Silverado Canyon Creek include many homes with septic systems built close to the creek, animals kept in close proximity to the creek, and a history of high Total Dissolved Solids.

## **Bacterial Data**

### Total Coliform

Total Coliform levels in Silverado Canyon Creek were very low. One site, Sil1, had 6% exceedences. Sil2 and Sil3 had no exceedences.

### E.coli

E.coli levels in Silverado Canyon Creek were moderate. The average percentage of exceedences was 8%.

## **Chemical Data**

### Ammonia-nitrogen

Average levels do not exceed .1mg/L during dry weather.

### Nitrate-nitrogen

Average levels met basin plan objectives during dry weather.

### Orthophosphate

Average levels at Silverado Canyon Creek were high. The average level was .411mg/L. The minimum reading was 0mg/L and the maximum reading was 1.5mg/L. during dry weather.

### PH

The average pH level in Silverado Canyon Creek was 8.063. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan during dry weather.

### Dissolved Oxygen

Dissolved oxygen (DO) levels in Silverado Canyon Creek were within acceptable the range for a warm water creek. The average DO was 9.11mg/L, with a minimum reading of 5.54mg/L and a maximum reading of 11.84mg/L.

### Conductivity/Total Dissolved Solids

Conductivity results were high at Silverado Creek. The average reading was 1293us. Based on this average, Total Dissolved Solids (\*667) were 862mg/L. This result exceeds the standards set by the RWQCB.

## **Bioassessment Data**

Bioassessment results showed that overall Silverado Creek is in good condition. Survey results for Sil1, Sil2, and Sil3 were consistently good, fair, or excellent.

## **Metals Survey Data**

Metal surveys at Silverado Creek sites detected trace amounts of Copper, Nickel, and Zinc, and Silver. However, there were no exceedences of state standards at any site.

## **Silverado Canyon Creek 1-Maple Springs**

Silverado Canyon Creek 1 (Sil1) is located near the Cleveland National Forest Parking Lot at the end of Silverado Canyon Road. The monitoring site is located just beyond the National Forest Gate. Access to the site is by a dirt footpath. Sil1 is a natural watercourse. This site is upstream of the community of Silverado. Land use is open space with some grazing/agriculture. Sil1 is ephemeral with no or very low flow in summer months.

## **Bacterial Data**

### Total Coliform

Total Coliform levels in Sil1 exceeded standards set in the Basin Plan during 6% of the monitoring events. There were a total of 18 monitoring events with 1 exceedences.

### E.coli

E.coli levels in Sil1 exceeded standards during 11% of the monitoring events. There were a total of 18 monitoring events with 2 exceedences.

## **Chemical Data**

### Ammonia-nitrogen

Ammonia levels were low and did not exceed .1mg/L.

### Nitrate-nitrogen

Nitrate levels met Basin Plan objectives.

### PH

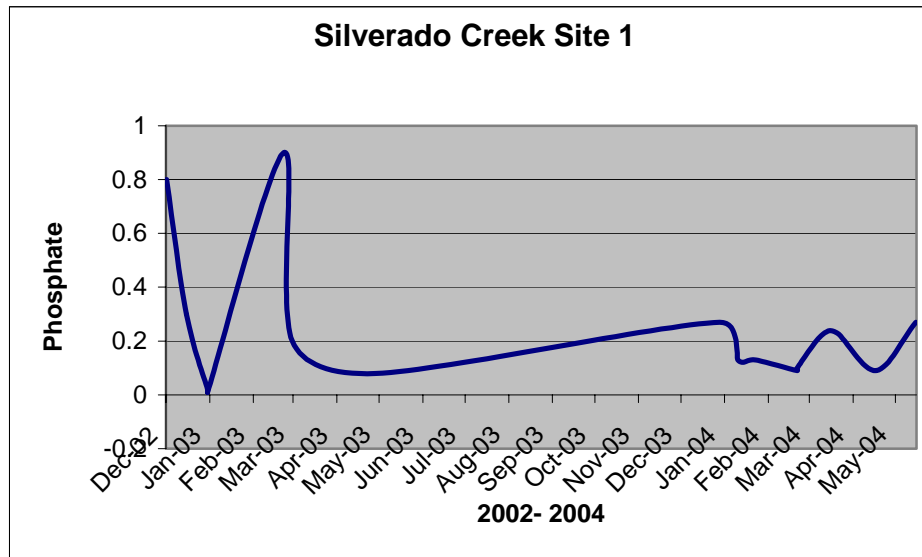
PH readings meet Basin Plan objectives.

### Dissolved Oxygen

Dissolved oxygen (DO) levels at Sil1 were within acceptable the range for a warm water creek. The average DO was 8.57mg/L, with a minimum reading of 5.54mg/L and a maximum reading of 11.84mg/L.

### Orthophosphate

Orthophosphate levels at Sil1 were high. The average level was .304mg/L. The minimum reading was .01mg/L and the maximum reading was 1.1mg/L (See Graph below).



Graph Fifteen: Silverado Creek1-OrthoPhosphate levels Dec 02-May 04.

### Conductivity/Total Dissolved Solids

Conductivity at SIL1 was high with an average reading of 1230us. Total Dissolved Solids average was 820mg/L. This result exceeds standards set by the RWQCB.

### Silverado Canyon Creek 2-Smisk

Silverado Canyon Creek 2 (Sil2) is located directly across Silverado Canyon Road from the Smisek Ranch entrance. Access to the site is by dirt footpath. The creek is a natural watercourse and a spring at this site provides year round water. Land use upstream is residential, open space, with some grazing/agriculture.

### **Bacterial Data**

#### Total Coliform

Total Coliform levels in Sil2 did not exceed standards established by the Basin Plan.

#### E.coli

E.coli levels in Sil2 exceeded standards during 4% of the monitoring events. There were a total of 23 monitoring events with 1 exceedence.

### **Chemical Data**

#### Ammonia-nitrogen

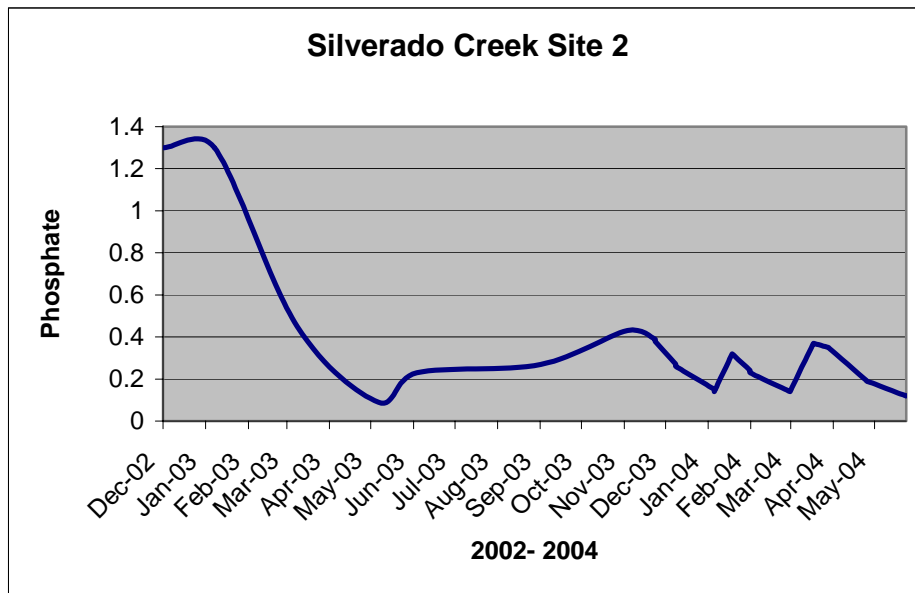
Ammonia levels were low and did not exceed .1mg/L.

Nitrate-nitrogen

Nitrate levels met Basin Plan objectives.

Orthophosphate

Orthophosphate levels at Sil2 were high. The average level was .451mg/L. The minimum reading was 0.08mg/L and the maximum reading was 1.4mg/L (See Graph below).



Graph Sixteen: Silverado Creek 2-Orthophosphate levels Dec02-May04.

PH

The average pH level at Sil2 was 8.024. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.47 and the maximum pH reading was 8.85. There were two exceedences at this monitoring site: 17/Jan/04-pH 8.51 and 12/Feb/04-pH 8.85.

Dissolved Oxygen

Dissolved oxygen (DO) levels at Sil2 were within acceptable the range for a warm water creek. The average DO was 8.89mg/L, with a minimum reading of 5.74mg/L and a maximum reading of 10.96mg/L.

Conductivity/Total Dissolved Solids

Conductivity at SIL2 was high with an average reading of 1291us. Total Dissolved Solids average was 861mg/L. This result exceeds standards set by the RWQCB.

**Silverado Canyon Creek 3-Slide Zone**

Silverado Canyon Creek 3 (Sil3) is located off Silverado Canyon Road, near the Silverado Café, just past the “Slide Area” warning road sign. Access to the site is by a dirt footpath. Land use

upstream is residential, open space, with some grazing/agriculture. Sil1 is ephemeral with no/little flow in summer months.

### Bacterial Data

#### Total Coliform

Total Coliform levels in Sil3 did not exceed standards established in the Basin Plan.

#### E.coli

E.coli levels in SAR6 exceeded standards during 9% of the monitoring events.

### Chemical Data

#### Ammonia-nitrogen

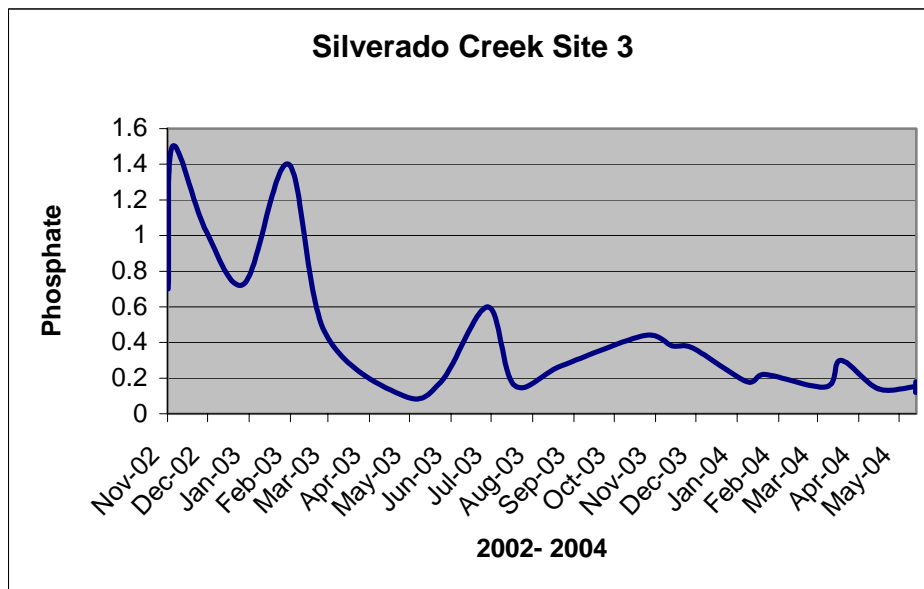
Ammonia levels were low and did not exceed .1mg/L

#### Nitrate-nitrogen

Nitrate levels were low and meet Basin Plan objectives.

#### Orthophosphate

Orthophosphate levels at Sil3 were high. The average level was .444mg/L. The minimum reading was 0mg/L and the maximum reading was 1.5mg/L (See Graph below).



Graph Seventeen: Silverado Creek3-Orthophosphate levels Dec02-May04.

#### PH

The average pH level at Sil3 was 8.097. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7 and the maximum pH reading was 8.68. There was one exceedence on 17/Jan/04 with a pH reading of 8.68.

### Dissolved Oxygen

Dissolved oxygen (DO) levels at Sil3 were within acceptable the range for a warm water creek. The average DO was 9.85mg/L, with a minimum reading of 7.78mg/L and a maximum reading of 11.7mg/L.

### Conductivity/Total Dissolved Solids

Conductivity at SIL3 was high with an average reading of 1359us. Total Dissolved Solids average was 906mg/L. This result exceeds standards set by the RWQCB.

## **Mill Creek**

Mill Creek is located in the County of San Bernardino. Mill Creek is fed by drainage from the San Bernardino Mountains. It runs through and drains the rural communities of Forest Falls and Mountain Home Village as well as open space in unincorporated San Bernardino County. The creek discharges into the Santa Ana River near Redlands at Greenspot Road and Florida Street. Mill Creek is a natural watercourse. The communities of Forest Falls and Mountain Home Village are not connected to a municipal sewer system and therefore utilize septic systems. Additionally, the water from mill Creek is diverted for residential and commercial use in the area. East Valley Resources Conservation District monitors three sites on Mill Creek.

Water quality issues Mill Creek include the use of septic systems close to the creek and water diversions.

### **Bacterial Data**

#### Total Coliform

There were no exceedences of Total Coliform levels in Mill Creek.

#### E.coli

E.coli levels in Mill Creek were very low. One site, Mil3, had exceedences of 8%.

### **Chemical Data**

#### Ammonia-nitrogen

Ammonia levels in Mill Creek were low during dry weather.

#### Nitrate-nitrogen

Average levels at Mill Creek were under the acceptable limit during dry weather. The minimum reading on Mill Creek was 0mg/L; the maximum reading was 7.6mg/L. The average reading was 1.28mg/L. The average readings were highest at Mil2 & Mil3.

#### Orthophosphate levels

Average levels in Mill Creek were high during dry weather. The average level was .496mg/L. The minimum reading was 0mg/L and the maximum reading was 2.7mg/L.

pH

The average pH level Mill Creek was 8.205. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7 and the maximum pH reading was 8.62. There were several exceedences in Mill Creek during the monitoring period.

Dissolved Oxygen

The average DO reading at Mill Creek was 9.13mg/L, with a minimum reading of 3.45mg/L and a maximum reading of 21.8mg/L. There was several dissolved oxygen (DO) readings at Mill Creek that was below the acceptable level for a warm water creek.

Conductivity/Total Dissolved Solids

The conductivity readings in Mill Creek were low. The average reading was 363us. Total Dissolved Solids (TDS) were also low. The average TDS reading was 242mg/L.

**Bioassessment Data**

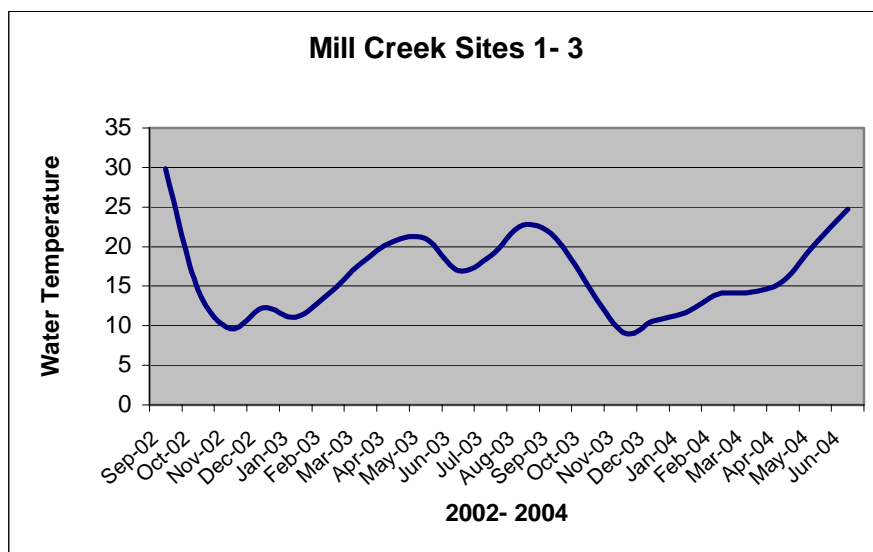
Bioassessment results showed that overall Mill Creek is in poor condition. Surveys were conducted on Mill and Mil3. All but one of these surveys showed poor results.

**Metals Survey Data**

There were no metals survey results above the detection limit at any Mill Creek site.

**Water Temperature**

Water temperature variations in Mill Creek were seasonally dictated. Summer months, typically from April to September, averaged over the 20° Celsius. In winter months, October to March, the average temperature was significantly lower, between 9° and 14° Celsius (See Graph below). 20° Celsius is the generally accepted number for the distinguishing mark between a warm and cold stream.



Graph Eighteen: Mill Creek-Average Water Temperature Sep02-Jun04.

## **Mill Creek 1**

Mill Creek 1 (Mil1) is located off Valley of the Falls Road in the rural community of Forest Falls. The monitoring site is located on the downstream side of the Torrey Pines Street Bridge. Access to the site is by dirt footpath. Mil1 is a natural watercourse. Land use in the vicinity is residential and recreational. Mil1 is snow fed and typically runs all year.

### **Bacterial Data**

#### Total Coliform

Total Coliform levels at Mil1 did not exceed standards established in the Basin Plan.

#### E.coli

E.coli levels at Mil1 did not exceed standards established in the Basin Plan.

### **Chemical Data**

#### Ammonia-nitrogen

Ammonia levels at Mil1 were low. Out of 23 monitoring events, 16 events had results of 0mg/L. The average reading was .053mg/L, above the goals of the Basin Plan.

#### Nitrate-nitrogen

Nitrate levels at Mil1 were well below the acceptable limit. The average reading was 0.868mg/L. The minimum reading was 0mg/L and the maximum reading was 3mg/L

#### Orthophosphate

Orthophosphate levels at Mil1 were high. The average level was .57mg/L. The minimum reading was 0mg/L and the maximum reading was 2.7mg/L.

#### PH

The average pH level at Mil1 was 8.06. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.57 and the maximum pH reading was 8.6. There was one exceedence at this site: 31/Jul/03 pH 8.6.

#### Dissolved Oxygen

The average DO reading at Mil1 was 8.45mg/L, with a minimum reading of 4.12mg/L and a maximum reading of 11.35mg/L. There was one dissolved oxygen (DO) reading at Mil1 that was below the acceptable level for a warm water creek.

#### Conductivity/Total Dissolved Solids

The average conductivity reading at Mil1 was 218us. The average reading for Total Dissolved Solids was 146. There were no exceedences at this site.

## **Mill Creek 2**

Mill Creek 2 (Mil2) is located off Mill Creek Road below the picnic area at the large fenced turnout on the south side of the road near the community of Mountain Home Village. Access is by dirt footpath. Mil2 is a natural watercourse. Adjacent land use is open space and rural residential. Mil2 is heavily used by for recreational purposes by swimmers and fisherman. Trash and debris are abundant at this site.

### **Bacterial Data**

#### Total Coliform

Total Coliform levels at Mil2 did not exceed standards established in the Basin Plan.

#### E.coli

E.coli levels at Mil2 did not exceed standards established in the Basin Plan.

### **Chemical Data**

#### Ammonia-nitrogen

Ammonia levels at Mil2 were low. Out of 28 monitoring events, 14 events had results of 0mg/L. The average reading was 0.02mg/L.

#### Nitrate-nitrogen

Nitrate levels at Mil2 were higher than Mil1 but well within the limits set by the Basin Plan. The average reading was 1.35mg/L. The minimum reading was 0mg/L and the maximum reading was 6.7.

#### Orthophosphate

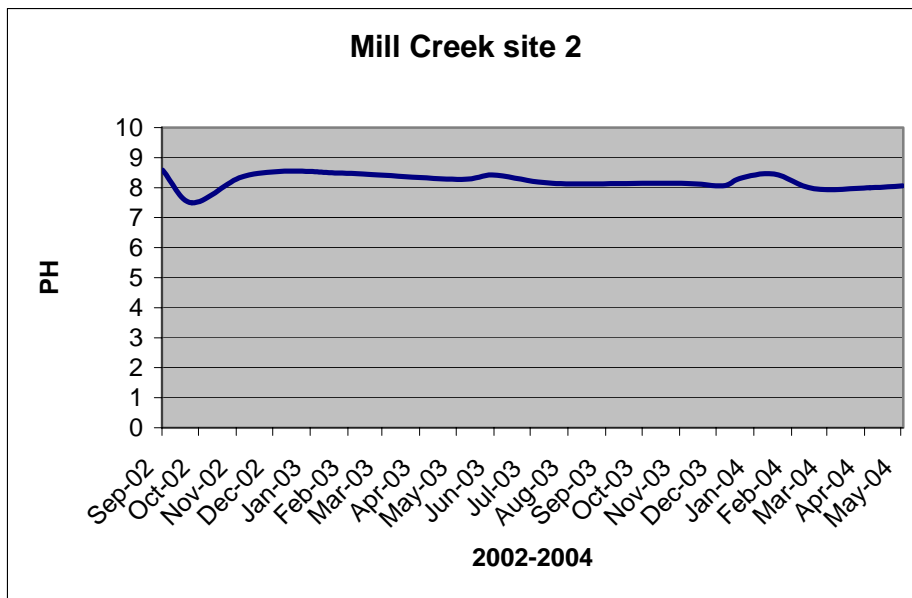
Orthophosphate levels at Mil2 were high. The average level was .50mg/L. The minimum reading was .01mg/L and the maximum reading was 2.5mg/L.

#### Dissolved Oxygen

The average DO reading for Mil2 was 9.66mg/L, with a minimum reading of 3.45mg/L and a maximum reading of 21.8mg/L. There were two dissolved oxygen (DO) readings at Mil2 that were below the acceptable level for a warm water creek (See Graph below).

#### PH

The average pH level at Mil2 was 8.28. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.5 and the maximum pH reading was 8.58. There were two exceedences at this site (See Graph below).



Graph Nineteen: Mill Creek2-pH Sep02-May04.

Conductivity/Total Dissolved Solids

The average conductivity reading at Mil2 was 435us. The average reading for Total Dissolved Solids was 290mg/L. There were no exceedences at this site.

**Mill Creek 3**

Mill Creek 3 is located off Mill Creek Road below the community of Mountain Home Village. The monitoring site is located just upstream of the Highway 38 bridge over Mill Creek. Access is by dirt footpath. Land use in the vicinity is rural residential and open space. Mil3 is a natural watercourse. The embankment has been stabilized with soil-cement and concrete. Mil3 lacks recreational parking but still experiences recreational use.

**Bacterial Data**

Total Coliform

Total Coliform levels at Mil3 did not exceed standards established in the Basin Plan.

E.coli

E.coli levels at Mil3 exceeded standards established in the Basin Plan during 8% of the monitoring events. There were 25 monitoring events and 2 exceedences.

**Chemical Data**

Ammonia-nitrogen

Ammonia levels at Mil3 were low. Out of 29 monitoring events, 17 events had readings of 0mg/L. The average reading was 0.022.

Nitrate-nitrogen

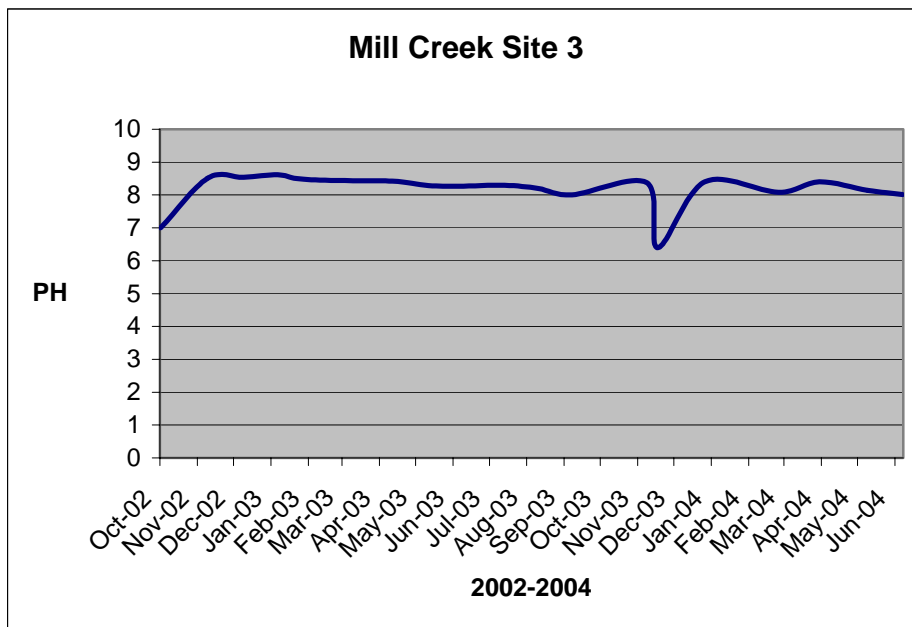
Nitrate levels at Mil3 were low. The average reading was 1.58mg/L. The minimum reading was 0mg/L and the maximum reading was 7.6mg/L.

Orthophosphate

Orthophosphate levels at Mil3 were high. The average level was .417mg/L. The minimum reading was 0mg/L and the maximum reading was 1.7mg/L.

PH

The average pH level at Mil3 was 8.25. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7 and the maximum pH reading was 8.62. There were several exceedences at this site (see chart below).



Graph Twenty: Mill Creek 3-pH Level Oct02-Jun04.

Dissolved Oxygen

Dissolved oxygen levels at Mil3 were within the acceptable range for a warm water creek. The average DO was 9.12mg/L, with a minimum reading of 6.34mg/L and a maximum reading of 13.46mg/L.

Conductivity/Total Dissolved Solids

The average conductivity reading at Mil3 was 416us. The average reading for Total Dissolved Solids was 277mg/L. There were no exceedences at this site.

## Golden Star Creek

Golden Star Creek is located off Van Buren Boulevard in Riverside County. Golden Star Creek runs through and drains portions of the city of Riverside as well as open space in unincorporated Riverside County. The headwaters are located in the hilly part of southwestern rural Riverside County. The creek discharges into the Santa Ana River through a underground pipe located downstream of a flood control dam located at the Golden Star Road creek crossing. Golden Star Creek is a combination of natural watercourse, earthen trapezoid, and concrete pipe. Local land use is variable and includes: open space, rural residential, urban residential, and commercial. Riverside-Corona Resources Conservation District monitors three sites on Golden Star Creek.

This region of the Santa Ana River Watershed is in various stages of rapid urban development. Water quality issues include construction activities, residential runoff, and animals kept in close proximity to the stream.

### Bacterial Data

#### Total Coliform

Total coliform results at Golden Star Creek were consistently high. The average percentage of exceedences was 27% of the monitoring events.

#### E.coli

E.coli results at Golden Star Creek were consistently high. The average percentage of exceedences at GS1 and GS2 was 34% of the monitoring events. There were no exceedences at GS3.

### Chemical Data

#### Ammonia-nitrogen

Average levels at Golden Star Creek do not exceed .1mg/L during dry weather

#### Nitrate-nitrogen

Average levels at Golden Star Creek meet basin plan objectives during dry weather.

#### Orthophosphate

Average levels in Golden Star Creek were high. The average level was 1.184mg/L. The minimum reading was .38mg/L and the maximum reading was 4.5mg/L. during dry weather.

#### PH

The average pH level in Golden Star Creek was 8.035. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.06 and the maximum pH reading was 8.69.

### Dissolved Oxygen

Dissolved oxygen (DO) levels at Golden Star Creek were within acceptable the range for a warm water creek.

### Conductivity

Conductivity at Golden Star Creek was high. The average reading was 1843us. Based on the result, the Total Dissolved Solids (\*667) were 1229mg/L. This exceeds standards set by the RWQCB.

### **Bioassessment Data**

Bioassessment survey was completed on GS1. All survey results showed poor water quality.

### **Metals Survey Data**

Metals survey results for Golden Star1 showed trace amounts of Copper and Zinc. There were no metals survey results above the detection limit at Golden Star2 or 3.

### **Golden Star Creek 1**

Golden Star Creek 1 (GS1) is located near the intersection of Van Buren Boulevard and Wood Road in the city of Riverside. The monitoring site is located off Bountiful Road to the west of Wood Road. Access is by a footpath along the creek. The channel is natural since it is a engineered riparian area built as part of a nearby tract home development. Local land use is currently changing from rural to urban. Construction activities adjacent these sites were common.

### **Bacterial Data**

#### Total Coliform

Total Coliform levels in GS1 exceeded standards set in the Basin Plan during 39% of the monitoring events. There were a total of 28 monitoring events with 11 exceedences. Total Coliform levels were consistently high from April 2003 to October 2003.

#### E.coli

E.coli levels in GS1 exceeded standards during 39% of the monitoring events. There were a total of 28 monitoring events with 11 exceedences.

### **Chemical Data**

#### Ammonia-nitrogen

Ammonia levels exceeded .1mg/L on four occasions.

#### Nitrate-nitrogen

Nitrate levels met basin plan objectives but were slightly elevated.

### Orthophosphate

Orthophosphate levels at GS1 were high. The average level was .955mg/L. The minimum reading was .38mg/L and the maximum reading was 3.1mg/L.

### PH

The average pH level at GS1 was 7.91. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.06 and the maximum pH reading was 8.69. There was one exceedence at this monitoring site: 6/Feb/03 pH 8.69.

### Dissolved Oxygen

Dissolved oxygen (DO) levels were within the acceptable range for a warm water creek.

### Conductivity

Conductivity readings were high at GS1. The average reading was 1577us. The Total Dissolved Solids average was 1051mg/L. This result exceeds the standards set by the RWQCB.

## **Golden Star Creek 2**

Golden Star Creek 2 (GS2) is located at the end of Ridge Run Road in the city of Riverside. Access is by a dirt path. The channel is natural. Local land use is currently changing from rural to urban but the area just around this site is semi rural, with many horses kept in the area. A large-scale *Arundo donax* removal project took place at this site just before monitoring began here for the project.

## **Bacterial Data**

### Total Coliform

Total Coliform levels in GS2 exceeded standards set in the Basin Plan during 21% of the monitoring events. There were a total of 29 monitoring events with 6 exceedences.

### E.coli

E.coli levels in GS2 exceeded standards during 29% of the monitoring events. There were a total of 28 monitoring events with 8 exceedences.

## **Chemical Data**

### Ammonia-nitrogen

Ammonia levels did not exceed .1mg/L during dry weather.

### Nitrate-nitrogen

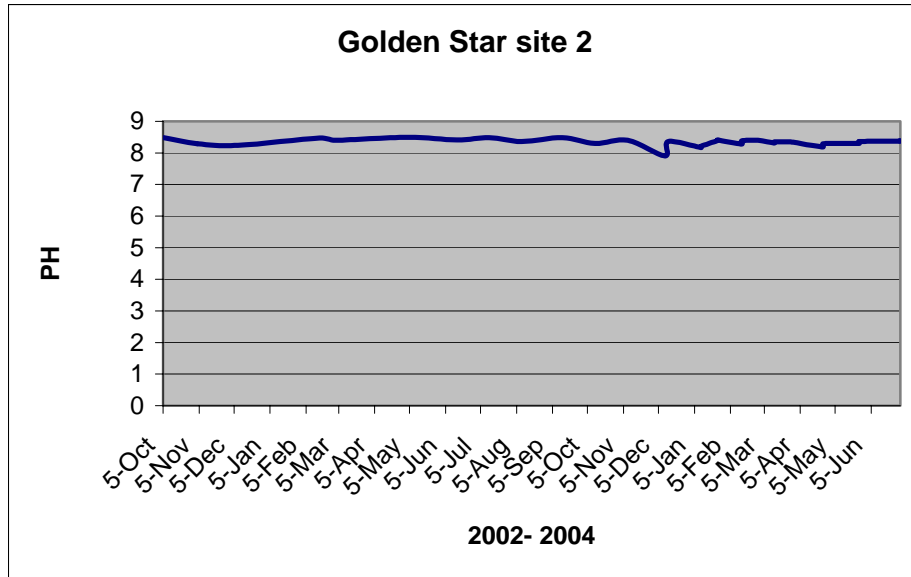
Nitrate levels met basin plan objectives but were slightly elevated.

### Orthophosphate

Orthophosphate levels at GS2 were high. The average level was .977mg/L. The minimum reading was .42mg/L and the maximum reading was 2.7mg/L.

pH

The average pH level at GS2 was 8.36. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.89 and the maximum pH reading was 8.54. There were four exceedences at this monitoring site (See Graph below).



Graph Twenty-One: Golden Star2-pH Levels Oct02-Jun04.

Dissolved Oxygen

Dissolved oxygen (DO) levels were within acceptable the range for a warm water creek.

Conductivity

Conductivity readings were high at GS2. The average reading was 2185us. The Total Dissolved Solids average was 1457mg/L. This result exceeds the standards set by the RWQCB.

**Golden Star Creek 3**

Golden Star Creek 3 (GS3) is located downstream of Golden Star Creek Road in the city of Riverside. Access is by dirt access road. The channel is soft bottom with rip rap sides and is just above a flood control dam. This area of the creek flows over the road during significant storms.

**Bacterial Data**

Total Coliform

Total Coliform levels in GS3 exceeded standards set in the Basin Plan during 21% of the monitoring events. There were a total of 29 monitoring events with 6 exceedences.

E.coli

E.coli levels in GS3 did not exceed the standards established in the Basin Plan.

## **Chemical Data**

### Ammonia-nitrogen

Levels exceeded .1mg/L on five sampling events.

### Nitrate-nitrogen

Nitrate levels met basin plan objectives.

### Orthophosphate

Orthophosphate levels at GS3 were high. The average level was 1.62mg/L. The minimum reading was .52mg/L and the maximum reading was 4.5mg/L.

### PH

The average pH level at GS3 was 7.82. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.58 and the maximum pH reading was 8.08.

### Dissolved Oxygen

Dissolved oxygen (DO) levels were within acceptable the range for a warm water creek.

### Conductivity

Conductivity readings were high at GS3. The average reading was 1767us. The Total Dissolved Solids average was 1178mg/L. This result exceeds the standards set by the RWQCB.

## **Temescal Creek**

Temescal Creek is located in Temescal Canyon between Lake Elsinore and Santa Ana River at Prado Dam. Temescal Creek runs through and drains the communities of Lake Elsinore, Aberdeene, and Corona in addition to unincorporated areas of Riverside County. The creek is the recipient of discharges from waste treatment plants in both Lake Elsinore and Corona. The headwaters lie at Lake Elsinore and then are supplemented with water from the Lake Elsinore Water Treatment Plant. The creek discharges into the Santa Ana River near Prado Dam in Riverside County. Temescal Creek consists of natural watercourse and concrete lined trapezoidal areas. Riverside-Corona Resources Conservation District monitored three sites on Temescal Creek.

The Temescal Creek watershed is undergoing tremendous change as it is transformed from an area of scattered rural residences, farms and gravel mines into a highly developed residential area of over 20,000 homes. Water quality concerns include agricultural use, mining activities, illegal dumping, urban runoff and the effects of flow from two waste treatment plants and a fishing lake.

## **Bacterial Data**

### Total Coliform

Total Coliform levels at Temescal Creek were consistently high. There were exceedences during 36% of the monitoring events.

### E.coli

E.coli levels at Temescal Creek were high. Although there were no exceedences at the upper site, results were very high at the lower sites.

## **Chemical Data**

### Ammonia-nitrogen

Average levels in Temescal Creek are below .1mg/L in dry weather

### Nitrate-nitrogen

Average levels in Temescal Creek meet basin plan objectives during dry weather

### Orthophosphate

Average levels in Temescal Creek were high. The average level was 1.025mg/L. The minimum reading was 0mg/L and the maximum reading was 2.6mg/L during dry weather

### PH

The average pH level in Temescal Creek was 8.03. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 5.9 and the maximum pH reading was 8.47. There was one reading below the acceptable pH level: 7/Jan/04 pH 5.9.

### Dissolved Oxygen

Dissolved oxygen (DO) levels in Temescal Creek were within acceptable the range for a warm water creek. The average DO was 8.73mg/L, with a minimum reading of 5.2mg/L and a maximum reading of 14.62mg/L.

### Conductivity/Total Dissolved Solids

Conductivity readings in Temescal Creek were high. The average reading for the creek was 1206us. Consequently, Total dissolved Solids (TDS) were in exceedence throughout the creek. The average reading for TDS was 804mg/L. this result exceeds standards set by the RWQCB.

## **Bioassessment Data**

Bioassessment survey results showed poor water quality in Temescal Creek. Surveys were conducted on Tem2 and Tem 3.

## **Metals Survey Data**

Metals survey results showed trace amounts of Chromium, Copper, Lead, Nickel, and Zinc at Temescal1 & 3. However, there were no exceedences of state standards at these sites. No metals were detected at Temescal2.

## **Temescal Creek 1**

Temescal Creek 1 (TEM1) is located north of Lake Street in Lake Elsinore just above the Temescal Canyon Rd. Bridge crossing. The site is accessed through an illegal dumping area next to the creek and is in a wooded area. During the sampling period the dumping area was cleaned up several times and attempts to restrict access to the site were unsuccessful. The creek flows in a natural channel here. Issues of concern at this site are water from the nearby treatment plant, and illegal dumping in the area.

### **Bacterial Data**

#### Total Coliform

Total Coliform levels at TEM1 exceeded standards established in the Basin Plan during 18% of the monitoring events. There were 28 monitoring events and 5 exceedences.

#### E.coli

E.coli levels at TEM1 did not exceed the standards established in the Basin Plan.

### **Chemical Data**

#### Ammonia-nitrogen

Ammonia levels at Tem1 were low. The average reading was .05mg/L

#### Nitrate-nitrogen

Nitrate levels at Tem1 were low. The average reading was .65mg/L. The minimum reading was 0 and the maximum reading was 2.7.

#### Orthophosphate

Orthophosphate levels at Tem1 were high. The average level was 1.74mg/L. The minimum reading was 0.48mg/L and the maximum reading was 2.5mg/L.

#### PH

The average pH level at Tem1 was 7.74. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 5.9 and the maximum pH reading was 8.22. There was one reading below the acceptable pH level: 7/Jan/04 pH 5.9.

#### Dissolved Oxygen

Dissolved oxygen (DO) levels at Tem1 were within acceptable the range for a warm water creek. The average DO was 8.33mg/L, with a minimum reading of 6mg/L and a maximum reading of 10.5mg/L.

#### Conductivity/Total Dissolved Solids

The average conductivity reading at Tem1 was 1379us. The average reading for Total Dissolved Solids (TDS) was 920mg/L. Readings for TDS were in exceedence of the established goal of 650ppm at 45 out of 48 monitoring events.

## **Temescal Creek 2**

Temescal Creek 2 (TEM2) is located just east of Temescal Creek Rd. near Indian Truck Trail Road. The monitoring site is in a wooded area and has a natural channel. The sample site is just below an artificial fishing lake. The area burned in the fall of 2003. The site is accessed by a dirt access road. Water quality issues in this area include the nearby fishing lake. There is a lot of trash in this area.

### **Bacterial Data**

#### Total Coliform

Total Coliform levels at TEM2 exceeded standards established in the Basin Plan during 21% of the monitoring events. There were 28 monitoring events and 6 exceedences.

#### E.coli

E.coli levels at TEM2 exceeded standards established in the Basin Plan during 7% of the monitoring events. There were 28 monitoring events and 2 exceedences.

### **Chemical Data**

#### Ammonia-nitrogen

Ammonia levels at Tem2 were low. The average reading was .03mg/L.

#### Nitrate-nitrogen

Nitrate levels at Tem2 were low. The average reading was .56mg/L. The minimum reading was 0mg/L and the maximum reading was 2.8mg/L.

#### Orthophosphate

Orthophosphate levels at Tem2 were high. The average level was .82mg/L. The minimum reading was .28mg/L and the maximum reading was 2.6mg/L.

#### pH

The average pH level at Tem2 was 7.73. This finding is within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.4 and the maximum pH reading was 8.16.

#### Dissolved Oxygen

Dissolved oxygen (DO) levels at Tem2 were within acceptable the range for a warm water creek. The average DO was 7.35mg/L, with a minimum reading of 5.29mg/L and a maximum reading of 9.73mg/L.

#### Conductivity/Total Dissolved Solids

The average conductivity reading at Tem2 was 1380us. The average reading for Total Dissolved Solids was 920mg/L. This reading exceeds the standards set by the RWQCB.

### **Temescal Creek 3**

Temescal Creek three (TEM3) is located just below the Lincoln Street Bridge in the city of Corona. The site is just above the outfall from the Corona waste treatment plant and is accessed by a dirt path from the road. The area hosts a significant population of homeless people and has a lot of trash. The water quality issues in this area include industrial and urban runoff, mining and agriculture.

#### **Bacterial Data**

##### Total Coliform

Total Coliform at Tem3 exceeded standards established in the Basin Plan during 69% of the monitoring events. There were 26 monitoring events and 18 exceedences.

##### E.coli

E.coli at Tem3 exceeded standards established in the Basin Plan during 38% of the monitoring events. There were 26 monitoring events and 10 exceedences.

#### **Chemical Data**

##### Ammonia-nitrogen

Ammonia levels at Tem3 were low. The average reading was .04mg/L.

##### Nitrate-nitrogen

Nitrate levels at Tem3 were higher than Tem1 &2 but were within acceptable limits. The average reading was 4.78mg/L. There was one unacceptable reading of 11mg/L in March 2004.

##### Orthophosphate

Orthophosphate levels at Tem3 were high. The average level was .53mg/L. The minimum reading was 0mg/L and the maximum reading was 2.1mg/L.

##### PH

The average pH level at Tem3 was 8.59. This finding is not within the acceptable range (6.5-8.5) as established in the Basin Plan. The minimum pH reading was 7.8 and the maximum pH reading was 9.47.

##### Dissolved Oxygen

Dissolved oxygen (DO) levels at Tem3 were within acceptable the range for a warm water creek. The average DO was 10.19mg/L, with a minimum reading of 5.2mg/L and a maximum reading of 14.62mg/L.

##### Conductivity/Total Dissolved Solids

The average conductivity reading at Tem3 was 857us. The average reading for Total Dissolved Solids was 572mg/L. There were no exceedences at this site.

## Quality Control

As part of this project Orange County Coastkeeper was required to develop a Quality Assurance Project Plan (QAPP) that served as the written description of the procedures and testing goals for the project. The QAPP contains a full description of the sampling process, volunteer/staff training in sampling methodology, and data quality goals and requirements. Following the procedures and standards outlined in the QAPP assures that the data collected as part of this project are accurate to a degree to be useful to the Santa Ana Regional Water Quality Control Board and other agencies, groups, or individuals in their studies of the waterbodies we are monitoring.

Samples tested in the field are of little use unless there is some sort of assurance that the testing procedures generate results that are accurate and precise. Accuracy describes how close a measurement is to its true value. This is usually determined by testing duplicate samples at a certified lab or by testing instrument standards at quality control sessions. Precision is the ability of a sample to be tested over and over again while repeating the same readings within the range of the instruments resolution. Precision is tested by using replicate samples tested in-house, and in the field. For both these parameters, we used the Data Quality Objectives (DQOs) contained in the QAPP.

Accuracy describes how close the measurement is to its true value. Accuracy is the measurement of a sample of known concentration and comparing the known value against the measured value. The accuracy of our chemical measurements was checked by performing tests on standards at quarterly Quality Control Sessions (Q.C. Sessions). A standard is a known concentration of a certain solution. Standards can be purchased from chemical or scientific supply companies. Standards may also be prepared by a professional partner, e.g. a commercial or research laboratory. OCCCK used standards purchased from both Del Mar Laboratories and Hach to determine accuracy of our nutrient measurements. We also submitted duplicate samples to Del Mar Laboratories for nutrient and conductivity analysis. All of our Q.C. Sessions are documented to record the accuracy and precision of the instruments and the ability of the volunteers and staff to use them.

Accuracy for bacteria is generally determined by analyzing a positive control sample twice annually. A positive control is similar to a standard, except that a specific discreet value is not assigned to the bacterial concentrations in the sample. However, in lieu of testing positive controls, OCCCK submitted duplicate samples from 10% of our sites to the Orange County Sanitation District microbiological lab once a quarter.

The OCCCK uses Del Mar Laboratories and the Orange County Sanitation District as certified labs and conducts semi-annual quality control sessions in order to validate the accuracy of the data collected. The multiple readings collected by volunteers during the Q.C. Sessions are used to determine precision as well.

Note: Accuracy from Q.C. Sessions was obtained by averaging all readings for a particular parameter then determining the difference between the average and the standard value. Percent accuracy was obtained by dividing the accuracy by the standard value and then multiplying by

100. Precision was obtained by taking the standard deviation of the readings. Percent precision was obtained by dividing precision by the mean reading and multiplying by 100.

### **Quality Assurance**

There are many factors in the process of collecting data that play a role in the quality of the data. These include, but are not limited to high pH, high chlorides, turbidity and water color, which could cause reagents to work improperly. To accomplish our quality assurance goals, sample blanks, split samples, duplicates, and instrument blanks are used both in the field and in the laboratory. The following is a review of each parameter, the quality assurance procedures, and the results of quality assurance analysis.

### **pH**

Three Oakton 3 pH meters were used in the water monitoring project. One of the pH meters was used in the San Bernardino and Riverside area, while the other two were used in the Orange County area. Before the meters were taken into the field, they were calibrated according to manufacture specifications, using three different standard solutions: pH 4, 7, and 10. Calibrating these instruments ensures that readings at the sites are accurate. Calibration also gives an indication of instrument drift, or how far the instrument reading has moved since its last calibration. In addition to calibration, non-bleeding pH test strips are used in the field to give an estimate of whether the meters are reading within the correct range.

A calibration log is kept of all calibrations made in the lab. Thus far, with the exception of three meter-tip replacements, the meters have calibrated with very few problems. The meters are also very easy to use, which makes us very confident in their ability to retrieve reliable data.

In Q.C. Sessions, the accuracy DQO (of +/- 2%) was met in 90% of the time: the exception was at one session held in the first quarter of 2003. The precision DQO (of +/- 2%) was met 80% of the time; the exceptions were the same Q.C. session in 2003 and once in a session the last quarter of 2002. Since early 2003, OCCK has consistently met its pH DQOs. Note: standard pH values were adjusted for temperature.

### **Dissolved Oxygen**

Three Oakton Dissolved Oxygen (DO) meters were used in the water monitoring project. One of the DO meters was used in the San Bernardino and Riverside area, while the other two were used in the Orange County area. Before each use, the meters were calibrated using the manufactures instructions. Calibrating these instruments ensures that readings at the sites are accurate. In addition to calibration, backup tests were conducted using Chemets Dissolved Oxygen Color Comparator Test to determine if the meters were reading within the correct range.

Dissolved Oxygen meters used for the collection of dissolved oxygen and temperature readings were checked for precision and accuracy at quarterly intercalibration sessions. Two buckets were set up for the test. One bucket is used as an ice bath to check the meter's temperature

sensor at 0 degrees Celsius, the other bucket is set up with water at ambient room temperature with an aerator in order to oxygenate the water to 100%. No problems have arisen from the Dissolved Oxygen meters, other than a loose connection in a wire that was promptly repaired.

### **Conductivity**

Conductivity meters at the OCCK were calibrated on site using standards purchased from a laboratory. The low conductivity reads from 0 to 1990  $\mu\text{S}$ . The high conductivity probe reads from 0 to 19,990  $\mu\text{S}$ . The low probe is calibrated in a 1413  $\mu\text{S}$  standard, while the high probe is calibrated in a 10,000  $\mu\text{S}$  standard. All calibrations are thoroughly documented for future inquiries into the probes credibility in measurements.

The project used three sets of conductivity meters. Each set consists of a high and a low conductivity meter. Like the pH meters, one set was used in the San Bernardino/ Riverside area, while the other two sets were used in Orange County.

Split sample conductivity tests at Del Mar lab have proven to show results within our quality control accuracy goals 77 % of the time, or 10 out of the 13 times. The accuracy DQO of +/- 1% (QAPP accuracy goals of standards and intercalibration sessions were met 70 % of the time. Overall, we were able to meet our accuracy objectives about 74% of all samplings.)

The conductivity probes sometimes took a long time to settle on a stable reading and readings tended to jump when the probe was removed from and re-immersed in the water. Volunteers were trained to measure conductivity for a sufficient time to ensure that a stable final reading was reached.

### **Ammonia-Nitrogen**

Ammonia-nitrogen is tested using a Hach DR-850 Colorimeter. Every quarter, standard solutions of ammonia-nitrogen were tested with the colorimeter in order to test the accuracy of the colorimeter. (Duplicate samples from sampling sites were sent into Del Mar laboratories for quality control. Q.C. sessions are also held every quarter in order to ensure that results from tested standards in the intercalibration session are accurate under the control of trained citizen volunteers. Trained volunteers at intercalibration sessions are also watched carefully in order to ensure that they use correct techniques while using these instruments).

One of the problems that we had with the ammonia-nitrogen test was that the minimum detection limit (MDL) at Del Mar Laboratories was 1 mg/l. Our results typically range from 0 to 0.5mg/L. We were not successful in finding any other commercial laboratory that could test lower than this level. Although 7 out of 16 tests did not meet our accuracy DQO, 6 of the 7 test results were below Del Mar laboratories MDL. which could have brought our percentage of passed quality control objectives from 43% to 81%. To correct the problem, OCCK began purchasing standards to test at Q.C. sessions beginning in early 2004. The data from the Q.C. sessions held in 2004 suggest that our data quality for ammonia is quite good. Although none of data meets the DQO, it is because the numbers are very small. In all cases, the mean accuracy is +/- 0.02 mg/L. Also, in all of the Q.C. sessions the precision objective was met.

\*\*Although we had problems with Del Mar's ammonia-nitrogen test range, our precision, which was determined from non-certified split samples tested in the field and the lab, met our quality control objectives 80% of the time.

### **Nitrate-Nitrogen**

Nitrate-Nitrogen is tested using a Hach DR-850 colorimeter. We initially experienced problems meeting quality control objectives. As a result, we changed our method of testing in late January 2003, from using packets of reagents to vacuum ampules. It was our concern that not all the reagent was being released from the foil packets into the sample. Using vacuum ampules solved the problem by automatically pulling in the correct amount of sample, creating less room for error, while at the same time bringing the precision of the test from 1.7 to .3 mg/l. Unfortunately, another source of error occurs with the vacuum ampule: if it is removed from the sample before the full amount of water is taken in, then the concentration of nitrate will be underestimated. Even given proper training in the correct testing methods, inadvertent errors most likely occurred a certain percentage of the time.

Split samples were taken to Del Mar laboratories and analyzed for nitrate-nitrogen. 7 out of the 16 samples taken to Del Mar laboratories, or 44% of all samples, met quality control objectives for accuracy. We met our accuracy goals 59% of the time in our intercalibration sessions and standards testing in the lab. Our precision, which was determined from non-certified split samples taken in the field, met our quality control objectives 100% of the time.

### **Orthophosphate**

We experienced numerous problems with our OrthoPhosphate testing. To achieve more accurate results, we changed our OrthoPhosphate test method starting May 2003. The initial test had a range from 0 to 30 mg/l, and a precision of .12 mg/l. In May 2003, we changed to an OrthoPhosphate test that ranges from 0 to 2.5 mg/l and has a precision of .05 mg/l.

The accuracy of our split sample (tested at Del Mar Laboratories) was poor. One possible cause of this was the fact that Del Mar Laboratories has a higher detection level for Orthophosphate in comparison to our method. This is important since Orthophosphate levels are often (and should be) very low in our waters. Standards we use to run analysis on our equipment have a concentration of .1mg/l. Del Mar Laboratory minimum detection limit is .5 mg/l. While they will report results below .5mg/l, their confidence level for those results (J-Flags) is low. Since our detection limit is lower than Del Mar Laboratory we changed our accuracy test to increase our ability to read spiked samples prepared by the lab. Due to this split sample testing problem, our accuracy for this parameter did not meet our goals. However, our precision was good when duplicate samples were run. Backup readings taken with another model of Hach Colorimeter and other brands of colorimeters borrowed for quality control matched our field readings. As a result of these problems, our Orthophosphate data is usable to identify patterns, but care should be used with individual numbers in data sets. Precision goals from non-certified split samples analyzed in the field and in the lab were met 100% of the time.

### **Microbiological parameters: E. coli and Total Coliform**

Bacteria samples taken in the field also underwent quality control checks. The Idexx bacteria test is extremely easy to use and leaves very little room for error as long as the temperature on the incubator can be monitored to insure that the temperature stabilizes within test parameters. A blank with de-ionized water is analyzed for cleanliness every bacterial sampling event. No blanks tested positive for bacteria.

Non-certified splits and duplicate samples processed in our in-house laboratory met quality control goals during every sampling event. Our certified split samples sent to the Orange County Sanitation District (OCSD) have also matched with our readings giving us confidence in our measurements. From the beginning of the project until March 2003, the OCSD was using a multiple tube fermentation process; we were using the Idexx Colilert 18 hour and 24 hour method. Charlie Mc Gee from the OCSD's microbiology lab informed us that the two different methods can not be compared exactly side by side, and that if there is a comparison then we should use + or - ½, a logarithmic unit of MPN/100ml in order to adjust our test to the deviation between the two tests. In order to make a more direct comparison between the results of the OCSD and our results at the OCCK we requested that OCSD to change their bacterial analysis test to the Idexx method.

Our results when comparing the multiple tube fermentation and the Colilert methods show that we met the 95% confidence level criteria for our quality control.

### **Recommendations**

Methodology needs to be changed for the Nitrate-Nitrogen and Phosphate tests. Results from these two parameters were unsatisfactory and review of our methods will enhance our ability to provide accurate and precise results on future projects. Additionally, we suggest an expansion and revision of our Technical Advisory Group. This will assist us in analyzing our methods and data more often, more accurately, and help questions get answered in a timely manner.

## **CONCLUSION**

Overall, this project went very well. We continuously refined our monitoring and quality control techniques to maintain and improve our data collection. We have achieved our goal of collecting high quality data for the Santa Ana Regional Water Control Board. Our quality control procedures identified areas where changes were needed such as our nitrate and Orthophosphate tests.

We have also reached our goal of public outreach. Over two hundred volunteers have directly participated in the project and have been trained in water monitoring techniques. Hundreds more have been educated on water quality problems through our participation in public events. Within the three county area citizens saw demonstrations of equipment, a Santa Ana River Watershed diorama, and received educational material on how to protect their watershed. The three organizations participating in the project worked well together and this led to a consistent and productive project.

**APPENDIX A**

LATITUDE AND LONGITUDE OF MONITORING SITES (DECIMAL DEGREES). NAD83

gs2	gold star 2	33.89612	117.35872	sar6	katella	33.80638	117.87415
gs3	gold star 3	33.90357	117.37589	sd1	bake parkway	X	X
mil1	mill creek 1	34.08915	116.92567	sd2	133 freeway	33.65388	117.7574
mil2	mill creek 2	X	X	sd3	sand canyon	33.65374	117.75767
mil3	mill creek 3	34.08522	117.02319	sd4	woodbridge	33.67665	117.80094
sant1	modjeska canyon	33.70869	117.63633	sd5	civic center	33.67665	117.80094
sant2	santiago oaks park	X	X	sd6	michelson	X	X
sant3	riverview golf course	X	X	sil1	maple springs	33.74805	117.5831
sar1	green river	33.87047	117.67193	sil2	smisek	33.74573	117.6012
sar2	gypsum	33.5224	117.43069	sil3	slide zone	33.74699	117.63256
sar3	yorba regional park	33.86396	117.77305	tem1	temescal creek 1	33.72888	117.395
sar4	lakeview	33.85502	117.81649	tem2	temescal creek 2	33.75755	117.45676
sar5	lincoln	X	X	tem3	temescal creek 3	33.89408	117.57774