IS MY CREEK CLEAN AND HEALTHY?

SAN DIEGO COASTKEEPER'S STATE OF OUR WATERSHEDS REPORT

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Cover photo credit: Shannon Switzer

San Diego Coastkeeper's Water Quality Monitoring Program is possible with the participation of individuals and organizations who generously donate their time, knowledge and skills so that we can collect this vital information.

San Diego Coastkeeper Water Monitoring Partners

Regional Partners

- Integrated Regional Water Management Program
- State Water Resources Control Board
- San Diego Regional Water Quality Control Board
- San Diego State University, Department of Public Health
- Southwestern College – Physical Sciences

Watershed Partners

- Surfrider Foundation San Diego Chapter
- Golden State Flycasters
- The San Diego River Park Foundation
- San Diego Stream Team
- Tijuana River National Estuarine Research Reserve
- Preserve Calavera
- Batiquitos Lagoon Foundation
- Friends of Rose Canyon
- San Dieguito River Park

Technical Advisory Committee

- Erick Burres, State Water Resource Control Board
- Lillian Busse, Regional Water Quality Control Board, San Diego
- Dr. R. Gersberg, San Diego State University
- Hiram Sarabia, University of California, San Diego
- Dennis Brown, City of San Diego Water Utilities

Individual Volunteers

- Funding from the following sources makes the Water Quality Monitoring Program possible: The San Diego Integrated Regional Water Management Program and the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, administered by the California Department of Water Resources.

and

- Anonymous Donor
- Cali Bamboo
- County of San Diego
- Hunter Industries
- Norcross Wildlife Foundation, Inc.
- San Diego Downtown Rotary
- The Parker Foundation

GENERAL INTRODUCTION

We live, work and play in watersheds. Even if we do not think about them every day, they support everything we do. Rain falls from the sky and moves over land. This movement of water drives the biological, chemical, and physical processes that create ecosystems on land. Coastal watersheds also link the land and our coast. As water moves over the landscape, it gathers, transforms and releases materials from the land to the sea.

Watersheds keep working even when we don't notice them. When rain falls in a healthy watershed, most of it slowly soaks into the ground. Plants use some water for growth and release the remaining water into the atmosphere (we call this evapotranspiration). What is left flows over the land and to our creeks as surface flow (Figure 1).

A little pavement goes a long way to ruining a creek: Impacts of urbanization

Human activities disrupt how watersheds function. As we created cities and populations grew in our region, we paved over the 'spongy' parts of watersheds. Surfaces that previously allowed water to infiltrate became hard. This stops water from soaking into the ground or being used by plants. These impervious surfaces, like parking lots, roads, and buildings, cause water to flow over the surface of a watershed. This surface flow, also known as stormwater, causes problems in our creeks, rivers and lagoons including increased pollution, faster and flashier flows and increased erosion.

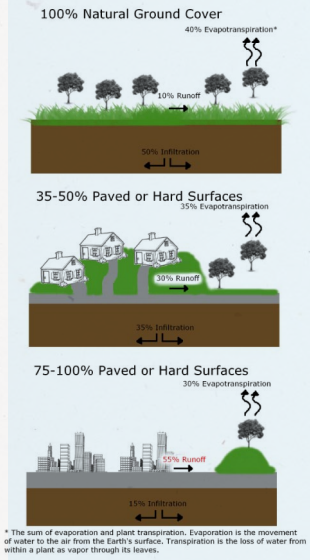

Figure 1. Urbanization changes the water cycle

During our long dry season, pollutants build on hard surfaces. When it rains, stormwater pushes the accumulated pollutants into our storm drains. In San Diego, like most of California, our storm drains generally do not connect to wastewater treatment plants, so everything flows untreated into our waters.

It does not take much pavement in a watershed to cause ecological harm—water quality and habitat impacts can start when as little as 10 percent of the watershed gets paved[2]. This makes protecting and restoring water quality very challenging. In addition to pollution from our cars, yards, and streets, contaminants flow into our storm drain system from industrial and construction areas, irrigation, the atmosphere and sewage spills. When not managed appropriately, industrial and construction sites can be significant sources of pollution[1].

All of these sources of pollution lead to water quality problems. The San Diego Regional Water Quality Control Board, our local water quality regulatory agency, lists over 200 bodies of water in the greater San Diego region as impaired for one or more pollutants. In addition, data collected by the State Water Resources Control Board shows that 78 percent of San Diego streams are in poor to very poor biological condition based on the health of their stream invertebrate communities*.

* This number reflects the number for the whole of San Diego Regional Board's footprint, which includes portions of Orange County and Riverside County.

San Diego Coastkeeper's Water Quality Monitoring Program

San Diego Coastkeeper protects and restores swimmable, fishable and drinkable waters in San Diego County. Our Water Quality Monitoring Program is just one of the many vital ways that we achieve our mission. Rain or shine, our volunteers collect rigorous, scientifically defendable water quality data every month at nine of our eleven coastal watersheds.

Early in Coastkeeper's history, we determined that regulatory decision-makers did not have sufficient baseline data on the water quality in our creeks and rivers. We began collecting water quality samples in 2000, and we started to fill gaps in our regional water quality dataset. Today, our Water Quality Monitoring Program is one of the largest volunteer water monitoring programs in the state.

Coastkeeper's Water Quality Monitoring Program's three primary goals are: to produce high quality data on the status of the inland waters of San Diego County; to disseminate this data to decision-makers; and to train local community members about water quality monitoring.

Coastkeeper trains more than 85 new volunteers a year and samples from 40 locations. Our program relies on the passion and expertise of partner organizations and volunteers.

We gather data on a range of chemicals and other indicators that can tell us about our creeks' health. We test for basic measurements like temperature, dissolved oxygen, pH, and conductivity. In addition, we process water samples for nutrients (nitrogen and phosphorus), metals (aluminum, cadmium, chromium, copper, lead, and zinc), bacteria and toxicity. When concentrations of any of these constituents are above water quality standards, it indicates there are problems in the watershed that can potentially harm wildlife or humans.

Figure 2. Coastkeeper monitoring locations

State agencies approved Coastkeeper's standard operating procedure. We follow a rigorous quality assurance and quality control plan to ensure that our data is high quality and defendable.

We also collect data on trash in creeks and the diversity of stream invertebrates, which indicates the biological impacts of urban runoff on creek ecosystems.

Trash is a major pollution concern in our region. Coastkeeper collects data on trash in our creeks and on our beaches as part of our Water Quality Monitoring Program and as part of our Marine Debris program. We work with local partners like Surfrider, San Diego Chapter and I Love a Clean San Diego to remove trash around the county, including our twice-monthly beach cleanups and the annual Coastal Cleanup Day. Like our water

quality program, we rely on volunteers to help collect, dispose, and document the type and amount of trash.

Vision for the State of Our Watersheds Report
Coastkeeper believes that by actively engaging our community members in learning about our watersheds, we can achieve better stewardship of the amazing natural resources in San Diego. We seek to transform our volunteers' passion for the environment into knowledge and action. It is our hope that this watershed report will be one step on that path. The goal of this report is to inform community groups and local decision-makers about Coastkeeper's monitoring program and the water quality in their watershed of interest.

Photo Credit: Jackie Loza

References
1. Tiefenthaler, L.L., Stein, E.D. & Schiff, K.C. Watershed and land use-based sources of trace metals in urban storm water. Environmental toxicology and chemistry / SETAC 27, 277-87 (2008).

2. White, M.D. & Greer, K.A. The effects of watershed urbanization on the stream hydrology and riparian vegetation of Los Peñasquitos Creek, California. Landscape and Urban Planning 74, 125-138 (2006).

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POLICIES TO PROTECT & RESTORE WATER QUALITY

The Clean Water Act is the main law that keeps our waters clean. Its goal is to restore and maintain the chemical, physical and biological integrity of the nation's waters. It prohibits pollution in navigable waters and sets water quality goals to protect wildlife, humans and human activities.

To achieve these goals, the United States Environmental Protection Agency developed water quality standards. These standards translate the goals into waterbody-specific objectives and that take into account: designated beneficial uses, water quality criteria and antidegradation policies. Once regulators establish water quality standards, they are included in a region's Basin Plan. Coastkeeper uses these values to evaluate our water quality monitoring data.

Every two years, states must gather all available data to assess the health of water bodies. After assessing the data, regulators (in our case, the Regional Water Quality Control Board) consider any stretch of creek, river, lagoon, bay or coast as officially polluted or 'impaired' if it fails to meet water quality standards. Regulators place these polluted waters on an 'impaired waters list', also known as the 303(d) list (in reference to the relevant Clean Water Act section).

Unfortunately, many of our waters appear on the polluted waters list. To address these problems, we must restore impaired waters. This often (but not always) takes the form of a Total Maximum Daily Load (TMDL) plan. This plan calculates the maximum amount of a given pollutant that may be put into the water without exceeding water quality standards – essentially a pollution diet.

COASTKEEPER'S WATER QUALITY INDEX

Is my creek healthy? On the surface, this simple question should have an easy answer. But in reality, it is a deeply complex question. Coastkeeper volunteers measure 17 different indicators. Examining each one of those indicators separately makes it hard to understand the health of a particular creek. We sought to consistently and clearly summarize what our data tells us about our watersheds. This goal set the basis for our Water Quality Index.

How is water quality calculated? At Coastkeeper, we understand that people want a clear picture of what happens in their water. To get this clear picture, we modified an existing water quality index created for the Federal Government of Canada, Ministry of the Environment, and adopted by the United Nations Environment Program[1]. To calculate the index, we examine how many measurements exceed water quality standards and by how much a measurement exceeds those standards (the frequency and amplitude of exceedances). Together, these two pieces of information provide a single number from one to 100 that is the basis for ranking watershed health.

Coastkeeper's water quality index (WQI) is not meant to replace a detailed analysis of monitoring data, nor do we expect it to be the main tool for management of water bodies. It does provide a broad overview of environmental health. That is why we also provide more detailed data for individual indicators in this report, so readers interested can pinpoint particular trends.

Our WQI is based solely on the data we collect. We included pH, dissolved oxygen, metals, two forms of nitrogen, total phosphorus, and two types of fecal indicator bacteria in our index. Some watersheds may perform worse (or better) if different or additional indicators were added to our WQI. For example, the Regional Water Board designated Los Peñasquitos Creek as impaired by sediment. Since we do not measure sediment, our index will not reflect the problems this watershed faces with this pollutant.

The Water Quality Index scores ranged from a high of 81.9 in Los Peñasquitos watershed to a low of 27.1 in the Tijuana River watershed, with most watersheds falling into the 'fair' category. No San Diego watershed ranked 'excellent'. (WQI of 95-100).

Excellent (WQI 100-84): Unfortunately, no watersheds were found to be in excellent condition.

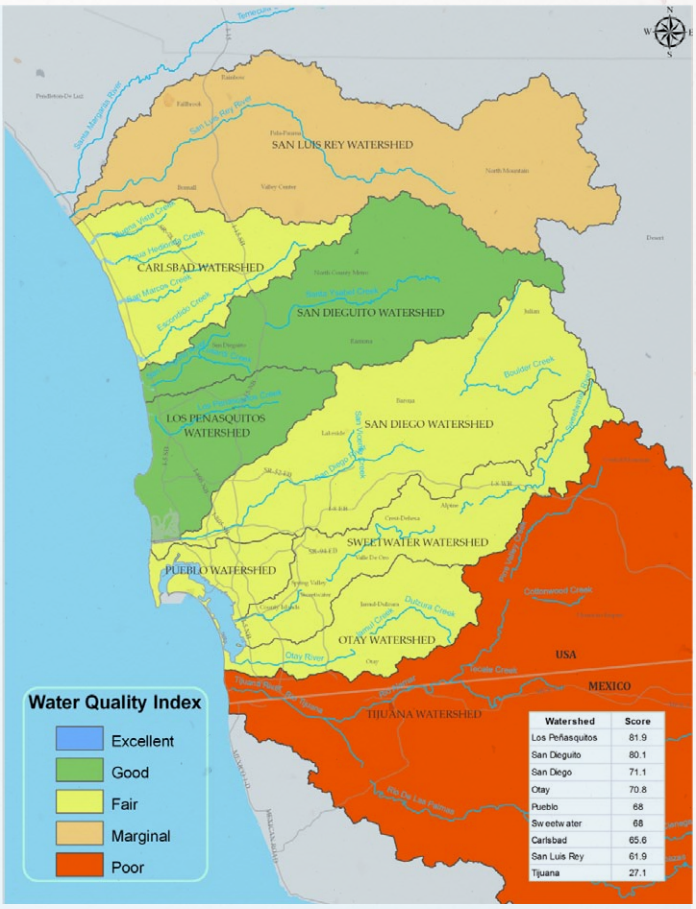
Good (WQI 80—94): The San Dieguito watershed was the only one of our watersheds that fell into the "good" category. While this watershed fared better than others, it still showed signs of some water quality problems. Most indicators had only a few exceedances. However, The San Dieguito watershed consistently had low level problems with Enterococcus (a fecal indicator bacterium), ammonia (a form of nitrogen) and phosphorus.

Fair (WQI 65—79): The vast majority of our watersheds fell into the fair category. San Diego, Los Penasquitos, Carlsbad, Pueblo, Otay, San Luis Rey and Sweetwater watersheds consistently exceeded regulatory thresholds for two or more indicators. For example, about two-thirds of the nitrate, phosphorus and Enterococcus samples that were taken during 2009-2010 in the Carlsbad Watershed exceeded thresholds. This pattern repeated itself across all 'fair' watersheds, one-third to two-thirds of the samples exceeded thresholds for two or more indicators.

Marginal (WQI 45—64): No watersheds were found to be in Marginal condition.

Poor (WQI 0—44): The Tijuana River watershed had exceedances in all the indicator categories except metals. The Tijuana River samples had the highest concentrations of ammonia, nitrates, phosphorus, and bacteria in the whole county. The overall greater magnitude of exceedances led to the Tijuana River samples categorized as "poor" by the index.

The following four chapters present detailed case studies of four watersheds in San Diego County -- in the north, mid-north, central and south counties. For additional information on data for each watershed, visit Coastkeeper's website.



Watershed	Score
Los Peñasquitos	81.9
San Dieguito	80.1
San Diego	71.1
Otay	70.8
Pueblo	68
Sweetwater	68
Carlsbad	65.6
San Luis Rey	61.9
Tijuana	27.1

Figure 3. Water Quality Index (WQI) scores

MID COUNTY: LOS PEÑASQUITOS WATERSHED

The Los Peñasquitos watershed runs from Poway to Torrey Pines State Park and south to Mission Beach (including Clairemont, La Jolla, Carmel Valley, Scripps Ranch and Pacific Beach). Highly urbanized with buildings, roads and concrete, this watershed's urban runoff drains to either the Los Peñasquitos Lagoon or Mission Bay. Both of these fragile water systems support diverse native fauna and flora. Peñasquitos means "little cliffs" and references the large open space in its canyons, where we now enjoy hiking, biking and riding horses.

Coastkeeper monitors water quality at seven sites in the watershed, three sampling sites measure water flowing into the Peñasquitos lagoon and four into Mission Bay. The 2009-2010 dataset for Rose Creek, which flows into Mission Bay, monitored water in the storm drain conveyance system and not water from the creek. Because of this difference, we will not discuss the Mission Bay sub-watershed in this report.

Coastkeeper's monitoring results
The Los Peñasquitos watershed ranked "fair" for the 2009-2010 monitoring seasons, earning a score of 78.3.

In general we found:

- **Healthy levels of dissolved oxygen, pH, and temperature** – basic water indicators of health. Most of our sites did have higher than normal levels of electrical conductivity, especially during the dry season. This indicated that the dry weather flows potentially transport too much of something that carries an electrical charge like detergents or salts.

- **Very low concentrations of dissolved metals.** Only one sample slightly exceeded basin plan standards (cadmium in October at Carmel Creek). 99.2% of total samples were below basin plan standards.Ð

- **Low indications of potential toxicity.** Only one sample each in Soledad Creek and Carmel Creek showed some potential toxicity in the sample. Both of these events occurred during the 2009-2010 rainy season. These data suggest that the low aquatic invertebrate scores found by other agencies are driven by sedimentation and habitat degradation, and not necessarily toxic water.

Photo credit: Jackie Loza

- **Slightly elevated ammonia and phosphorus concentrations.** Almost every sample taken showed ammonia and phosphorus levels at or slightly above the basin plan thresholds. Nutrient sampling at the Los Peñasquitos sites did not begin until February of 2010, so it is difficult to infer trends from our current data set.

- **Generally low *E. coli* concentrations.** For most of the monitoring period, the Peñasquitos sites had low *E. coli* concentrations, with 100% of samples meeting regulatory thresholds during the dry season. Compared to most of the region, the wet season had few samples that exceeded the threshold.

Coastkeeper developed an index that distills all of the water quality indicators we measure into one easy-to-understand metric that communicates the overall health of a watershed.

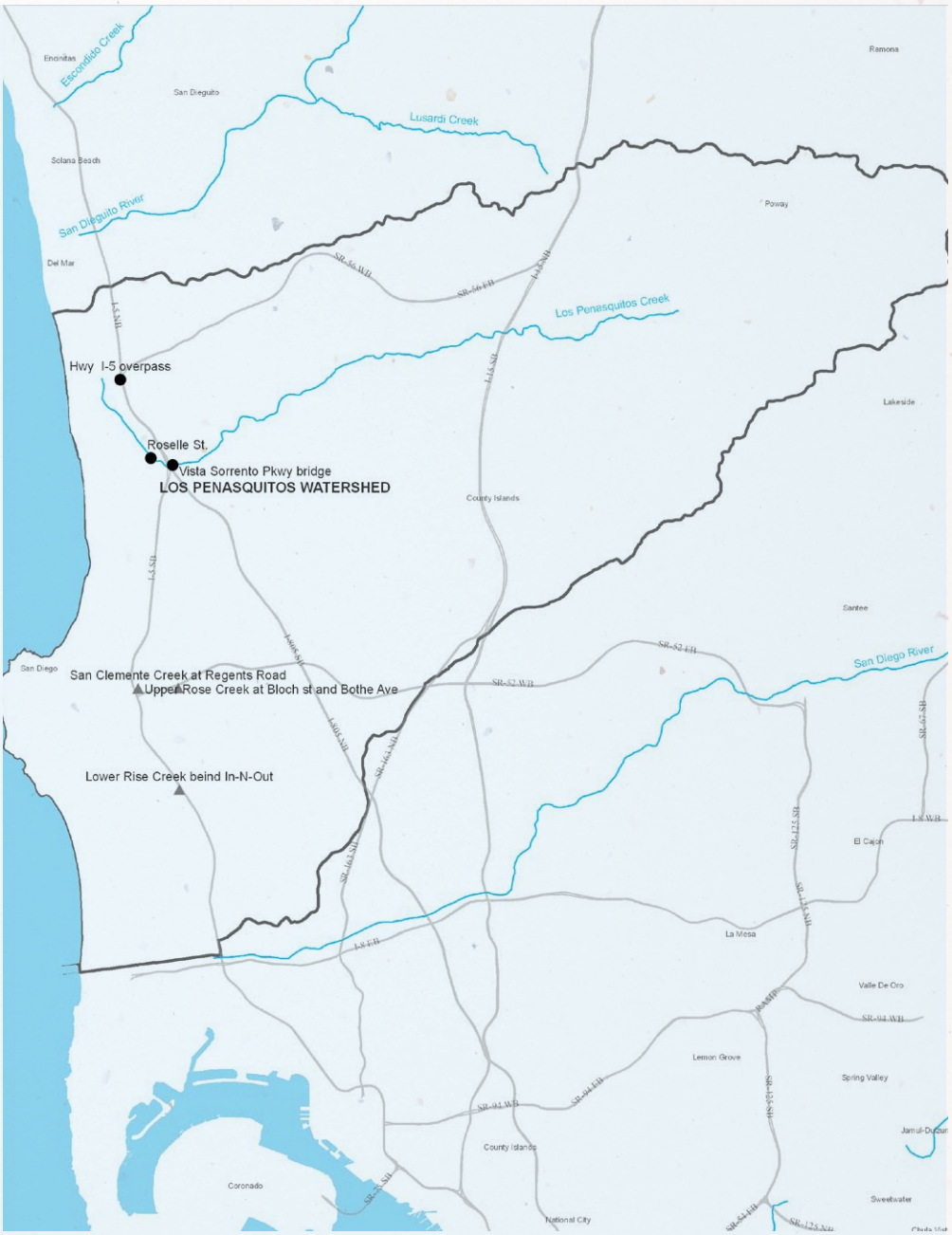


Figure 4. The Los Peñasquitos watershed

- **Moderate Levels of Enterococcus.** Over 50% of the samples had levels of Enterococcus that were above the safe level thresholds. Unlike *E. coli*, these results are not heavily tied to the wet or dry season; exceedances are spread through the whole year. 100% of the samples for Los Peñasquitos creek had Enterococcus levels that were above safe levels, both during the wet and dry seasons. This is a shorter data set, not starting until June of 2010, so it is difficult to infer trends.

LOS PEÑASQUITOS WATERSHED

The Los Peñasquitos watershed comprise two separate and distinct drainages: the Los Peñasquitos Creek watershed, which drains into the Los Peñasquitos lagoon and the Mission Bay watershed, which drains into Mission Bay. The combined watershed lies almost entirely west of Interstate 15, and comprises a rough triangle between parts of Del Mar, Mission Bay and Poway.

The Los Peñasquitos Creek Watershed covers roughly 100 square miles. The watershed drains an area that stretches from Poway in the upper reaches down to the Los Peñasquitos lagoon in Del Mar. The watershed has three major streams: Carmel Creek to the north, Los Peñasquitos Creek in the middle and Soledad Creek in the southern portions of the watershed. Soledad Creek is also often referred to as Carroll Canyon Creek.

The Mission Bay watershed comprises Rose Creek, San Clemente Creek and Tecolote Creek. These waters drain roughly 80 square miles of land into Mission Bay. Rose Creek and San Clemente creek get their start near the Marine Corps Air Station, Miramar. Approximately half of the length of these streams is in the relatively undeveloped air base. Until 2011, the Rose Creek sites were located in storm drain conveyance systems, and not in the creek itself. This makes the data incomparable to other sampling locations in the creek, and so it won't be discussed in this report.

Types and sources of water pollution in Los Peñasquitos watershed

For more than 50 years, the Los Peñasquitos watershed has experienced rapid urbanization. Between 1966 and 1999, the percentage of urbanized land has risen from 9% to 37% of total watershed area[1]. This development has increased the number of hard, nonporous surfaces such as roads, parking lots and driveways. These expanding areas of impermeable surfaces reduce the amount of water that soaks into the ground, delivering more water into the creeks. From 1973 to 2000, runoff into the creek increased by 200%, or about four percent per year[1]. This water picks up pollutants such as nutrients from fertilizer and metals from road surfaces as it flows across the developed areas. In this watershed, dry weather urban runoff (overwatering, for example) increases the total nitrogen, total phosphorus and fecal indicator bacteria problems in the creeks[2].

Monitoring done by governmental jurisdictions in the watershed shows high levels of total dissolved solids and fecal indicator bacteria during both the wet and dry seasons[3]. Both of these constituents are symptoms of over-irrigation and other urban runoff sources. The storm drain system has been shown to contribute to the elevated levels of total nitrogen, total phosphorus and fecal indicator bacteria to the streams in the watershed[2]. The invertebrates that make up the base of the food web show significant signs of impairment[2]. The water has also been shown to be toxic to a type of water flea, *Ceriodaphnia dubia*, which is a common indicator of water toxicity[2].

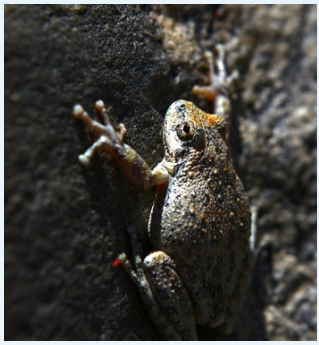


Photo credit: Shannon Switzer

The California Treefrog (*Pseudacris cadaverina*) makes its home in the Los Penasquitos Lagoon. This small 1-2 inch frog blends in with its background to avoid predators. When in danger, the frog takes refuge under water.

The Regional Water Quality Control Board identified excessive sediments as a major problem in the Los Peñasquitos Lagoon[4]. The deposition and build up of sediments into the lagoon alters the natural exchange of freshwater and seawater. This has led to the destruction of sensitive saltmarsh habitat. As a result of this habitat degradation, invasive plants and animals are replacing the sensitive native flora and fauna of the lagoon.

Coastkeeper volunteer conducting water quality sampling in the Los Peñasquitos watershed

Photo credit: Shannon Switzer

The State Park rangers in the Los Penasquitos lagoon plant native Mulefat (*Baccharis salicifolia)* in the upland area of the lagoon. This woody perennial blooms from April to October and can grow up to 12 feet in height.

How are regulators making the creek cleaner?
Federal and state water quality regulators require cities to control and reduce pollutants in a watershed. To achieve this, they must implement a variety of programs including best management practices like street sweeping, water quality monitoring, education programs, and other special pilot projects. The Regional Water Quality Control Board lays out these requirements in a municipal storm water permit. When pollution becomes too high in a body of water, regulators consider it officially "impaired". For these impaired waters, regulators must write a cleanup plan to reduce the total amount of pollutants entering the water.

The Regional Water Quality Control Board is currently finalizing the cleanup plan for sedimentation in the lagoon, which will reduce the sedimentation to the pre-1970's rate and increase the amount of saltmarsh habitats[4]. This reduction is scheduled to happen 10 years from the date of implementation.

The governmental jurisdictions in the watershed also concentrate on reducing pollutants through education activities that seek to reduce the amount of urban runoff into the creeks. The governmental jurisdictions also engage in residential water conservation outreach and planning for low impact development.

LOS PEÑASQUITOS CLEANUP PLAN

The San Diego Water Board works with responsible parties within the Los Peñasquitos watershed to develop a sediment cleanup plan, known as a Total Maximum Daily Loading plan (TMDL), for Los Peñasquitos Lagoon. The TMDL establishes targets for sediment transport into the Lagoon and preservation of habitat acreage. The TMDL also establishes an implementation plan, which takes an adaptive management approach that allows regulators and stakeholders to improve the understanding of the Lagoon through research and monitoring of the Lagoons.

Cathryn Henning
Water Resource Control Engineer
San Diego Regional Water Quality Control Board

Where do Coastkeeper's volunteers monitor?
Coastkeeper currently monitors at seven sites in the Los Peñasquitos watershed.

Three sites are located in the Los Peñasquitos drainage area:

- Carmel Creek at Sorrento Valley Road and I-5,
- Soledad west of I-5 at Estuary Way and
- Peñasquitos Creek east of I-5 at Vista Sorrento Parkway.

The Soledad creek site is located after it meets up with Los Peñasquitos Creek. This arrangement allows us to separate the water quality effects of the more urbanized Soledad Creek from the less developed Los Peñasquitos Creek.

We monitor four additional sites in the Mission Bay watershed. Until 2011, we monitored these sites in storm drain channels leading into Rose Creek. Since the monitoring is outside of the main channel of the creek, we omitted this data from this report. In February of 2011, we moved these sites into the main channel, but we have not collected enough data to make inferences on the water quality of the creek.

LOS PEÑASQUITOS LAGOON

Part of the Torrey Pines State Reserve, Los Peñasquitos Lagoon is a 252-hectare estuary that receives drainage from a 239-square-kilometer watershed. The State gives it the highest level of protection through its designation as a Marsh Natural Preserve, as it is one of few remaining salt marshes in the Southern California. The lagoon houses several state and federally listed species and critical habitats needed to support them and serves as an important refuge for migratory birds following the Pacific Flyway. It is the closest coastal lagoon to the only Areas of Special Biological Significance located within San Diego County. Urbanization greatly impacts Los Peñasquitos Lagoon and state agencies currently list it as an impaired water body in the Clean Water Act Section 303(d). Learn more about the Los Peñasquitos Lagoon at *penasquitos.org*

- Mike Hastings, Los Penasquitos Lagoon Foundation

BASIC INDICATORS

Key Trends in Coastkeeper dataset:

- Dissolved oxygen was at healthy levels for all but three samples. Soledad creek in January 2009 and Peñasquitos creek in August 2010 had values just under the threshold (4.43 and 4.41 mg/L, respectively).

- pH levels were consistently within the normal ranges (6.5-8.5)*.

- There is currently no threshold for conductivity in San Diego, but according to the State Water Resources Control Board, freshwater streams should typically be in the 100 to 2000 μS/cm range[5]. Values in this range only occurred during February and December of 2010 (both during rainy seasons). Conductivity, or the ability to pass an electric current in water, can be raised by the addition of dissolved solids as well as industrial or municipal runoff*.

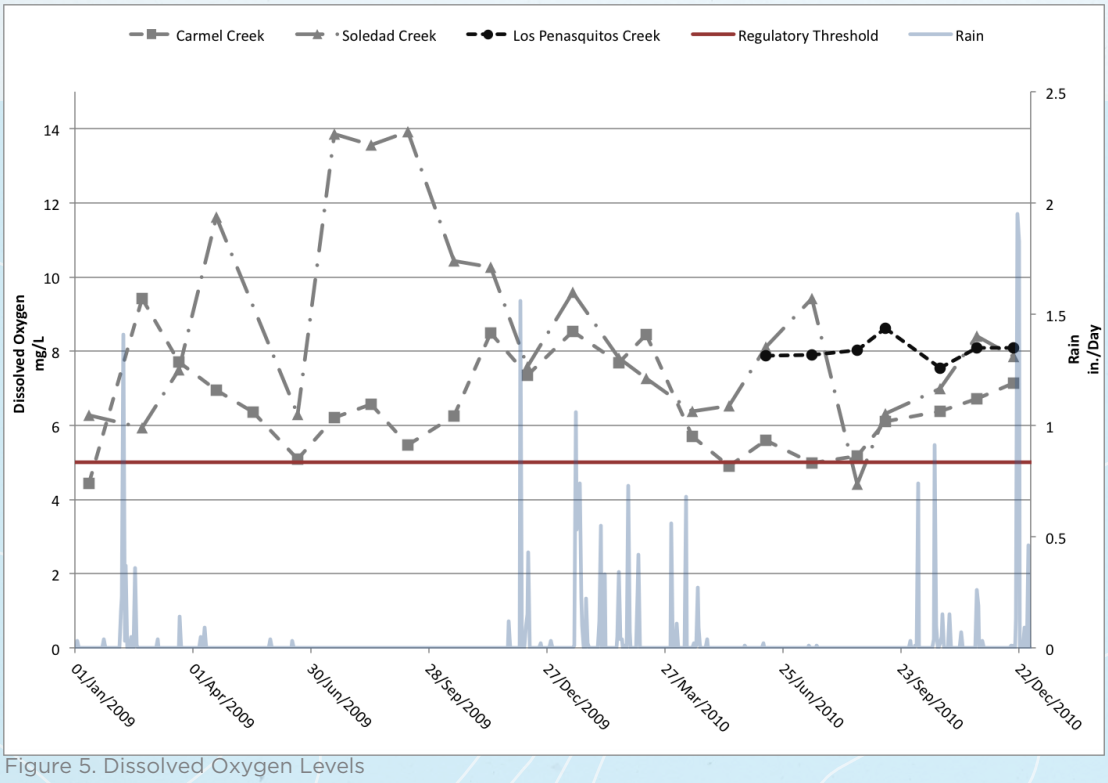


Figure 5. Dissolved Oxygen Levels

What are basic indicators? Coastkeeper measures four types of basic indicators: dissolved oxygen, temperature, pH and conductivity.

* Data not displayed

NUTRIENTS—NITRATES

Key Trends in Coastkeeper dataset:

- 2010 nitrate levels are consistently below regulatory threshold.
- Peñasquitos Creek and Soledad Creek experienced a slight increase in concentrations during the 2010-2011 rainy season.
- Carmel Creek experienced a slight increase in nitrate concentration approximately one month after the last of the 2009-2010 rains.

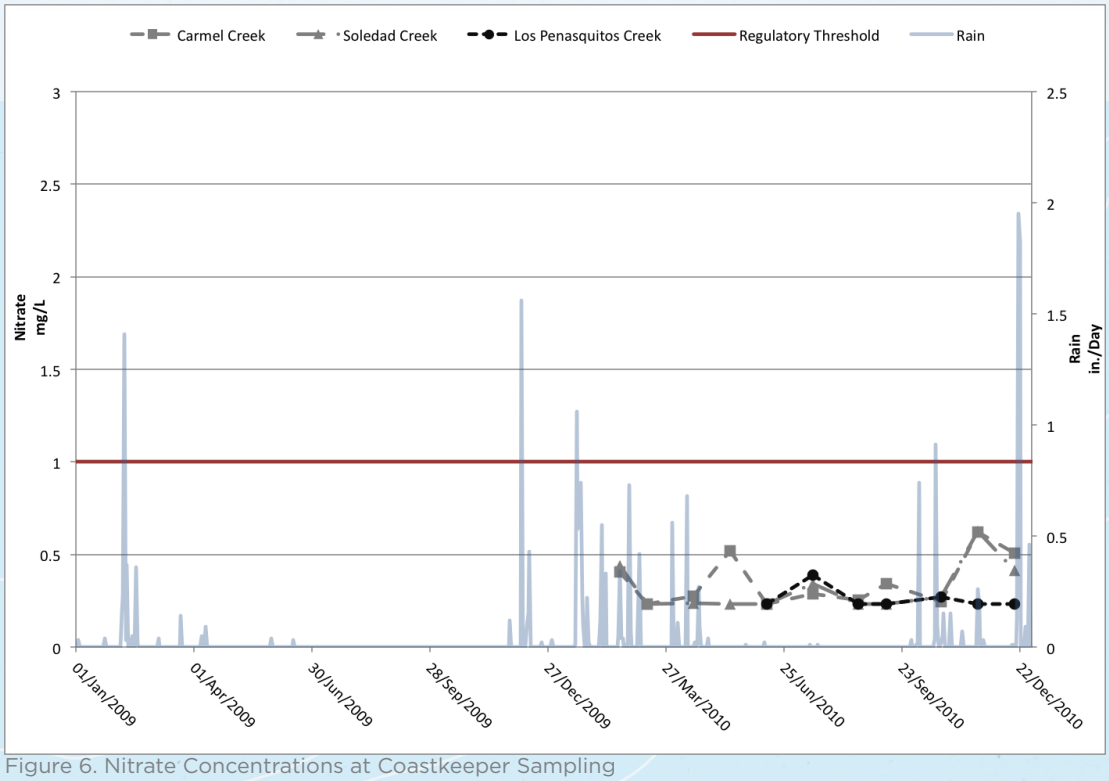


Figure 6. Nitrate Concentrations at Coastkeeper Sampling Sites

What are nitrates? Nitrates are a form of nitrogen found in soil and water and are essential for plant growth. At high concentration nitrates can be toxic to wildlife or cause excessive growth of photosynthetic organisms.

NUTRIENTS - AMMONIA

Key Trends in Coastkeeper dataset:

- Coastkeeper began measuring ammonia in February 2010.
- Peñasquitos Creek has ammonia values at or slightly above basin plan thresholds. Ammonia concentrations in Soledad Creek are approximately twice as high as in Peñasquitos Creek indicating ongoing problems in the creek
- Ammonia concentrations in Soledad Creek and Peñasquitos Creek west of I-5 spiked in November 2010. This spike is consistent with the spike in nitrate levels and is seen across the San Diego region. Interestingly, Peñasquitos creek east of I-5 does not show these spikes, indicating a highly localized source.

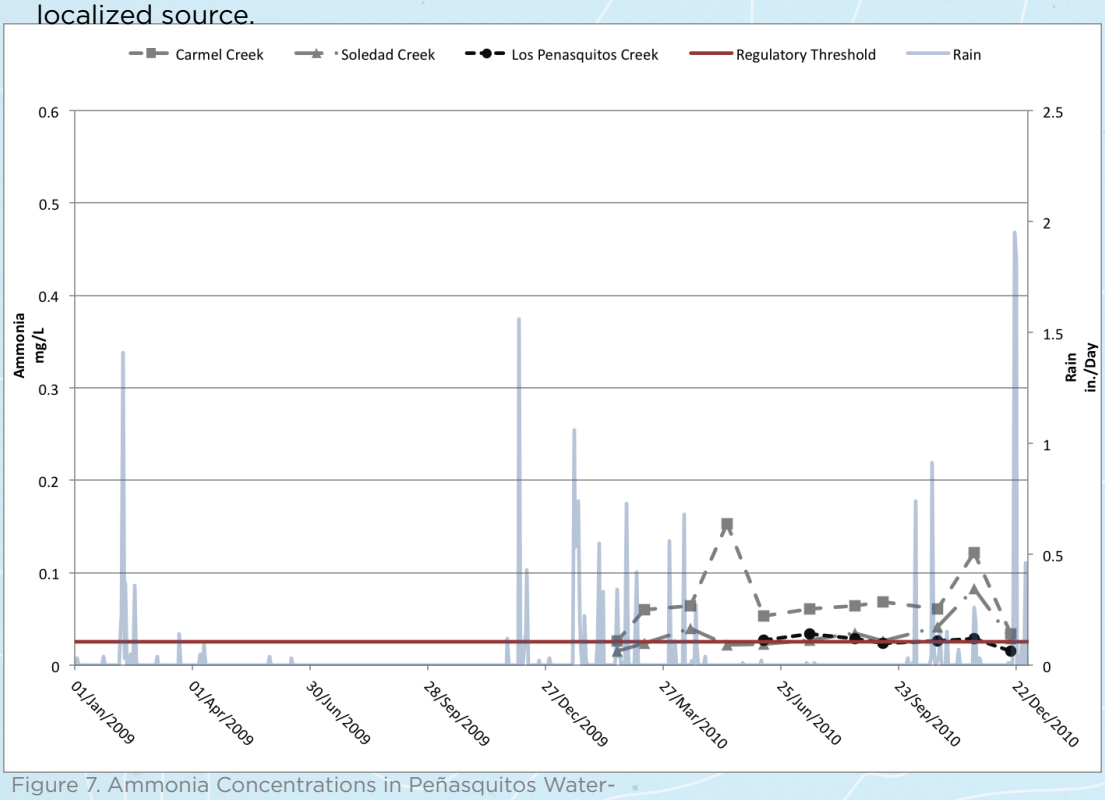


Figure 7. Ammonia Concentrations in Peñasquitos Watershed

What is ammonia? Like nitrate, ammonia is another important part of the nitrogen cycle in ecosystems. It is a by-product of the metabolism of aquatic animals and is eventually converted into nitrate by bacteria. Manufacturers widely use it in fertilizers, household and industrial cleaners, plastics and explosives. Ammonia is toxic to most aquatic life, especially at high pH.

NUTRIENTS - PHOSPHATE

Key Trends in Coastkeeper dataset:

- Peñasquitos and Soledad Creek samples were generally at or slightly above the basin plan standards.
- All phosphate samples in Carmel Creek except July of 2010 exceeded regulatory thresholds.
- Unlike in other regions in San Diego, the phosphorus concentrations do not spike in November 2010.

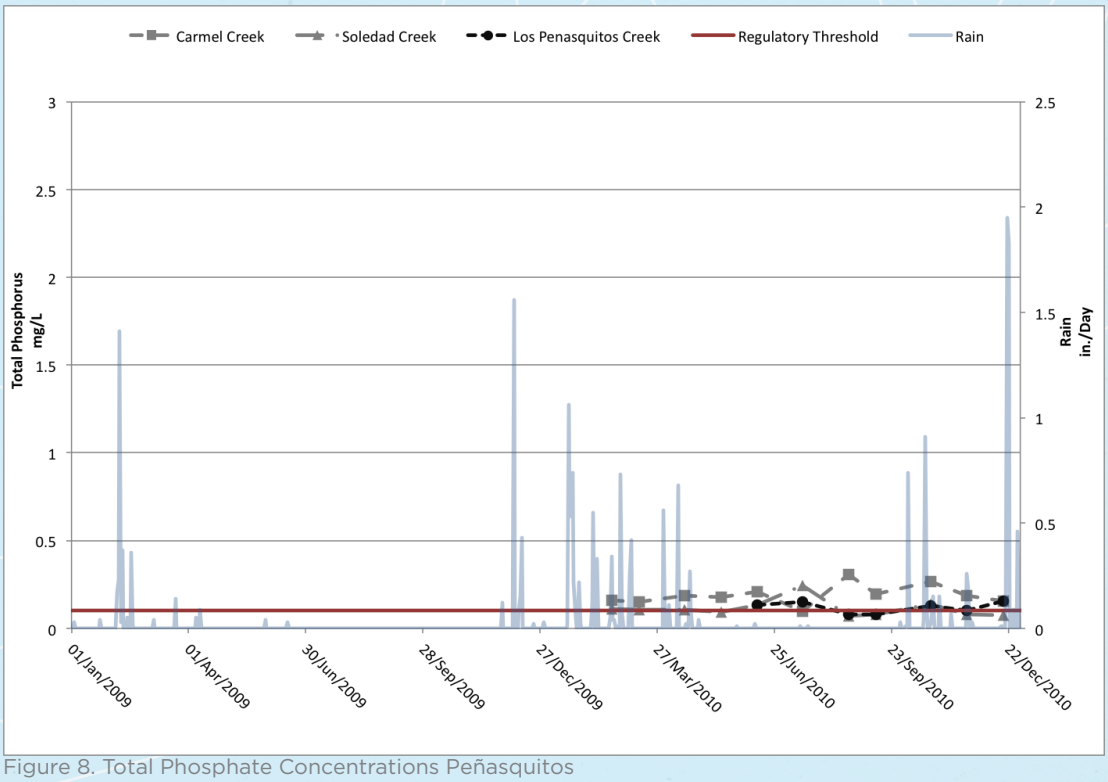


Figure 8. Total Phosphate Concentrations Peñasquitos Watershed

What is phosphate? Phosphate is a nutrient essential for plant growth and is one of the building blocks of DNA. It is the most biologically important form of phosphorus for aquatic systems. Too much phosphorus in water can cause rapid algal growth, called blooms or eutrophication, which can lead to decreased oxygen levels in creek water. In some instances this can cause fish kills or prevent other animals from thriving. It is commonly used in fertilizers. Other sources of phosphorus include human and animal waste (i.e., sewage), industrial wastes and soil erosion.

FECAL INDICATOR BACTERIA – ENTEROCOCCUS & COLIFORM

Key Trends in Coastkeeper dataset:

- With the exception of two spikes during the rainy season, *E coli* levels were below Basin Plan thresholds.
- Total coliform concentrations were generally high throughout 2009 and during the 2010-2011 rainy season. The concentrations were somewhat lower during the 2010 dry season*.
- Every sample collected in 2010 in Peñasquitos Creek exceeded Enterococcus regulatory thresholds, with an increase happening during the rainy season. Peñasquitos Creek west of I-5 shows elevated levels of Enterococcus concentrations during the rainy season.
- 71% of the samples from Carmel Creek exceeded Enterococcus regulatory thresholds. There does not appear to be a strong association with rain.

What are fecal indicator bacteria? Fecal indicator bacteria are an indication of whether pathogens that can cause human illness are present in water. Coastkeeper measures three forms: Enterococcus, *E. coli*, and total coliform bacteria. *E. coli* is generally considered the best metric for evaluating freshwater. These bacteria and their associated pathogens can come from any warm-blooded animal such as the family dog, wild birds or humans. This poses significant management challenges as the source can be difficult to pinpoint.

* Data not shown

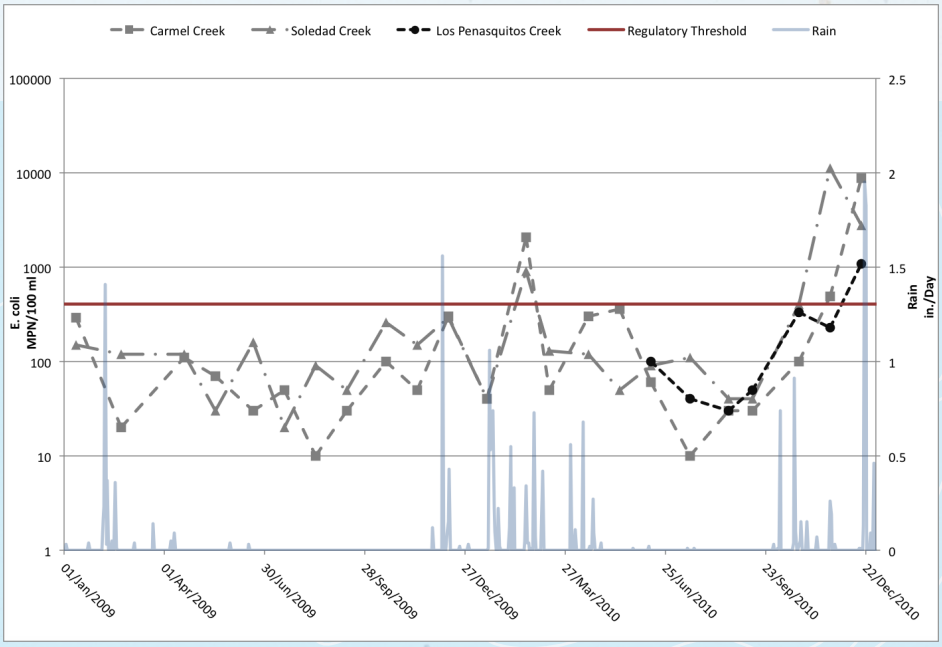


Figure 9. *E. coli* concentrations in 2009 and 2010

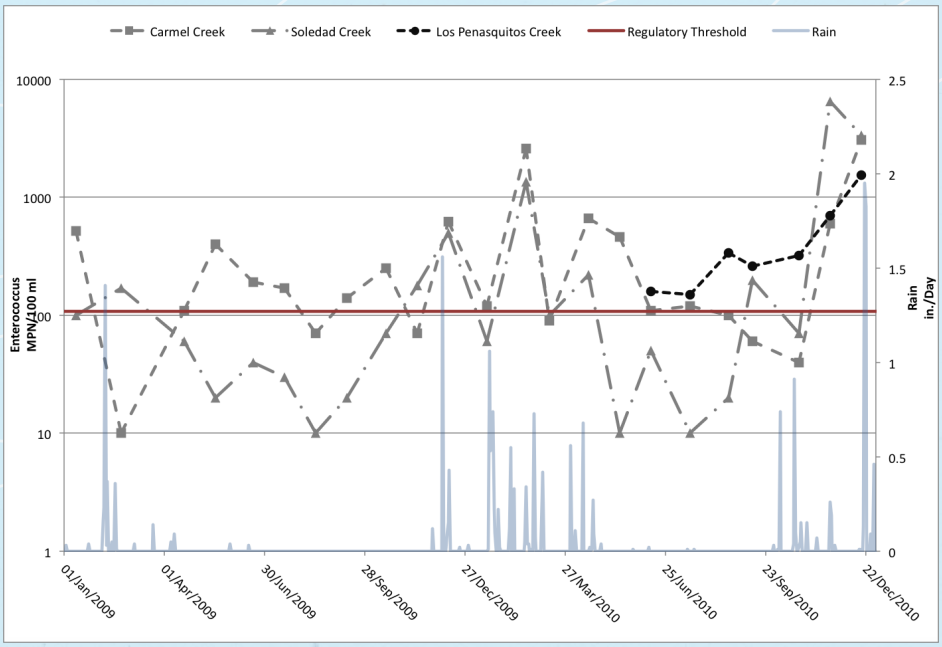


Figure 10. Enterococcus concentrations in 2009 and 2010

TOXICITY

Key Trends in Coastkeeper dataset:

- During the 2010 rainy season, both Carmel and Soledad Creeks had a sample that showed some indications of harmful toxicants in the system.
- Most of the samples show no evidence of harmful levels of toxins in the sample.

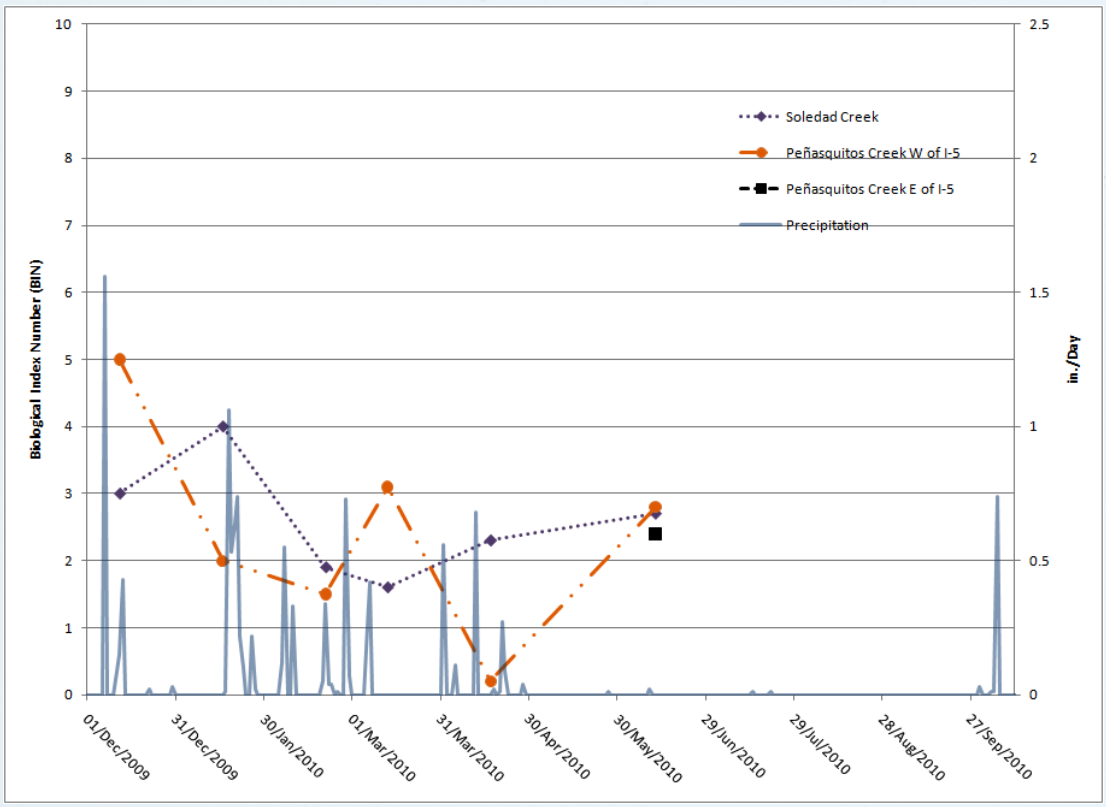


Figure 11. Toxicity

What is toxicity? Toxicity is the degree to which any substance can cause harm to humans or other organisms[6]. Through our partnership with Assure Controls, Coastkeeper relies on a rapid toxicity test to screen for toxicity in our creeks. It measures the ability of a single-celled marine organism (dinoflagellate) to produce light (bioluminescence) after exposure to any harmful substance that might be present in our water sample. The lower the level of light indicates the plankton are severely stressed or have died from toxic exposure. To screen for toxicity, this test categorizes results into 'bins' (also known as a Biological Index Number) based on the amount of light reduction. Zero to three is considered a normal response with no toxic effect detected, four to six is a cause of concern or needs further review and seven to ten is a toxic event.

DISSOLVED METALS

Key Trends in Coastkeeper dataset:

- Metal concentrations in the Los Penasquitos watershed are generally very low.
- October 2010 had a spike in copper concentrations, but this value is still lower than the 80 μg/L basin plan threshold ‡.
- Only one sample had a slight exceedence of regulatory standards (cadmium in October at Carmel Creek). In general, Soledad Creek at Estuary Way had the highest dissolved metals concentrations in the watershed. However, these concentrations only slightly exceeded thresholds.

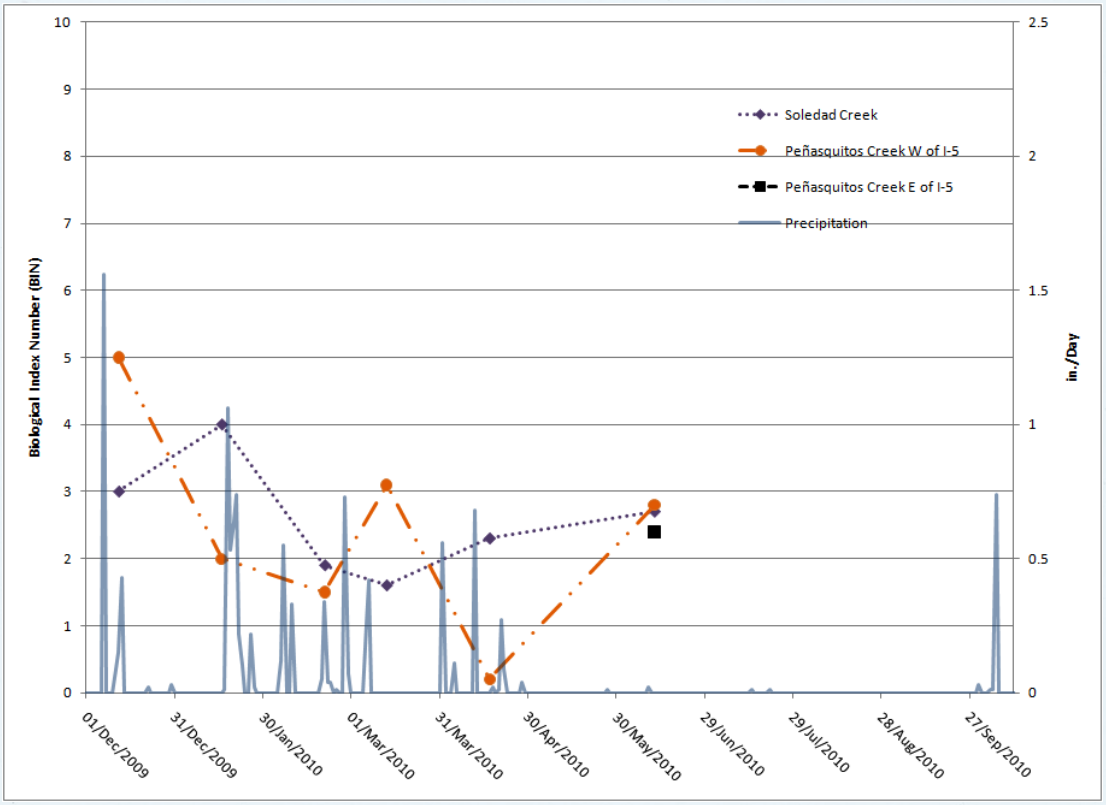


Figure 12. Metals

What are dissolved metals? Dissolved metals can cause a wide range of negative impacts to aquatic organisms in creeks and the waters that they drain to—they can reduce growth, harm reproduction and, in high enough concentrations, can cause death. Urban runoff is a major conduit of metals into the creek. Higher concentrations of metals tend to originate in areas with more industrial and commercial activities, and dissolved metal concentrations tend to peak with the first flush of a rain storm.

‡ Regulatory Thresholds (Basin Plan Standards) for dissolved metals are as follows: Cadmium:>2.0 g/L; Chromium >16 µg/L; Copper >80 µg/L; Lead >65 µg/L; Nickel>470 µg/L; Zinc >120 µg/L

TRASH

Key Trends in Coastkeeper dataset:

- Coastkeeper volunteers collected over 12,000 lbs of trash this reporting period.
- In 2010, volunteers cleaned up more sites than in 2009, explaining why 2010 trash levels are higher.

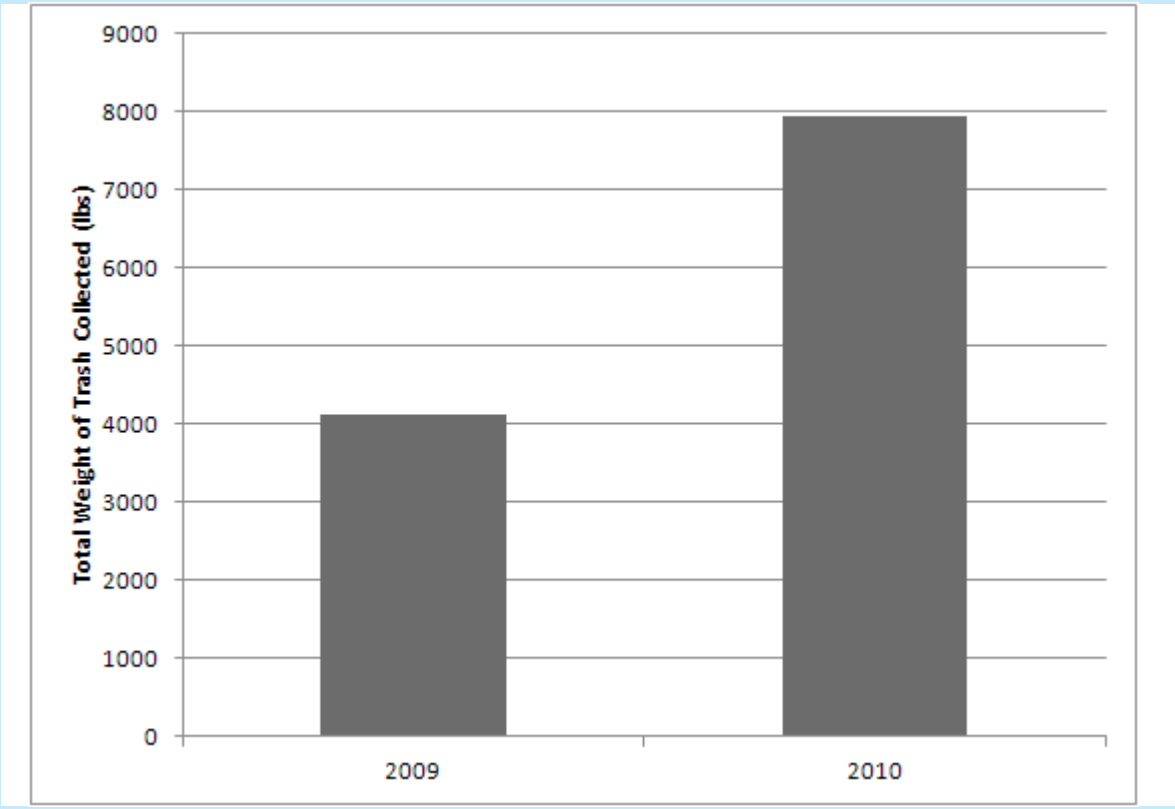


Figure 13. Total Trash Collected

ANNUAL TOTALS	2009	2010
Number of Sites	8	14
Miles Cleaned	21	32
Number of Volunteers	1607	2068

Figure 14.

What is trash? In addition to being unsightly, trash can harbor pathogens, degrade wildlife habitat and contribute to flooding problems in creeks. Animals can ingest trash or become entangled in it, and it can eventually flow from our creeks to our beaches and the ocean.

IN ADDITION TO BEING UNSIGHTLY, TRASH CAN HARBOR PATHOGENS, DEGRADE WILDLIFE HABITAT AND CONTRIBUTE TO FLOODING PROBLEMS IN CREEKS. ANIMALS CAN INGEST TRASH OR BECOME ENTANGLED IN IT. TRASH CAN EVENTUALLY FLOW FROM OUR CREEKS TO OUR BEACHES AND THE OCEAN.

Photo credit: Shannon Switzer

Photo credit: Shannon Switzer

RESOURCES AND REFERENCES

1. White, M.D. & Greer, K.A. The effects of watershed urbanization on the stream hydrology and riparian vegetation of Los Peñasquitos Creek, California. *Landscape and Urban Planning* **74**, 125-138 (2006).

2. *Los Peñasquitos Watershed Urban Runoff Management Program - Fiscal Year 2009 Annual Report. Area* (2010).

3. Copermittees, L.P.W. *Los Peñasquitos Watershed Urban Runoff Management Program. Fiscal Year 2008 Annual Report.* (2009).

4. *Draft Sediment TMDL for Los Peñasquitos Lagoon. Quality* (2011).

5. Clean Water Team Electrical Conductivity/Salinity Fact Sheet. Fact Sheet 3.1.3.0. The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment 0, 2-6 (2004).

6. Miller, G. WordNet: a lexical database for English. Communications of the ACM 38, 39-41 (1995).

CENTRAL COUNTY: PUEBLO WATERSHED

San Diego's smallest watershed, Pueblo Watershed consists of three smaller sub-watersheds: Paleta Creek, Switzer Creek and Chollas Creek. It leads the region for population density and hosts a broad range of local sources of pollution including high-density residential neighborhoods, commercial areas and many light to heavy industrial areas.

Coastkeeper monitors water quality at three stations in Chollas Creek. San Diego's long dry season means many of our sites are dry for much of the year. For this report, we focus on our site at Federal Boulevard as it has flow for most of the year and thus our most continuous dataset.

Coastkeeper's monitoring results
The 2009-2010 monitoring seasons revealed water quality in Chollas Creek is in fair condition, earning a score of 71.7 on Coastkeeper's water quality index. Coastkeeper's data confirm that during the rainy season, we find more water quality problems than during the dry season.

In general we found:

- **Healthy levels of dissolved oxygen, pH and temperature — basic indicators of water quality health.** We did frequently measure higher than normal levels of conductivity (how much electric current can pass through water). This indicates that there is potentially too much of something that can carry an electrical charge, like detergents, metals or dissolved salts in the water.

- **Low dissolved metal concentrations.** All samples were within safe thresholds. It may seem incongruous that Coastkeeper's sampling did not detect any metal concentrations that exceeded regulatory "unsafe" thresholds. This pattern is typical of stream water quality conditions in Southern California – a study of fifteen coastal watersheds in Southern California found that on average, in-stream concentrations did not exceed standards for metals[1]. This pattern changes during wet weather[2].

- **Frequent indications of potential toxicity.** Five of seven samples showed moderate toxicity. Coastkeeper uses Assure Controls rapid toxicity test to screen for the presence of toxicity in our samples. We know that during rain events water in Chollas Creek[2] and at its mouth is toxic[3]. However, storm events tend to create pulses of contaminants that can lead to greater toxicity.

Coastkeeper developed an index that distills all of the water quality indicators we measure into one easy-to-understand metric that communicates the overall health of a watershed. This index ranks Pueblo Watershed water quality over the past year as 'fair'.

Figure 15.

- **High levels of trash.** This pollutant continues to plague Chollas Creek. During Coastal Cleanup Day in 2009 and 2010, nearly 1,300 volunteers removed 70,000 pounds of trash from Chollas Creek (Figure 26).

- **High volunteer engagement.** Our volunteers contributed 350 hours over two years to help keep water cleaner in Chollas Creek (Figure 26).

It's raining, it's pouring—pollution
Water quality tends to worsen when it rains. Storms create pulses of runoff that hold higher concentrations of pollutants. This makes it easier to detect exceedances of thresholds. Coastkeeper's data for Chollas generally confirmed this pattern.

During the rainy season we found:

- Some nutrient concentrations like nitrate and ammonia, spiked during the rainy season. Even though nitrate concentrations increased during the rainy season, nitrate concentrations exceeded safe thresholds only once in November.

- High concentrations of bacteria in Chollas Creek. *E.coli* and Enterococcus concentrations exceeded safe thresholds 30 to 50 percent of the time, with the highest exceedances during the rainy season. While recreation in Chollas Creek is more limited than at local beaches, the frequent exceedances of the Enteroccocus, and to a lesser extent *E. coli*, raise concerns about the risk of exposure to children or other local residents who may be using the creek for recreation. Local regulatory agencies have put a cleanup plan in place to help reduce the amount of bacteria flowing into Chollas and other creeks and shorelines in the region.

Figure 16. Excess algae growing in Chollas Creek.

When it is dry, we saw:

- Phosphate concentrations were frequently at unhealthy levels. In 2009, phosphate concentrations exceeded safe thresholds 100% of the time.

- Spikes in phosphate concentrations in 2009. Conversely, phosphate concentrations were generally low for all sampling events in 2010. It is currently not clear what was driving this pattern.

Figure 17. Trash at the mouth of Chollas Creek. Credit: NASSCO

PUEBLO WATERSHED AND CHOLLAS CREEK

At roughly 60 square miles, the Pueblo Watershed packs the most urbanization into San Diego County's smallest watershed. Pueblo is roughly nine times smaller than the San Luis Rey watershed – the largest watershed wholly in the County. Pueblo Watershed runs through the heart of the City of San Diego and its boundaries overlap with portions of the City of Lemon Grove, La Mesa and National City.

The Pueblo Watershed comprises three sub-watersheds: Switzer, Paleta and Cholla Creek. Each drains directly into San Diego Bay. The community focuses on management, monitoring, and restoration of Chollas Creek because it has the most water quality and habitat problems. And at 32 square miles, it is also the largest drainage in the Pueblo Watershed.

Chollas Creek starts in Lemon Grove and La Mesa. The majority of the creek flows through the City of San Diego past seven neighborhoods (City Heights, Oak Park, Encanto, Chollas View, Mt. View, Mt. Hope, and Southcrest). Three San Diego Council Districts (Districts 3, 4 and 8) represent these neighborhoods and their 160,000 residents.

Chollas Creek has two main forks, both of which run through the most densely populated part of the city. As a result, we have altered or lost much of its native habitat and natural course. Long stretches of the creek are hardened, straightened or driven underground. Because of this loss, the local communities crafted a vision for restoring some of the former habitat of Chollas Creek. Known as the Chollas Creek Enhancement Plan, this community-driven project describes the vision for restoring habitat in the creek and transforming adjacent open space into useable areas.

Photo credit: Mark Wagner

The coastal sage scrub habitat of the Pueblo watershed is home to the Cactus Wren. It nests among the spines of the Cholla cactus. The Cactus Wren is listed as a threatened species due in part to habitat degradation.

North branch Chollas Creek.

Photo credit: Todd Stands, Groundworks San Diego

Photo credit: Shannon Switzer

There are 800 storm drain outfalls that direct storm water from streets, lawns and bu
This poses formidable challenges for maintaining and managing the water quality an

GROUNDWORK SAN DIEGO-CHOLLAS CREEK

This group leads the Chollas Creek Enhancement Program. Its mission is to bring about the sustained regeneration, improvement and management of the physical environment by developing community-based partnerships and youth stewardship.

The Chollas Creek Watershed lags far behind San Diego's seven other watersheds in all indicators of economic, environmental and public health. Groundwork addresses these environmental justice challenges through recreation and natural area restoration and conservation; stewardship; outdoor education; youth leadership

uildings into Chollas Creek.
d health of the creek.

How does the creek get dirty?

Prior to urban development, native and drought tolerant plants dominated the land in Pueblo Watershed. Decades of urban development changed this natural landscape into a residential and commercial landscape, with an abundance of houses and commercial areas. Hard surfaces like roads, parking lots and buildings now cover much of the Chollas Creek drainage area. These hard surfaces force all of the stormwater into the city's storm drains, which then empty into the creek. The dominance of hard surfaces drives many of the urban runoff problems in the creek, which in turn contributes to the degradation of water quality in San Diego Bay[4].

According to City of San Diego monitoring, concentrations of pollutants like copper, zinc and lead exceed levels that are safe for wildlife. Prior to 2004, the household pesticide diazinon was routinely measured at levels above acceptable thresholds[2]. In addition, Chollas Creek consistently has high levels of fecal indicator bacteria. Where Chollas Creek meets San Diego Bay, local researchers documented that the stormwater draining out of the creek creates a plume of toxic water[3]. The flow of contaminated water from Chollas Creek, in conjunction with pollution from historical and contemporary industrial activity along the adjacent shoreline, has made the mouth of Chollas Creek a toxic environment for wildlife –fewer invertebrates live in this part of the Bay and the sediments contain moderate to high levels of toxic materials.

Pollution in Chollas Creek originates from many sources, making it challenging to control and reduce. Residential areas contribute to this problem. The fertilizer we apply to our lawns, the oil leaking from our cars and the pet waste we don't pick up all eventually make its way into a storm drain or the creek. But homes are not the only problem. According to the City of San Diego, the types of non-residential land uses that produce pollutants like heavy metals, pesticides and bacteria include (but are not limited to) activities associated with car and boat maintenance, cleaning and storage; garden nurseries and landscaping; and pest control services. We find many of these sources, particularly for metals, along commercial strips concentrated near Interstates 5,

development; and watershed management.

Groundwork is leading a Chollas Creek Watershed Opportunities Assessment, a comprehensive analysis of existing conditions, opportunities and constraints for habitat protection, habitat restoration, cultural resources, public access, public safety and water quality in the watershed. This project will create a unified vision for improving the health of the watershed and will provide specific recommendations to implement improvements in an integrated fashion guided by stakeholder involvement at all levels. It will build upon this report and other significant studies and projects and set the stage for a comprehensive Chollas Creek Watershed Management Plan.

— **Leslie Reynolds**, Executive Director, Groundworks San Diego

15 and 805 and Highway 945. These pollution sources disproportionately affect neighborhoods like City Heights, Logan Heights, Barrio Logan and Southcrest. The pollution harms water quality in the creek and hurts the people living in the community.

How are regulators making the creek cleaner? Federal and state water quality regulators require cities to control and reduce pollutants in a watershed. To achieve this, they must implement a variety of programs including best management practices like street sweeping, monitoring water quality, education programs and other special pilot projects. The Regional Water Quality Control Board lays out these requirements in a municipal stormwater permit. When pollution becomes too high in a body of water, regulators consider it officially 'impaired.' For these impaired waters, regulators must write a cleanup plan to reduce the total amount of pollutants entering the water.

Chollas Creek's reputation as the region's "most impaired water body" colors most conversations about the creek. The reputation is not undeserved. The Regional Water Quality Control Board initiated four cleanup plans to control various types of pollution (the household pesticide diazinon, dissolved metals in the creek, bacteria, and toxicity and degraded benthic communities at the mouth). The creeks polluted reputation is rooted in its recent history – since the 1990s, monitoring by the City of San Diego frequently detected high concentrations of metals like copper, lead and zinc during wet weather.

SAN DIEGO'S SOUTH BAY

The low-income communities along San Diego Bay's working waterfront are predominantly Latino, and are disproportionately impacted by pollution, discriminatory land-use practices and lack of regulatory enforcement. For more than 30 years, Environmental Health Coalition has worked in neighborhoods like these to build grassroots campaigns that confront these conditions.

Barrio Logan and Old Town National City are among the oldest neighborhoods in San Diego County. Diesel trucks crisscross the communities to and from shipping terminals while mixed zoning allows chrome plating shops, chemical supply houses, and other toxic industries to move in and locate adjacent to homes, schools and parks.

Thanks to the work of EHC, National City has an updated General Plan that includes Environmental Justice as an element. Barrio Logan residents are breathing less air pollution from diesel trucks and soon will have an updated Community Plan created with resident input. These community-driven initiatives have bolstered commitment for achieving EHC's goal of environmental and social justice – a goal accomplished by empowered communities acting together to make social change.

— **Laura Hunter**,
Environmental Health Coalition

Cleaning up the pollution in Chollas Creek will not be easy, even with these plans in place. The cleanup plan for the pesticide diazinon is working. Concentrations of the pesticide in the creek have steadily gone down since the federal government banned its sale in 2002. The other pollution problems in the creek present greater challenges for cleaning up. The Regional Water Quality Control Board expects that the plans for metals and bacteria will take roughly 20 years to achieve their goals. All of the jurisdictions responsible for reducing the amount of these pollutants in Chollas Creek have developed implementation plans designed to meet the requirements of the metals and bacteria plans and reduce the flow of pollutants into the creek.

Where do we monitor?
Coastkeeper currently monitors water quality at three stations in Chollas Creek at:

- Market Street and the I-15;
- Federal Boulevard; and
- the intersection of 38th and Alpha streets (Figure 15).

These sites reflect how urban areas affect water quality in the mid, to lower portions of the drainage. In San Diego, it does not rain for much of the year. The long dry season means many of our sites have no water in the creek during the summer and fall. Therefore, for this report, we focus on our site at Federal Boulevard as it has flow for most of the year and thus the most continuous dataset

The coast barrel cactus (*Fetocactus viridesious*) is one of several sensitive plant species that still calls Chollas Creek home. The barrel cactus is a beautiful succulent that blooms between May and June. Urbanization, horticultural collecting and non-native plants threaten its survival in California. You can find the barrel cactus in chaparral and coastal scrub in the tributary canyons and along the Encanto Branch of Chollas Creek.

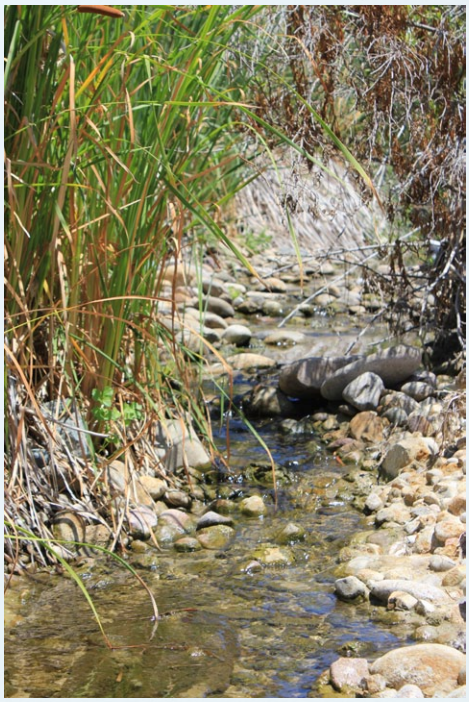


Photo credit: Jackie Loza

BASIC INDICATORS

Key Trends in Coastkeeper dataset

- Dissolved oxygen levels were consistently in the safe zone (above Basin Plan thresholds) during 2009 and 2010*.
- Water temperatures ranged from 14°C – 29°C (57.2F — 84.2 F)*.
- Generally, pH at Federal Boulevard was within normal ranges (6.5 – 8.5) with the exception of one sample (June, 2010) that was well above normal with a pH of 9.5.*
- Conductivity, or the ability of water to pass an electrical current in water, can be raised by the addition of dissolved solids, as well as industrial or municipal runoff. Conductivity also increases with increase water temperatures.
- There is currently no threshold for conductivity in San Diego, but according to the State Water Resources Control Board, freshwater streams should typically be in the 100 to 2000 μS/cm[5]. Only six of our samples collected at Federal Boulevard were below this level.

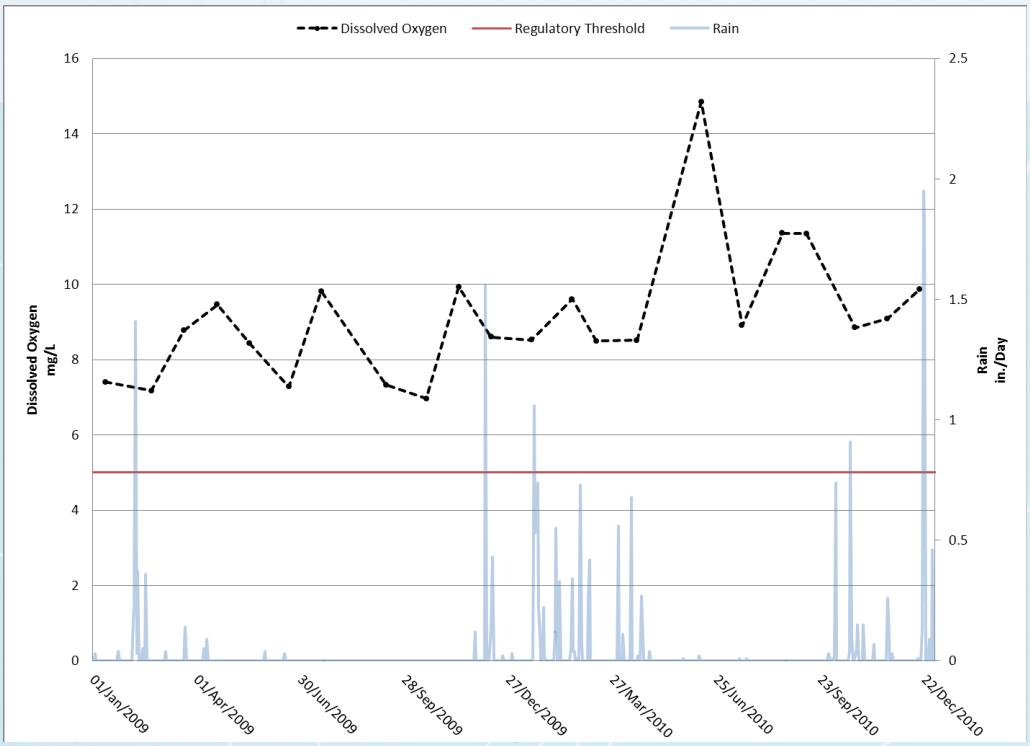


Figure 18. Conductivity in Chollas Creek at Federal Blvd

What are basic indicators? Coastkeeper measures four types of basic indicators: dissolved oxygen, temperature, pH and conductivity.

* Data not displayed

NUTRIENTS—NITRATES:

Key Trends in Coastkeeper dataset:

- Nitrates remained relatively low (below thresholds) for most of the year.
- During the rainy season, nitrate concentrations tended to increase but were still generally below thresholds. At Federal Boulevard, only one sampling event (November 2010) showed nitrate concentrations that were double the Basin Plan threshold.
- Nitrate concentrations in Chollas Creek at Market Street also exceeded Basin Plan thresholds in November 2010 (1.7 mg/L) and December 2010 (1.3 mg/L). *

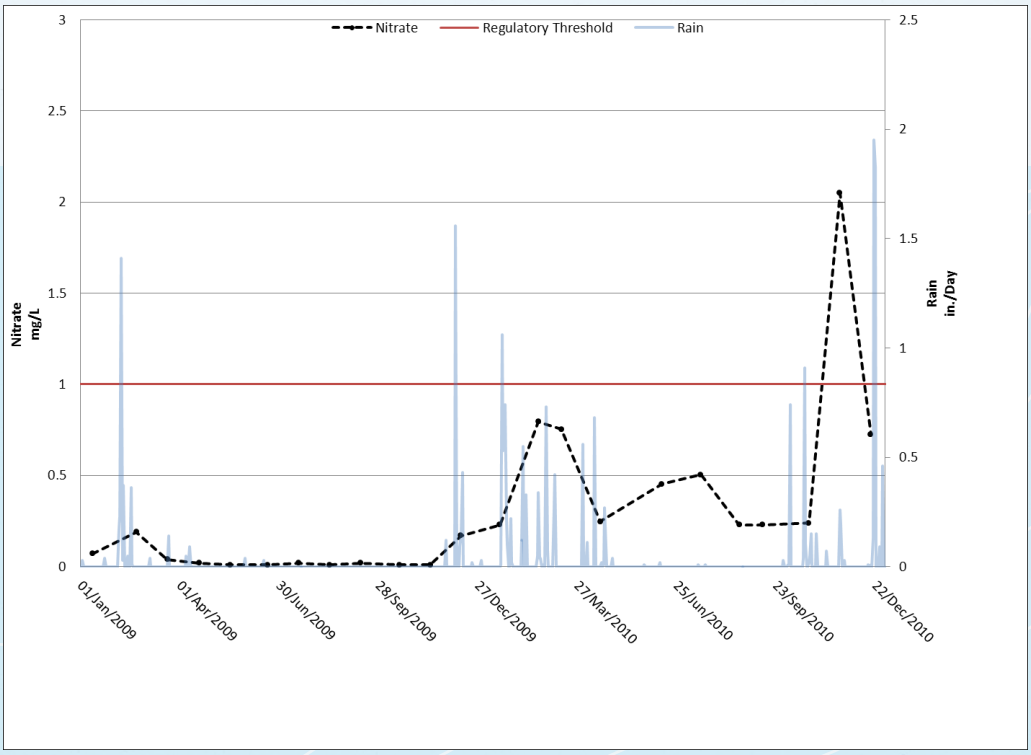


Figure 19. Nitrate Concentrations in Chollas Creek at Federal Blvd

What are nitrates? Nitrates are a form of nitrogen found in soil and water and are essential for plant growth. At high concentration nitrates can be toxic to wildlife[1] or cause excessive growth of photosynthetic organisms.

* Data not displayed

NUTRIENTS - AMMONIA:

Key Trends in Coastkeeper dataset:

- Coastkeeper began measuring ammonia in 2010.
- Generally, ammonia levels were at, or slightly above, healthy thresholds indicating potentially low level but chronic problems with ammonia in this creek.
- Similar to nitrate, the concentration of ammonia spiked in November 2010. This is also true for the other stations monitored in Chollas. This spike did coincide with a rain event, but our ammonia data set is too short to draw any conclusions.

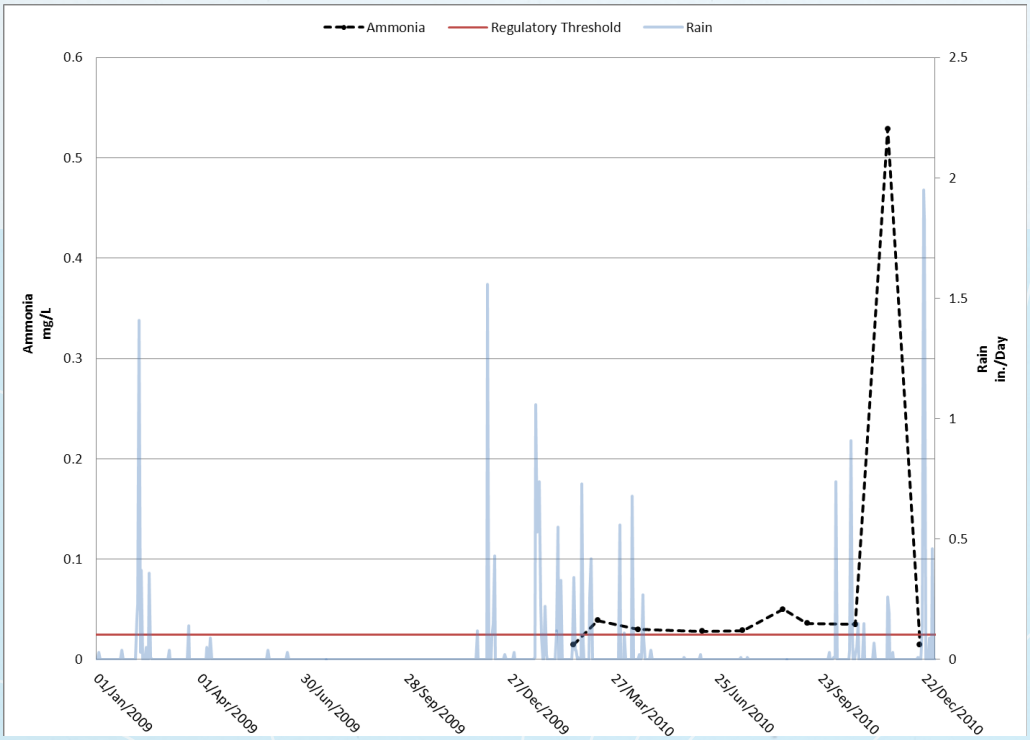


Figure 20. Ammonia concentrations in Chollas Creek at Federal Blvd

What is ammonia? Like nitrate, ammonia is another important part of the nitrogen cycle in ecosystems. It is a by-product of the metabolism of aquatic animals and is eventually converted into nitrate by bacteria. Manufacturers widely use it in fertilizers, household and industrial cleaners, plastics and explosives. Ammonia is toxic to most aquatic life, especially at high pH.

NUTRIENTS - PHOSPHATE:

Key Trends in Coastkeeper dataset:

- In 2009, all phosphate samples exceeded Basin Plan thresholds. The highest of these exceedances occurred in the dry season.
- Phosphate concentrations had the reverse pattern from nitrate, concentrations were elevated in dry season in 2009 and were relatively low throughout 2010.

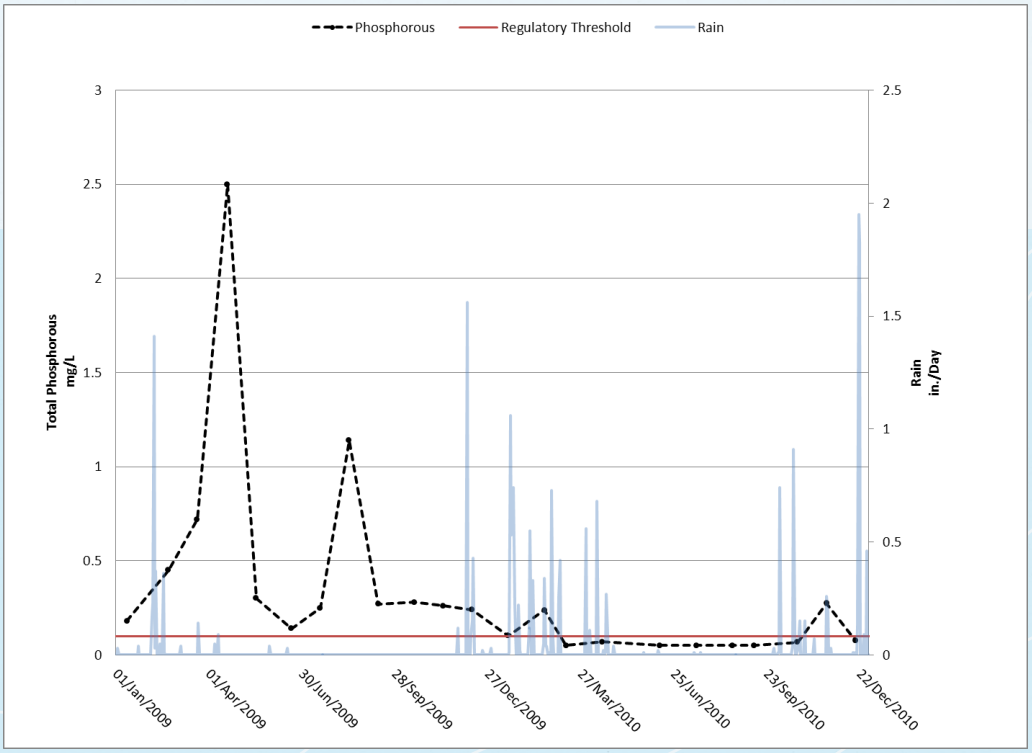


Figure 21. Phosphorus concentrations in Chollas Creek at Federal Blvd

What is phosphate? Phosphate is a nutrient essential for plant growth and is one of the building blocks of DNA. It is the most biologically important form of phosphorus for aquatic systems. Too much phosphorus in water can cause rapid algal growth, called blooms or eutrophication, which can lead to decreased oxygen levels in creek water. In some instances this can cause fish kills or prevent other animals from thriving. It is commonly used in fertilizers. Other sources of phosphorus include human and animal waste (i.e., sewage), industrial wastes and soil erosion.

FECAL INDICATOR BACTERIA – ENTEROCOCCUS & COLIFORM

Key Trends in Coastkeeper dataset:

- Enterococcus exceeded Basin Plan standards for about half the sampling dates, while E. coli concentrations exceeded Basin Plan standards four times over the two sampling years. There are no Basin Plan standards for total coliform.

- Generally, the highest levels of E. coli and Enterococcus occurred during wet weather. In contrast, total coliforms, while high during wet weather, also showed elevated concentrations in the dry season.

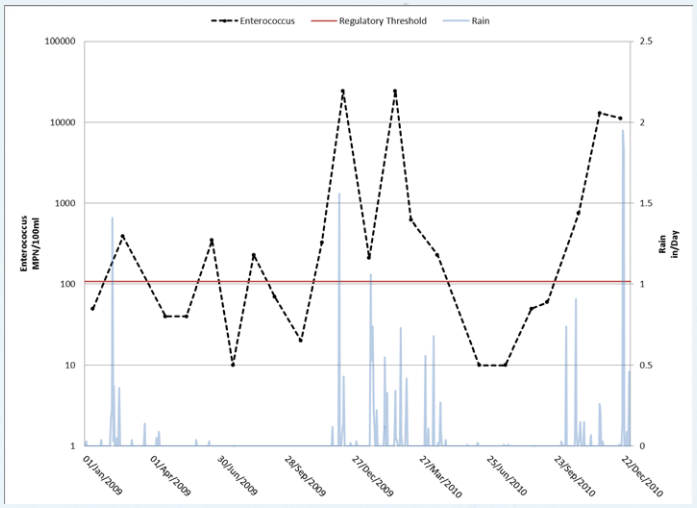


Figure 22.Enterococcus concentrations, Chollas Creek, Federal Blvd

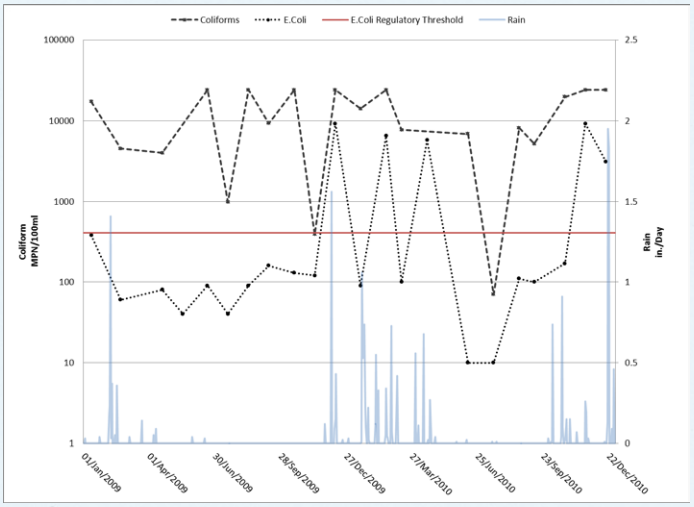


Figure 23. Coliform concentrations in Chollas Creek at Federal Blvd

What are fecal indicator bacteria? Fecal indicator bacteria are an indication of whether pathogens that can cause human illness are present in water. Coastkeeper measures three forms: Enterococcus, *E. coli*, and total coliform bacteria. *E. coli* is generally considered the best metric for evaluating freshwater. These bacteria and their associated pathogens can come from any warm-blooded animal such as the family dog, wild birds or humans. This poses significant management challenges.

TOXICITY

Key Trends in Coastkeeper dataset:

- Coastkeeper does not currently measure toxicity every month so it is challenging to infer any seasonal patterns at this time.
- The majority of samples from Chollas Creek are at the low end of the 'needs further review' response.
- None of the samples showed a definite toxic response

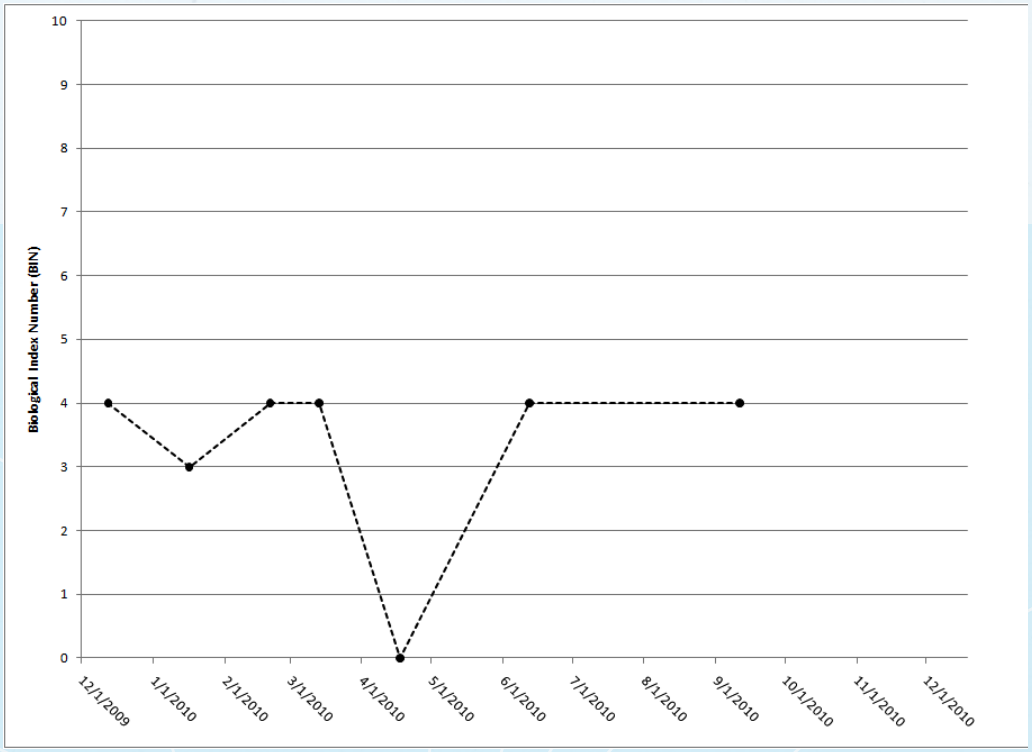


Figure 24. Toxicity in Chollas Creek at Federal Blvd

What is toxicity? Toxicity is the degree to which any substance can cause harm to humans or other organisms[5]. Through our partnership with Assure Controls, Coastkeeper relies on a rapid toxicity test to screen for toxicity in our creeks. It measures the ability of a single-celled marine organism (dinoflagellate) to produce light (bioluminescence) after exposure to any harmful substance that might be present in our water sample. The lower the level of light indicates the plankton are severely stressed or have died from toxic exposure. To screen for toxicity, this test categorizes results into 'bins' (also known as a Biological Index Number) based on the amount of light reduction. Zero to three is considered a normal response with no toxic effect detected, four to six is a cause of concern or needs further review and seven to ten is a toxic event.

DISSOLVED METALS

Key Trends in Coastkeeper dataset:

- Coastkeeper only began measuring dissolved metals in 2010.
- There are no strong seasonal patterns, with the exception of zinc and copper concentrations, which increased in the wet season.
- Dissolved concentrations for chromium, cadmium, and lead were all below 1 μg/L and are not displayed in figure 11.
- All of the measured metals were far below regulatory 'safe' thresholds and no exceedances were detected ‡.

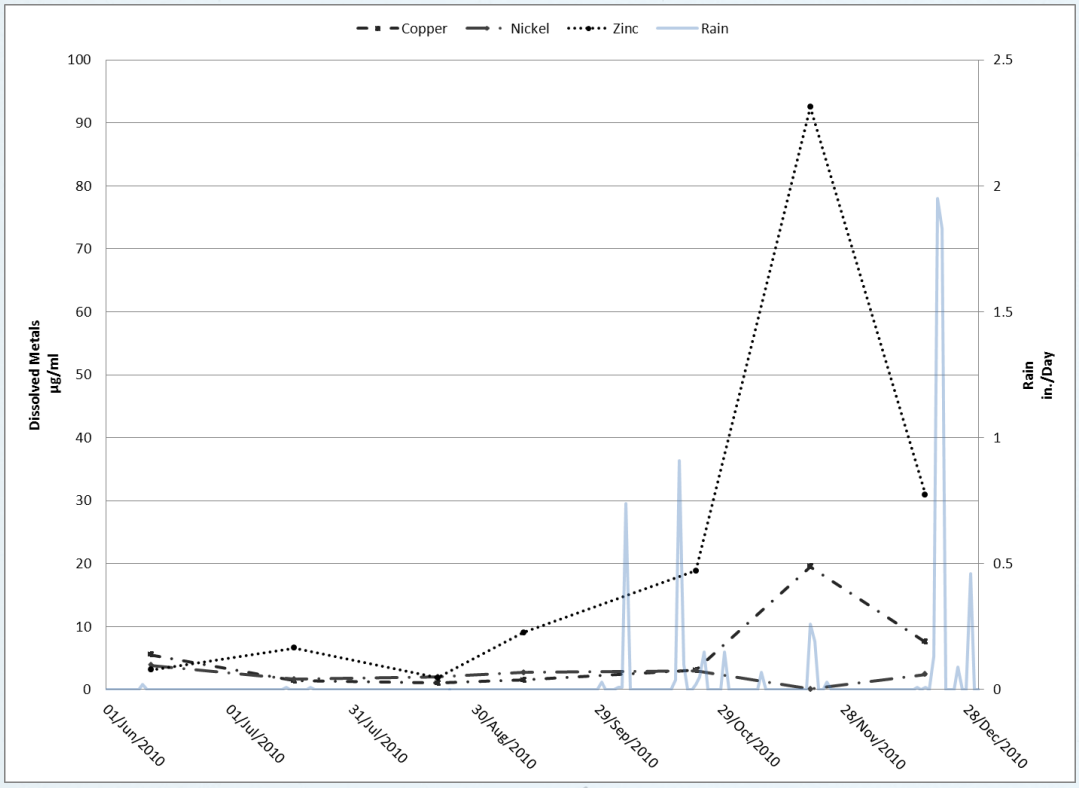


Figure 25. Concentration of dissolved metals in water samples collected from Chollas Creek at Federal Boulevard in 2010

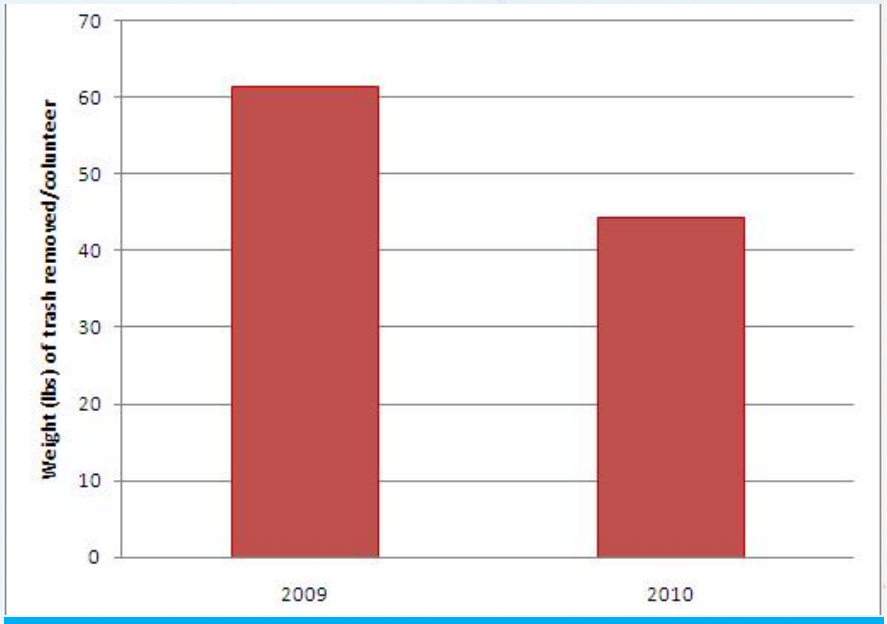
What are dissolved metals? Dissolved metals can cause a wide range of negative impacts to aquatic organisms in creeks and the waters that they drain to—they can reduce growth, harm reproduction and, in high enough concentrations, can cause death. Urban runoff is a major conduit of metals into the creek. Higher concentrations of metals tend to originate in areas with more industrial and commercial activities, and dissolved metal concentrations tend to peak with the first flush of a rain storm.

‡ Regulatory Thresholds (Basin Plan Standards) for dissolved metals are as follows: Cadmium:>2.0 µg/L; Chromium >16 µg/L; Copper >80 µg/L; Lead >65 µg/L; Nickel>470 µg/L; Zinc >120 µg/L

TRASH

Key Trends in Coastkeeper dataset:

- Coastkeeper's Marine Debris Program collects trash at a dozen sites in Chollas Creek for Coastal Cleanup Day. The numbers from this event reflect the severity of the problem in Chollas – almost 1,300 people removed close to 70,000 lbs of trash from Chollas Creek during that day.
- In 2010, approximately 30% less trash was collected than 2009, perhaps due to fewer sites and volunteers.
- In addition to Coastal Cleanup Day, Coastkeeper, in partnership with I Love a Clean San Diego, have begun quantifying the amount of trash in Chollas Creek using state approved protocols for trash assessment. Data is not yet available for this.



COASTAL CLEANUP DAY TOTALS:	2009	2010
Number of Sites	13	11
Miles Cleaned	17	15
Number of Volunteers	660	638
Pounds of Trash Removed	40,513	28,332

Figure 26

What is trash? In addition to being unsightly, trash can harbor pathogens, degrade wildlife habitat and contribute to flooding problems in creeks. Animals can ingest trash or become entangled in it, and it can eventually flow from our creeks to our beaches and the ocean.

Photo credit: Shannon Switzer

Photo credit: Shannon Switzer

RESOURCES AND REFERENCES

Technical Resources

Coastkeeper is not the only entity that monitors water quality in the Pueblo Watershed. If you are interested in reading more about other water quality monitoring programs, we encourage you to read the following technical resources:

Stormwater Toxicity in Chollas Creek and San Diego Bay, California. *http://www.ncbi.nlm.nih.gov/pubmed/12620010*

Surface Water Ambient Monitoring Program Report on the Pueblo San Diego Hydrologic Unit January 2008. *http://www.swrcb.ca.gov/rwqcb9/water_issues/programs/swamp/docs/908pueblosandiegorpt.pdf*

San Diego Bay Watershed Urban Runoff Management Program 2009—2010 Annual Report. *http://www.projectcleanwater.org/pdf/wurmp/san_diego_bay_wurmp_ar_fy09_10_report.pdf*

Chollas Creek Total Maximum Daily Load 2009–2010 Water Quality Compliance Monitoring Final Report. *http://www.sandiego.gov/stormwater/pdf/chollastmdlmonitoringreport10.pdf*

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2. Kolb, R. (City of S.D.T.& S.W.D. Chollas Creek Dissolved Metals TMDL and Special Studies Monitoring Draft Results Monitoring Sites and Special Studies. (2010).

3. Schiff, K., Bay, S. & Diehl, D. Stormwater toxicity in Chollas Creek and San Diego Bay, California. Environmental Monitoring and Assessment 81, 119-32 (2003).

4. National Research Council Urban Stormwater Management in the United States. Management 510 (National Academies Press: Washington, D.C., 2008).

5. Clean Water Team Electrical Conductivity/Salinity Fact Sheet. Fact Sheet 3.1.3.0. The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment 0, 2-6 (2004).

NORTH COUNTY: SAN LUIS REY WATERSHED

From its headwaters in the Palomar and Hot Springs mountains, the San Luis Rey River flows down to the ocean at Oceanside. This large watershed is sparsely populated and, unlike most of the watersheds Coastkeeper monitors, it also has a large amount of open space and agricultural land.

The Southern Steelhead Trout once traveled between the ocean and the San Luis Rey in significant numbers. The population was thought extirpated but biologists spotted at least one returning Southern Steelhead in San Luis Rey river as recently as 2007 so hope remains that the river will support a larger population in the future.

Coastkeeper currently monitors water quality at four locations on the mainstem (at the Pacific Coast Highway Bridge, the Douglas Ave Bridge, Mission Ave and Highway 76, and the Old Highway 395 bridge) and one two tributaries (Gomez Creek and Pauma Creek). We collaborate with Golden State Flycasters to collect samples every other month in the San Luis Rey Watershed.

Coastkeeper's monitoring results

Our Water Quality Index categorized water quality in the San Luis Rey Watershed as "fair." Pollution sources in this watershed include residential and commercial activity, but this watershed also contains a significant amount of agricultural activity, a source of pollution that is more challenging for regulators and local governments to abate.

In general we found:

- **Consistent problems with basic indicators** While pH levels remained healthy throughout our sampling period, our volunteers found that dissolved oxygen concentrations fell below regulatory thresholds in 26% of sampling events.

THE SOUTHERN STEELHEAD TROUT ONCE TRAVELED BETWEEN THE OCEAN AND THE SAN LUIS REY IN SIGNIFICANT NUMBERS. HOPE REMAINS THAT THE RIVER WILL SUPPORT A LARGER POPULATION IN THE FUTURE.

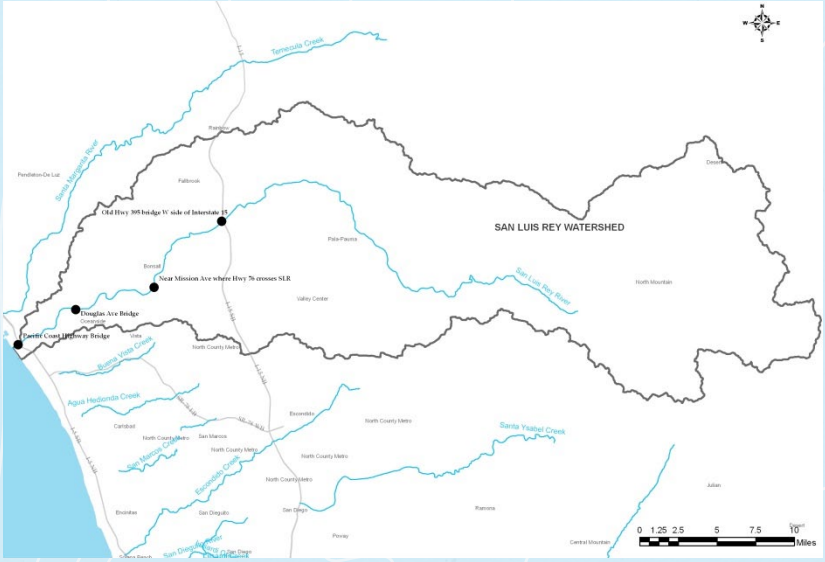


Figure 27: Coastkeeper Monitoring locations in the San Luis Rey Watershed

Our lowest values (below 2.5 mg/L) occurred at our Douglas Avenue Bridge site. Samples also showed high levels of conductivity – 60 percent of our samples were higher than the State Water Board's recommended threshold of 2000 μS/cm[1].

- **High concentrations of nutrients -** All three of our nutrient indicators showed consistent exceedances of regulatory thresholds. Phosphate levels exceeded thresholds in four sampling events, with some concentrations were two to seven times higher than the regulartory threshold. Both nitrate and ammonia exceeded thresholds about 48 percent of the sampling events. Interestingly, exceedances occurred in dry weather as well as wet weather.

- **Problems with bacterial indicators -** Our volunteers found that our samples did not exceed *E. coli* that frequently – only 18 percent of our samples exceeded the regulatory threshold. However, samples did show a high magnitude of exceedances with at least one sample being sixty times higher than the regulatory threshold. Conversely, our volunteers showed that Enterococcus exceedances were both frequent (exceeding thresholds in 67% of our sampling events) but also of a high magnitude (with magnitudes ranging from two to sixty times higher than the threshold).

Photo credit A. Witheridge

SAN LUIS REY WATERSHED, ONCE HOME TO HISTORICAL RUNS OF SOUTHERN STEELHEAD, NOW LACKS SUFFICIENT TROUT-FRIENDLY HABITAT TO MAINTAIN HEALTHY OCEAN-GOING SOUTHERN STEELHEAD.

The San Luis Rey River creates a plume from its mouth in Oceanside after a storm in March 2011.

Photo credit: Shannon Switzer

SAN LUIS REY WATERSHED

The San Luis Rey Watershed splashes down from its headwaters in the Palomar and Hot Springs Mountains before hitting the ocean at the shores in Oceanside. The San Luis Rey watershed lies in the northern reaches of San Diego County, between the Santa Margarita Watershed and the Carlsbad Watershed. The watershed stretches across 560 square miles, making it the third largest in San Diego County.

The San Luis Rey Watershed may be big, but its human population is one of the smallest. Unlike many of its southern neighbors, the San Luis Rey Watershed contains very little urban landscape. Vacant/open space takes up half the watershed, while agricultural (cattle grazing, nurseries, citrus and avocado groves) and residential each account for about 15 percent of the watershed[2]. Local jurisdictions occurring within the watershed include the cities of Oceanside, Vista, and Escondido, and the counties of San Diego and Riverside[2]. The territories of six federally recognized Tribal Indian Reservations also overlap with this watershed.

Many people probably think of salmon and trout as being emblematic of Northern California. But Southern California remains a vital part of the salmon story. The Southern Steelhead Trout once traveled between the ocean and many of the rivers of San Diego County, including San Luis Rey. While Southern Steelhead no longer swim in large numbers in our watersheds, biologists spotted at least one returning Southern Steelhead in San Luis Rey river as recently as 2007[3]. According to the Center for Ecosystem Management and Restoration, San Luis Rey Watershed, once home to historical runs of Southern Steelhead, now lacks sufficient trout-friendly habitat to maintain healthy ocean-going Southern Steelhead. Significant restoration efforts will be needed to bring back this important species back to the river. There are still some healthy populations of Rainbow Trout, such as in Pauma Creek, a tributary to San Luis Rey River.

Steelhead trout (Oncorhynchus mykiss) is a rainbow trout that lives most of its life in the ocean. Like salmon, steelheads give birth in freshwater streams, and after one to three years, they migrate to the sea. Years later they return to their place of birth to spawn. Urban development, dams, water diversions and habitat destruction has decimated the runs of these native fish. The steelhead trout embodies the connection between inland and ocean waters.

Photo credit: Eric Engbretson / U.S. Fish and Wildlife Service

How does the creek get dirty?

With so much open space and so little industrial activity, it may seem surprising that the San Luis Rey watershed suffers from any pollution problems. Yet, the water quality in the watershed regularly fails to meet our state's water quality standards. As a result, state water quality regulators declared the San Luis Rey River officially impaired by chloride, fecal coliform bacteria, phosphorus, total dissolved solids, total nitrogen and toxicity[4].

The municipalities in the watershed and the County of San Diego all share responsibility for managing and reducing pollution entering into and leaving the storm drain systems in the watershed. These jurisdictions identified two "high priority pollutants", bacteria and nutrients, and determined three primary sources of the pollution in the watershed: agriculture (including nurseries), residential areas (including new development) and restaurants[2]. Some evidence exists that the high levels of chloride and total dissolved solids may originate from natural groundwater sources and Foss Lake, one of the county's only inland salt water wetlands, in addition to water imported from the Colorado River basin[2].

Photo credit USGS

The Least Bell's Vireo nests in riparian areas in the San Luis Rey Watershed and other parts of the Central Valley, northern Baja and Southern California.

Formerly one of California's most abundant bird species, this vireo declined to only 300 pairs by 1986 when federal officials listed it as endangered. This prompted officials to launch an intensive restoration program. Populations began to increase around the state including in a 10-mile stretch of the San Luis Rey watershed, where the population numbers went from just 24 birds to 114 in 2004. The road to full recovery for this species is not done and the San Luis Rey watershed is a critical part of its future success.

How regulators make the creek cleaner.

Consistent problems with fecal indicator bacteria concentrations in our creeks and shoreline areas across the county led the Regional Water Quality Control Board to establish one Total Maximum Daily Load plan for all parts of the county suffering from elevated levels of bacteria. Because of its consistent and high levels of fecal indicator bacteria, the Regional Board included the San Luis Rey river and shoreline areas in the cleanup plan. Initiated in 2010, the Total Maximum Daily Load plan sets a twenty-year timeline for reducing the amount of fecal indicator bacteria to a point that protects human health.

The Regional Water Quality Control Board requires that municipalities and the County of San Diego assess the health of waterways in each watershed as part of their stormwater regulations. To comply with these regulations, the cities of Oceanside, Vista, and Escondido, and the County of San Diego conduct a variety of watershed monitoring, and education and outreach programs. To better understand the sources of some of the priority pollutants, the cities undertook two important studies in addition to their routine water monitoring activities. The first investigated to what extent residential areas in the City of Oceanside generate stormwater pollution. Preliminary results showed that when it rains, single-family residential areas create some of the types of pollutants that we find in San Luis Rey River including fecal indicator bacteria, turbidity and pesticides[2]. The City of Oceanside also led an effort to identify the source of bacteria in the watershed so that the City could reach the goals of the Total Maximum Daily Load plan and protect the health of people using the beaches and creek areas in Oceanside.

The San Luis Rey watershed faces particular challenges in addressing its water pollution problems as many of its sources of pollution (agriculture, groundwater and imported water) did not have strong regulations to address protecting the waterway from and cleaning up pollution problems.

Where do we monitor?

Coastkeeper currently monitors water quality at four locations on the mainstem:

- at the Pacific Coast Highway Bridge,
- the Douglas Avenue Bridge,
- Mission Avenue and Highway 76, and
- the Old Highway 395 Bridge).

We also monitor one location at two tributaries (Gomez Creek and Pauma Creek). This allows us to capture information from important upstream water quality – information that is vital to our key watershed partner, Golden State Flycasters. Unlike many of our other sites, Coastkeeper volunteers collect samples from the San Luis Rey Watershed every other month instead of monthly.

The following section provides an overview of the indicators we measure and the status and trends we have observed over the 2009-2010 monitoring period. Coastkeeper monitors more sites in the San Luis Rey watershed than most of our other watersheds. For this chapter we present the data as an average from all the sites.

You can find individual site data at *www.sdcoastkeeper.org.*

The San Luis Rey River during a large storm event.
Photo credit: Shannon Switzer

Where the San Luis Rey meets the ocean.
Photo credit: A. Witheridge

Bacterial pollution is a challenging water quality problem. Sources of fecal indicator bacteria (typically used to indicate the presence of harmful microbes, such as viruses and protozoa) are humans, wild and domestic animals and plants and soils. Identifying and understanding the source of bacterial pollution is the first step to preventing pollution and in reducing the human health risk. To identify the sources of bacteria causing historical beach advisories, the City of Oceanside conducted a microbial source study in the San Luis Rey Watershed. So far, our research has identified key sources in the watershed where there is likely a human source of bacteria, in addition to assessing the impact of wild birds (gulls) on water quality at the river mouth. We are moving forward with developing and implementing targeted management practices to identify and reduce the anthropogenic sources (caused by humans) of bacteria to improve water quality in the watershed.

— **Alison Witheridge,**
Environmental Specialist with
the City of Oceanside

SUMMARY OF MONITORING DATA

BASIC INDICATORS

Key Trends in Coastkeeper dataset:

- Coastkeeper data showed that pH and conductivity levels stayed in the normal range for all sites.
- On average, the dissolved oxygen concentrations were in healthy ranges except during August and October 2009.
- Dissolved oxygen concentrations in the two upstream tributary sites (Gomez and Pauma Creek) dropped to almost zero in August 2009†.
- In downstream sites at the Douglas Bridge and Highway 395, dissolved oxygen concentration dropped below healthy thresholds for multiple months during the dry season in 2009 and 2010.
- Our site at Mission Avenue was the only site where dissolved oxygen concentrations remained at healthy levels for all of our sampling events.

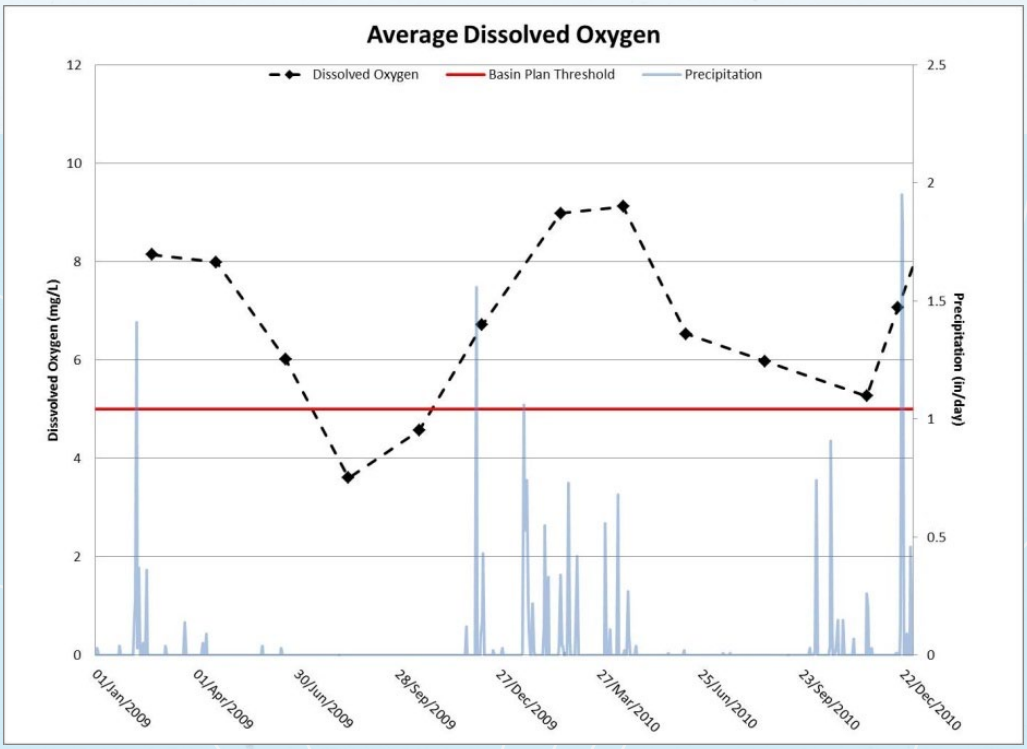


Figure 28. Average dissolved oxygen concentrations from current Coastkeeper monitoring sites, 2009-2010.

What are basic indicators? Coastkeeper measures four types of basic indicators: dissolved oxygen, temperature, pH and conductivity.

* Data not displayed
† For data on individual sites, please visit www.sdwatersheds.org

NUTRIENTS—NITRATES:

Key Trends in Coastkeeper dataset:

- On average, 2009 nitrate concentrations were moderately better than the average concentrations in 2010.
- February 2009 consistently showed nitrate concentrations above water quality standards at downstream sites (Pacific Coast Highway Bridge, Douglas Avenue Bridge and Mission Avenue) ‡.
- Sites at Highway 395 and in Gomez Creek demonstrated the most frequent exceedances of nitrate water quality standards, with all (Highway 395) or 83% of samples being above nitrate healthy thresholds.
- Pauma Creek nitrate concentrations remained at healthy levels for every sampling event in 2009 and 2010.

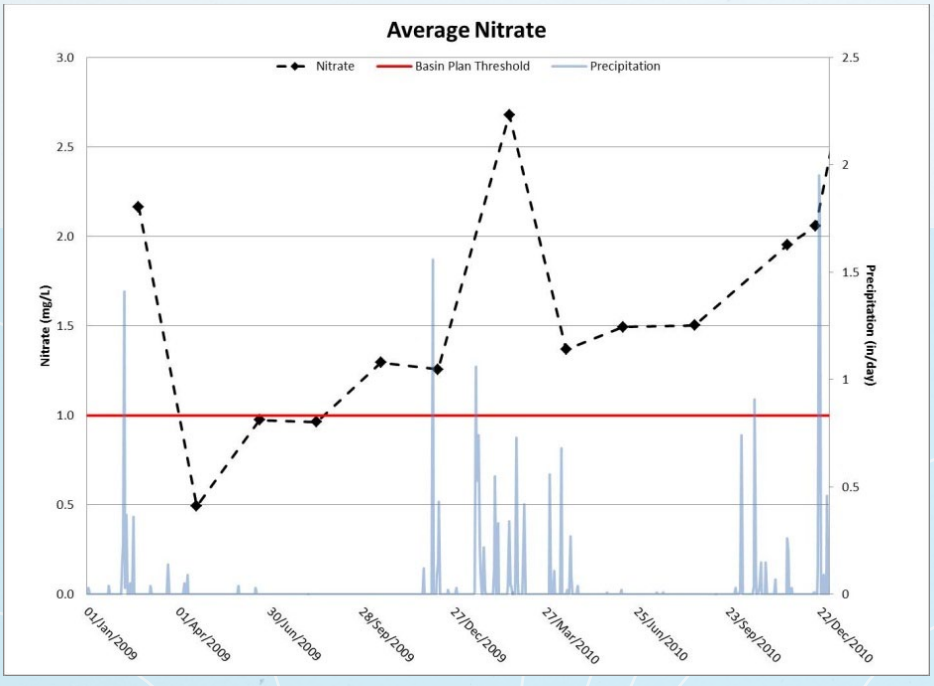


Figure 29. Average nitrate concentrations from current Coastkeeper monitoring sites, 2009-2010.

What are nitrates? Nitrates are a form of nitrogen found in soil and water and are essential for plant growth. At high concentration nitrates can be toxic to wildlife[1] or cause excessive growth of photosynthetic organisms.

‡ For data on individual sites, please visit www.sdwatersheds.org

NUTRIENTS - AMMONIA:

Key Trends in Coastkeeper dataset:

- Coastkeeper did not measure ammonia in the San Luis Rey Watershed in 2009.
- On average, ammonia concentrations were slightly above regulatory healthy thresholds across all 2010 sampling events.
- Similarly, our site at Douglas Avenue exceeded regulatory thresholds 66% of the time.
- Our most downstream site (at Pacific Coast Highway) showed the highest and most frequent exceedances of regulatory healthy thresholds, and only one sample (November 2010) fell within the healthy range‡.
- The remaining sites had ammonia concentrations that hovered just above or just below the threshold.

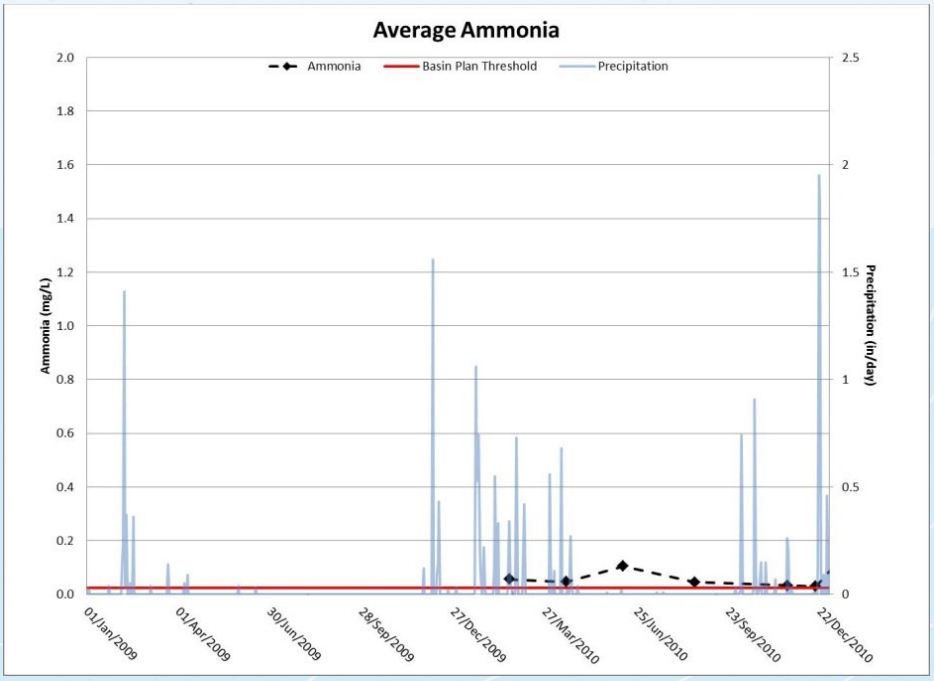


Figure 30. Ammonia concentrations

What is ammonia? Like nitrate, ammonia is another important part of the nitrogen cycle in ecosystems. It is a by-product of the metabolism of aquatic animals and is eventually converted into nitrate by bacteria. Manufacturers widely use it in fertilizers, household and industrial cleaners, plastics and explosives. Ammonia is toxic to most aquatic life, especially at high pH.

‡ For data on individual sites, please visit www.sdwatersheds.org

NUTRIENTS - PHOSPHATE:

Key Trends in Coastkeeper dataset:

- In 2009, phosphorus concentrations were generally higher than in 2010.
- In 2009, all of the sites on the mainstem of the river exceeded regulatory thresholds for 100% of the sampling events. Our sites on Pauma Creek and Gomez Creek had one sampling event that fell below regulatory threshold.
- All sites exhibited a large spike in phosphorus concentrations in August 2009.
- In 2010, phosphorus concentrations generally hovered around the regulatory threshold. Exceedances of the phosphorus threshold generally decreased in upstream areas, with Gomez Creek having no exceedances and Pauma Creek having only one. Conversely, samples from the Pacific Coast Highway site and Douglas Avenue Bridge site exceeding 50% and 100% (respectively) of the time.

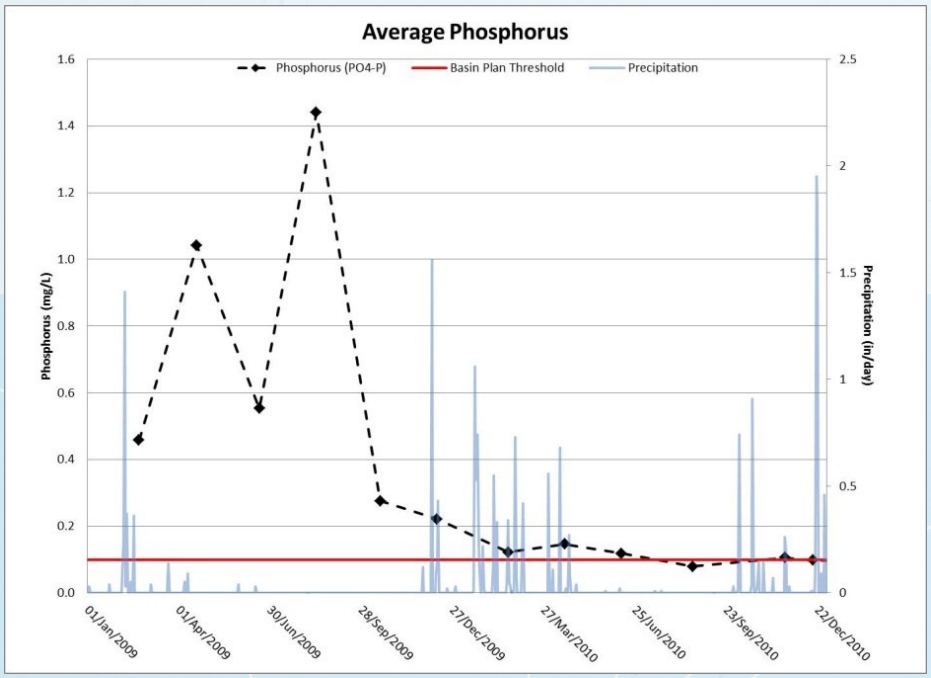


Figure 31. Phosphate Concentrate

What is phosphate? Phosphate is a nutrient essential for plant growth and is one of the building blocks of DNA. It is the most biologically important form of phosphorus for aquatic systems. Too much phosphorus in water can cause rapid algal growth, called blooms or eutrophication, which can lead to decreased oxygen levels in creek water. In some instances this can cause fish kills or prevent other animals from thriving. It is commonly used in fertilizers. Other sources of phosphorus include human and animal waste (i.e., sewage), industrial wastes and soil erosion.

FECAL INDICATOR BACTERIA – ENTEROCOCCUS & COLIFORM

Key Trends in Coastkeeper dataset:

- *E. coli* concentrations were generally low in both sampling years. Almost all sampling events in 2009 had concentrations of *E. coli* below regulatory thresholds.

- In 2010 E. coli concentrations were also generally low but exceedances were more frequent. At the Mission Avenue Bridge site, 66 percent of the samples exceeded thresholds and 50 percent of the samples collected at Gomez Creek exceeded the regulatory healthy standards. The large spike in *E. coli* in November 2010 was driven by the concentration of *E. coli* at Gomez Creek.

- Enterococcus concentrations were generally higher than *E. coli*. For example, 83 percent of the samples taken from two sites on the San Luis Rey River showed exceedences. Exceedances occurred during the wet season as well as the dry season.

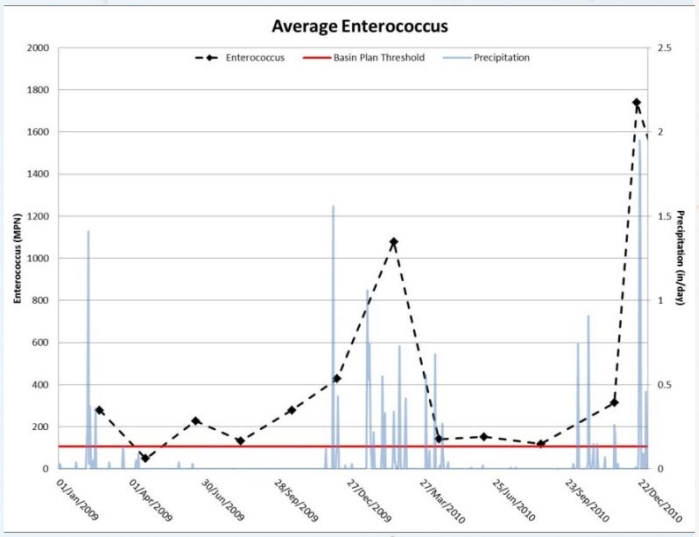


Figure 32. Average Enterococcus concentration from all Coastkeeper sites in San Luis Rey watershed.

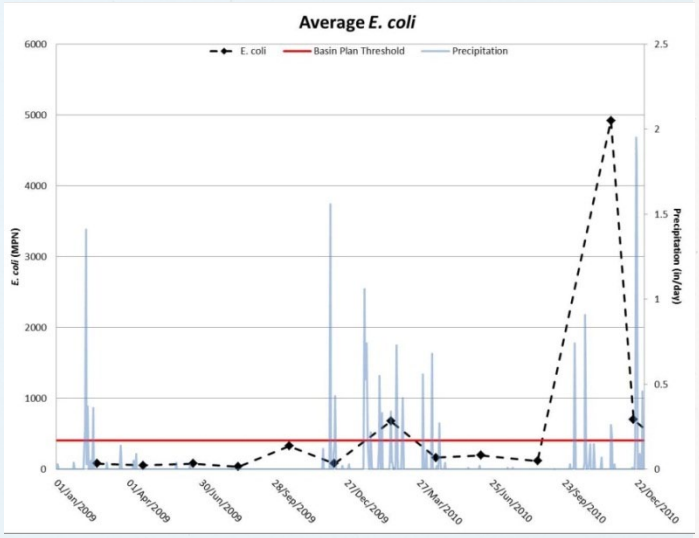


Figure 33. Average E. coli concentration from all Coastkeeper sites in San Luis Rey watershed.

What are fecal indicator bacteria? Fecal indicator bacteria are an indication of whether pathogens that can cause human illness are present in water. Coastkeeper measures three forms: Enterococcus, *E. coli*, and total coliform bacteria. *E. coli* is generally considered the best metric for evaluating freshwater. These bacteria and their associated pathogens can come from any warm-blooded animal such as the family dog, wild birds or humans. This poses significant management challenges.

TOXICITY

Key Trends in Coastkeeper dataset:

- Coastkeeper volunteers only analyzed San Luis Rey samples for toxicity four times during 2009 and 2010.
- On average, samples from San Luis Rey watershed fell into a normal range of toxic response.
- However, several sites showed occasional spikes in the Biological Index Number (BIN) values. The highest spikes occurred during the December, 2009 sampling at our Mission Avenue site (BIN = 6) and Highway 395 site (BIN = 5). This sampling event took place during a rain event perhaps leading to additional toxicants being washed into the creek at these sites.

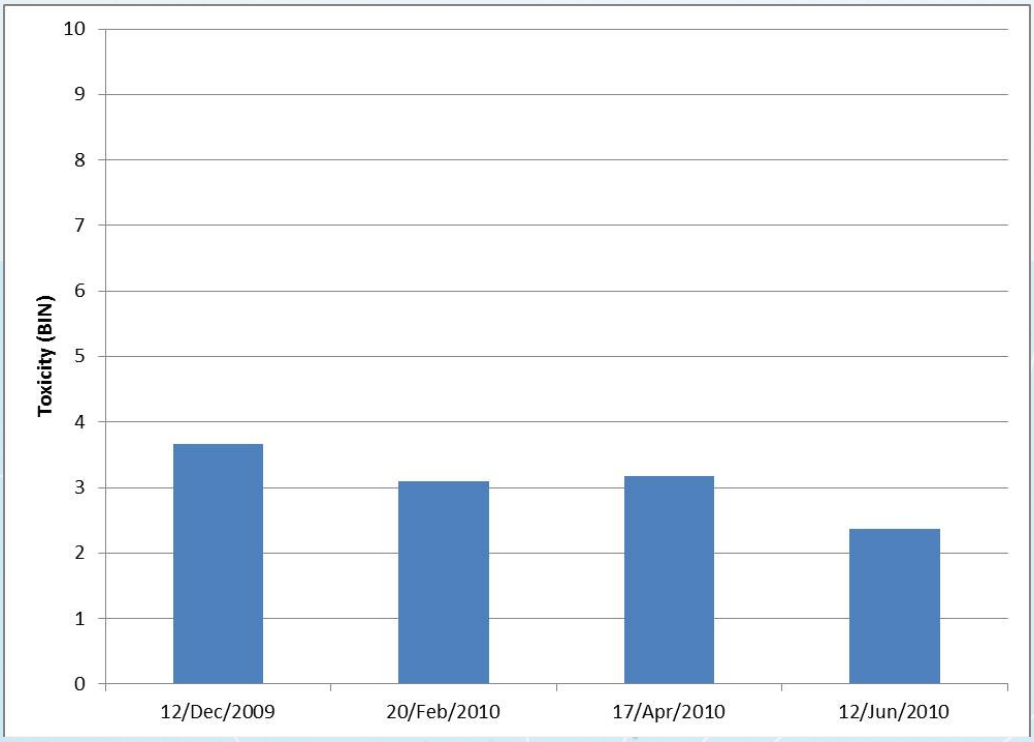


Figure 34. Average toxicity values from monitoring sites in the San Luis Rey Watershed.

What is toxicity? Toxicity is the degree to which any substance can cause harm to humans or other organisms[6]. Through our partnership with Assure Controls, Coastkeeper relies on a rapid toxicity test to screen for toxicity in our creeks. It measures the ability of a single-celled marine organism (dinoflagellate) to produce light (bioluminescence) after exposure to any harmful substance that might be present in our water sample. The lower the level of light indicates the plankton are severely stressed or have died from toxic exposure. To screen for toxicity, this test categorizes results into 'bins' (also known as a Biological Index Number) based on the amount of light reduction. Zero to three is considered a normal response with no toxic effect detected, four to six is a cause of concern or needs further review and seven to ten is a toxic event.

DISSOLVED METALS

Key Trends in Coastkeeper dataset:

- Coastkeeper only began measuring for dissolved metals in 2010. Because we sample in the San Luis Rey Watershed every other month, our dataset is limited for this watershed.
- In general, the concentration of dissolved metals was low in our sites in San Luis Rey watershed.
- Some metals (copper and zinc) increased during the wet season but the spikes did not occur during or immediately after a rain event.
- All of the metals we measured were well below regulatory thresholds ‡.

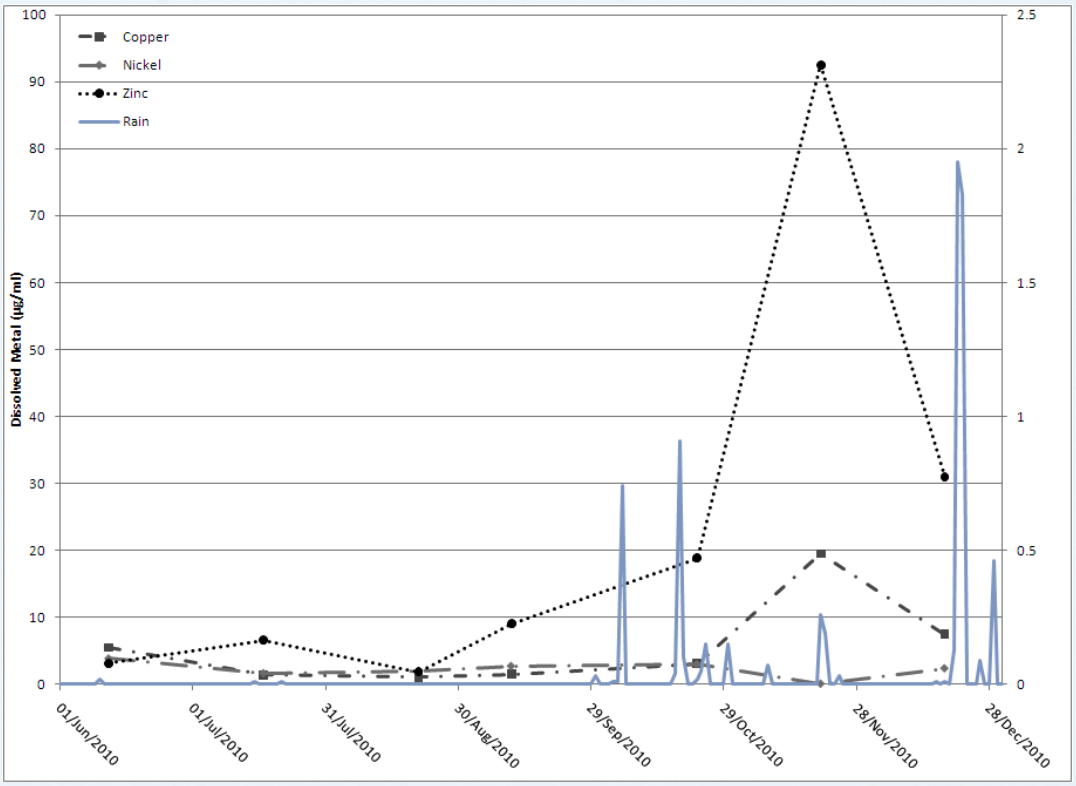


Figure 35. Concentration of dissolved metals in water samples collected from San Luis Rey

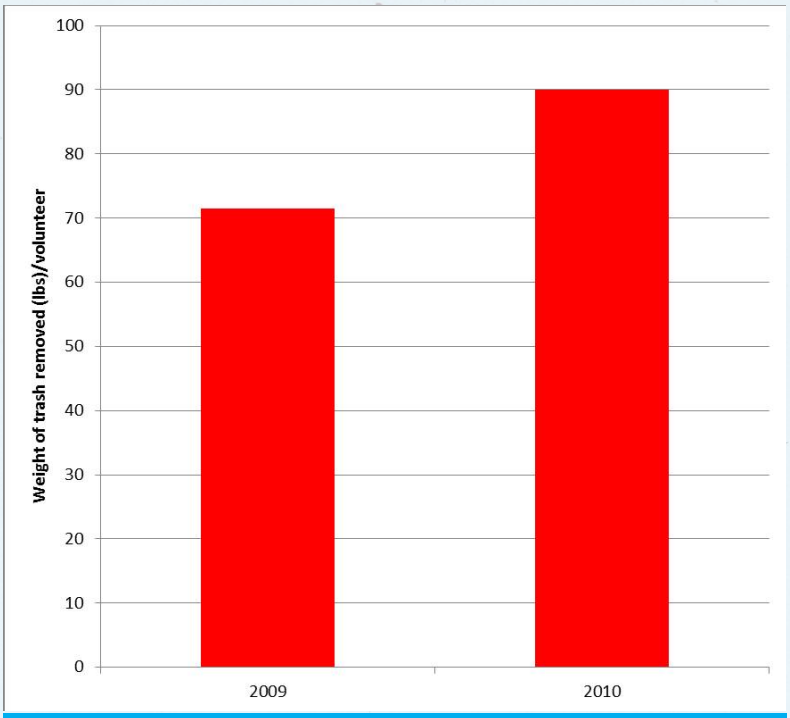
What are dissolved metals? Dissolved metals can cause a wide range of negative impacts to aquatic organisms in creeks and the waters that they drain to—they can reduce growth, harm reproduction and, in high enough concentrations, can cause death. Urban runoff is a major conduit of metals into the creek. Higher concentrations of metals tend to originate in areas with more industrial and commercial activities, and dissolved metal concentrations tend to peak with the first flush of a rain storm.

‡ Regulatory Thresholds (Basin Plan Standards) for dissolved metals are as follows: Cadmium:>2.0 µg/L; Chromium >16 µg/L; Copper >80 µg/L; Lead >65 µg/L; Nickel>470 µg/L; Zinc >120 µg/L

TRASH

Key Trends in Coastkeeper dataset:

- Coastkeeper volunteers collected trash as part of Coastal Cleanup Day at various sites in the San Luis Rey watershed. In 2009, volunteers removed trash in Fallbrook and at Oceanside Pier. In 2010, Coastkeeper added Oceanside Harbor to our Coastal Cleanup Day sites.
- Volunteers removed a total of 36,480 and 43,718 pounds of trash from the watershed in 2009 and 2010, respectively.
- Despite having slightly fewer volunteers in 2010, volunteers removed and disposed of a larger weight of trash than in 2009.
- The majority of the trash removed from the watershed came from the inland site in Fallbrook, where volunteers collected 35,600 pounds of trash in 2009 and 43,120 pounds of trash in 2010.



COASTAL CLEANUP DAY TOTALS:	2009	2010
Number of Sites	2	3
Length of River Cleaned (mi)	17	7.5
Number of Volunteers	510	486

Figure 36

Trash accumulates in the San Luis Rey river.
Photo credit: Shannon Switzer

What is trash? In addition to being unsightly, trash can harbor pathogens, degrade wildlife habitat and contribute to flooding problems in creeks. Animals can ingest trash or become entangled in it, and it can eventually flow from our creeks to our beaches and the ocean.

RESOURCES AND REFERENCES

Technical Resources

Coastkeeper is not the only entity that monitors water quality in the Pueblo Watershed. If you are interested in reading more about other water quality monitoring programs, we encourage you to read the following technical resources:

City of Oceanside, City of Vista, and County of San Diego (2011). San Luis Rey River Watershed Urban Runoff Management Program Annual Report for Fiscal Year 2009-10. Prepared for California Regional Water Quality Control Board San Diego Region 9, January 2011. 234 pgs *http://www.ci.oceanside.ca.us/civica/filebank/blobdload.asp?BlobID=26183*

City of Oceanside (2011). Lower San Luis Rey River Bacterial Source Identification Project Project Report SWRCB Grant No. 07-577-550-2 September 2011. 108 pgs.

Jacobson, S., Kawasaki, F. and J. Marshall. (2010). Final Report for Grant A07-S1 *Steelhead Habitat Restoration in the San Luis Rey River: Water Quality and Bioassessment Analysis*, Submitted by the Trout Unlimited-San Diego chapter to California Dept. of Fish and Game and Pacific States Marine Fisheries Commission. pp. 1-227. *http://www.california-fly-fishing.org/GSF-CMS/uploads/Conservation%20Reports/Part%201%20Introduction%20and%20Water%20Chemistry.pdf*

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5. State Water Resources Control Board 2010 Integrated Report Clean Water Act Sections 303(d) and 305(b).

6. George A. Miller (1995). WordNet: A Lexical Database for English. Communications of the ACM Vol. 38, No. 11: 39-41.

The Tijuana River Watershed covers 1,750 square miles (1.12 million acres) over both sides of the international border between California and the state of Baja California in Mexico[1].

Coastkeeper and its watershed partner, Surfrider Foundation, San Diego Chapter, monitor water quality at three stations in the Tijuana River and three sites in the Tijuana Estuary. We collect samples at our river sites as long as they still flow - San Diego's long dry season means our river sites are dry for much of the year. For this report, we focus on our sites in the river, as opposed to our estuary sites, as this is more representative of the rest of our Water Quality Monitoring Program dataset.

Coastkeeper's monitoring results

The 2010-2011 monitoring season revealed that water quality in the Tijuana River Watershed is in poor condition, earning a score of 28. Coastkeeper's data indicate that nutrients and bacteria remain the most problematic water quality pollutants in the Tijuana River Watershed.

In general we found:

- **Consistent low dissolved oxygen concentrations -** concentrations of dissolved oxygen at two of our three river sites were generally at unhealthy levels.

- **High conductivity -** 82 percent of our samples showed high levels of conductivity (how much electric current can pass through water). This indicates that there is potentially too much of something that can carry an electrical charge, like detergents, metals or dissolved salts in the water.

- **Low dissolved metal concentrations -** All samples were within safe thresholds. This pattern is typical of stream water quality conditions in Southern California – a study of fifteen coastal watersheds in Southern California found that on average, in-stream concentrations did not exceed standards for metals[2].

Figure 37. Locations of Coastkeeper watershed monitoring sites.

- **Very high concentrations of nutrients** When we analyzed the river samples for phosphorus and ammonia, the concentrations consistently exceeded the maximum concentration that our methods can detect. Nitrate concentrations exceeded regulatory thresholds 50% of the time across all sites.

- **Variable but high levels of fecal indicator bacteria -** *E. coli* and Enterococcus concentrations exceeded regulatory standards 89 to 94 percent (respectively) of the time across all sites during the 2010-2011 monitoring season.

COASTKEEPER AND ITS WATERSHED PARTNER, SURFRIDER FOUNDATION, SAN DIEGO CHAPTER, MONITOR WATER QUALITY AT THREE STATIONS IN THE TIJUANA RIVER AND THREE SITES IN THE TIJUANA ESTUARY. WE COLLECT SAMPLES AT OUR RIVER SITES AS LONG AS THEY STILL FLOW - SAN DIEGO'S LONG DRY SEASON MEANS OUR RIVER SITES ARE DRY FOR MUCH OF THE YEAR. FOR THIS REPORT, WE FOCUS ON OUR SITES IN THE RIVER, AS OPPOSED TO OUR ESTUARY SITES, AS THIS IS MORE REPRESENTATIVE OF THE REST OF OUR WATER QUALITY MONITORING PROGRAM DATASET.

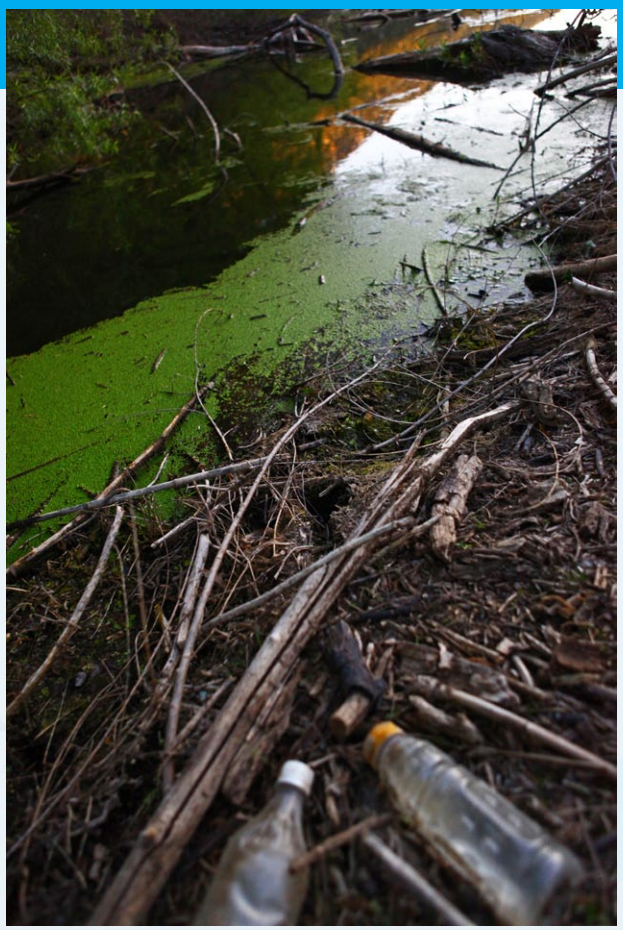


Photo credit: Shannon Switzer

In our estuary sites, we found:

- **In the summer — concentrations of all indicators were generally low, likely due to flushing by tidal action.** For example, in the summer, our equipment could not reliably detect nutrient concentrations because their concentrations were too low.
- **In the rainy season — concentrations of nutrients and fecal indicator bacteria (*E. coli* and Enteroccocus) tended to increase** – about half of our *E. coli* and Enteroccocus samples were above regulatory thresholds.

TIJUANA RIVER WATERSHED: POLLUTED BUT CRITICAL HABITAT

Polluted waters, artificially straightened channels and degraded riverine habitat are all part and parcel of this watershed's story. But the Tijuana River still provides habitat to over 370 species of birds, flows through five miles of open valley, delivers water into an expansive estuary and empties in the Pacific to form one of the most famous surf breaks in San Diego. The Tijuana River Watershed can defy its polluted expectations if we choose to see it.

Figure 38.

Although it is the largest watershed that drains into San Diego waters, 70 percent of the watershed is contained in the Mexican side of the border. Just south of the City of Tijuana, the river flows through a 6.6-mile concrete flood control channel and crosses the international boundary into California and discharges to the Tijuana Estuary on the U.S. side of the international border.

On the U.S. side of the border, the river runs through the cities of Imperial Beach, the City of San Diego and San Diego County. Over 80 percent of the watershed on the US side is either undeveloped or open space[1]. Conversely, two major urban centers (Tijuana and Tecate) exist on the Mexican side of the watershed. The current population of the entire watershed is approximately one million people[2].

Like most other watersheds in the greater San Diego region, the Tijuana River receives very little rain every wet season (November through April). The upper watershed areas receive up to 25 inches per year, while the lowland areas receive about 10 inches[2]. In winter, big storms create brief periods of very high flow. Little to no water flows in the river north of the border during the summer in part because less rain falls in the watershed but also because the South Bay International Wastewater Treatment Plant captures and holds flows during the summer.

The spread of urban areas around Tijuana removed or seriously disturbed much of the riparian vegetation in the river corridor[4]. But coastal sage scrub and chaparral plants like western sycamore,

Salt Marsh Bird's Beak (*Cordylanthus maritimus*) is an endangered plant that calls the upper marsh of the Tijuana Estuary home. The Tijuana Estuary is one of only 10 locations where the Salt Marsh Bird's Beak is found.

Photo credit: CalFlora

cottonwoods, and willows still line some of the Tijuana River banks, as do invasive species like giant reed and tamarisk. Where the river empties into the estuary, the plant community shifts to one dominated by wetland plants. This part of the watershed houses two large federal protected areas: the Tijuana River National Estuarine Research Reserve and the Tijuana Slough National Wildlife Refuge. These protected areas contain a variety of unique habitats, including dune, salt panne, salt marsh, mudflat, brackish pond, and vernal pool[2]. Collectively, these protected areas provide critical habitat for many different species and remains particularly important for migrating birds. In 2005, the Ramsar Convention designated the Tijuana Estuary as a "Wetland of International Importance."

Surfrider Foundation, San Diego Chapter and its members care deeply about the health of beaches and wetlands and people who recreate in them. That is why we started our Border Sewage – No B.S. campaign. Through No B.S., we hope to raise awareness of this incredibly overwhelming problem. Surfrider has been involved with the border sewage issue for over a decade fighting to avoid the negative environmental impacts and public health risks of discharging any raw sewage and debris directly into the ocean. Surfrider is committed to working with other environmental organizations to operate as a strong united front.

- Dan Murphy
Surfrider Foundation, San Diego Chapter

How does the river get dirty?

The Tijuana River Watershed is well known for its pollution problems. The water in the river regularly exceeds regulatory safe thresholds for a wide range of pollutants: bacteria, sediment, pesticides, heavy metals, nutrients, trash, and toxicity[1,4]. These exceedances led the State Water Resources Control Board to designate the American portions of the river and estuary as officially impaired by twelve types of contaminants.

Rivers of course don't stop at borders. Even though a smaller portion of the river flows through the U.S., the water quality in the downstream portion reflect the accumulated problems of the whole watershed. Agricultural practices on the U.S. portion contribute to water quality problems[4]. Rapid population growth without the necessary infrastructure to support it around Tijuana drives much of the remaining water quality problems. The number of people living in the Tijuana region continues to grow at a rapid rate, often moving into areas that have little or no formal planning or infrastructure. When unplanned developments emerge, particularly in steeply sloped canyon areas, vegetation disappears from slopes. Denuded canyon slopes lead to increased erosion, sending sediment into the river. Contaminants "stick" to sediment, so this increased sediment brings metals, PCBs, nutrients, and pesticides with it into the mouth of the river[5]. Improperly managed waste removal also results in the accumulation of trash in the canyons, which get flushed into the river during big storm events. Trash remains a major pollution challenge for this watershed.

Photo credit: Shannon Switzer

Sewage Runs Through It

Increasing human population puts pressure on the river in other ways. During big rain storms, large volumes of rain water mixes with wasterwater and overwhelms the capacity at treatment facilities, often resulting in sewage spills or bypasses of the treatment plant. Unplanned growth in the Tijuana region has also left many peoples' homes unconnected to the wastewater treatment system. About 25 to 30 percent of homes in the Tijuana River region do not have a direct connection to the local sewage infrastructure[3]. Collectively, this results in frequent spills of untreated or partially treated sewage into the river and often out to the ocean. In the early 1990s, up to 38,000 million gallons per day of raw wastewater from Mexico flowed down the Tijuana River and out through the National Estuarine Research Reserve, polluting the beaches of south San Diego County and Playas de Tijuana. Despite efforts from governments on both sides of the border to correct many of these problems, sewage continues to plague the Tijuana River. In 2010, just one spill in June released over 2 million gallons of wastewater into the Tijuana River Valley.

When sewage flows into the Tijuana River, its effects are felt up and down the coast, often resulting in beach closures. Between April 1, 2010 and March 31, 2011 some or all of South County beaches stayed closed for a total of 237 total days to prevent public exposure to pathogens potentially lurking in Tijuana River water[4]. Particularly during the rainy season, individual beaches remain closed for long periods of time—between 2010 and 2011, one south county beach remained closed from December 2010 until beyond March 2011[6].

How are regulators making the river cleaner?

Despite the challenge of bringing two nations together to solve water quality problems, progress has been made, particularly in improvements to the wastewater infrastructure. Prior to the 1970s and 1980s, up to 10 million gallons of untreated sewage discharged into the river valley daily and led to almost continuous closure of beaches in Imperial Beach and Coronado[5]. The City of Tijuana built new treatment facilities but the volume of sewage needing treatment still outstripped treatment capacity. Negotiations between both countries led to the construction of the International Wastewater Treatment Plant north of the border in San Ysidro.

Recently, Mexico and the U.S. agreed to increase the level of treatment occuring at the International Plant and in November of 2010, the plant began full secondary treatment in order to meet U.S. federal standards. Another major step forward occurred in the past two years with the construction of two new sewage treatment plants: Arturo Herrera and La Morita. These infrastructure improvements underpin efforts by U.S. and Mexican authorities to eliminate sewage pollution of the river valley and coastal waters, hopefully protecting water quality at San Diego and Tijuana beaches[6].

Sadly, many pollution challenges remain in the Tijuana River Watershed. Sediments from erosion, trash, and chemicals continue to degrade the water quality and habitat integrity of the Tijuana River Watershed. To help craft a roadmap for solutions to these problems, an alliance of more than thirty federal, state, and local government agencies, scientists, and environmental community and affected stakeholders established the Tijuana River Valley Recovery Team to protect the Tijuana River Valley from the impacts of trash and sediment and to restore the Tijuana River floodplain to a balanced wetland ecosystem.

TIJUANA RIVER WATERSHED

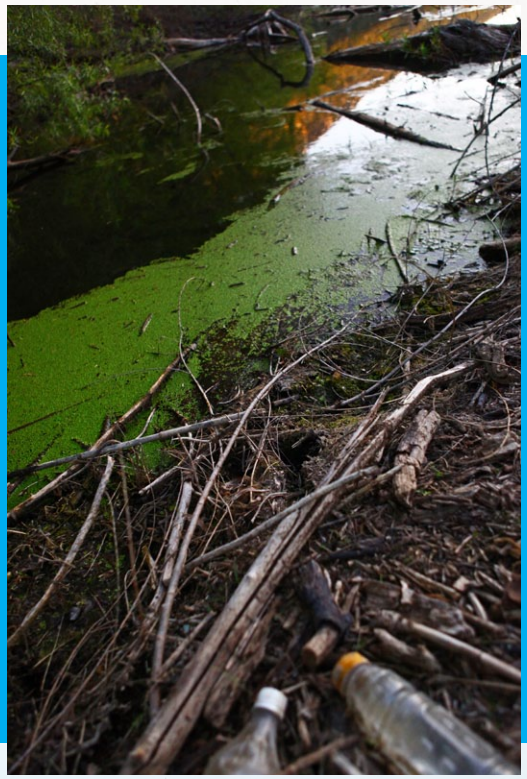
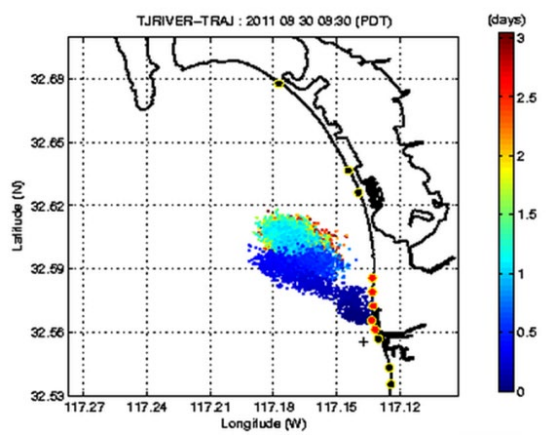


Photo credit: Shannon Switzer



Have you wondered where all that water (and pollution in it) from the Tijuana River goes? Apparently, so have local researchers. That is why the Southern California Coastal Observing Network created the Tijuana River Plume Tracker.. The Plume Tracker uses surface current data to estimate where the flows of the Tijuana River go once they reach the ocean. This data forms one piece of information used by local regulators when deciding to close beaches. *http://www.sccoos.org/data/trackingIB*

Where do we monitor?

Initially, our volunteer team monitored three sites in the Tijuana Estuary:

- at the Visitor Center,
- Grove Avenue, and
- in Oneonta Slough.

We measured here because of the importance of the ecosystem and the strong interest of our watershed partner, Surfrider Foundation, San Diego.

In 2010, we added three sites:

- where the river crosses under Saturn Boulevard,
- Hollister Bridge, and
- Dairy Mart Bridge.

This allows us to remain consistent with our monitoring strategy in other watersheds where monitoring is only done in freshwater. Our estuary monitoring sites become the focus of our monitoring efforts during the dry season, when most of our river sites are dry. This report focuses on the data from our river sites. The following section discusses the results from our river sites for the 2010-2011 rainy season.

THE TIJUANA ESTUARY— VITAL TRANSITION BETWEEN LAND AND SEA:

Before the Tijuana River empties into the ocean, it meanders through the Tijuana Estuary. In the estuary, river water mixes and exchanges with seawater that flows in and out with the tides. When we collect samples in the estuary, our samples reflect the influence of the river and the ocean, with ocean water often diluting the river signal. From 2009 through 2010, our water quality monitoring in the estuary tended to show low levels of nutrients. In the summer, nutrients were often at or below the minimum detection level of our analysis equipment. In the winter, when the estuary receives more river water, nutrient concentrations increased, in particular ammonia levels. In winter, we also observed that fecal indicator bacteria tended to increase as well – about half of our *E. coli* and Enteroccocus samples were above regulatory thresholds. For more details on the data from our estuary sites, please visit *www.sdcoastkeeper.org.*

Photo credit: Shannon Switzer

SUMMARY OF MONITORING DATA

BASIC INDICATORS

Key Trends in Coastkeeper dataset:

- The pH at our Tijuana River sites fell within the normal range. Conductivity (data not shown) tended to be high — there is currently no threshold for conductivity in San Diego, but according to the State Water Resources Control Board, streams should typically be in the 100 to 2000 μS/cm[8]. Only four of 23 samples collected in the Tijuana River were below this level.

- Dissolved oxygen was generally below the regulatory threshold at our Saturn Boulevard and Hollister Bridge sites. Low dissolved oxygen levels, even temporarily, impairs river organisms' ability to take in oxygen. Our site at the Dairy Mart Bridge did not show the same problems with dissolved oxygen. Concentrations of dissolved oxygen were consistently at or above the regulatory threshold at this site.

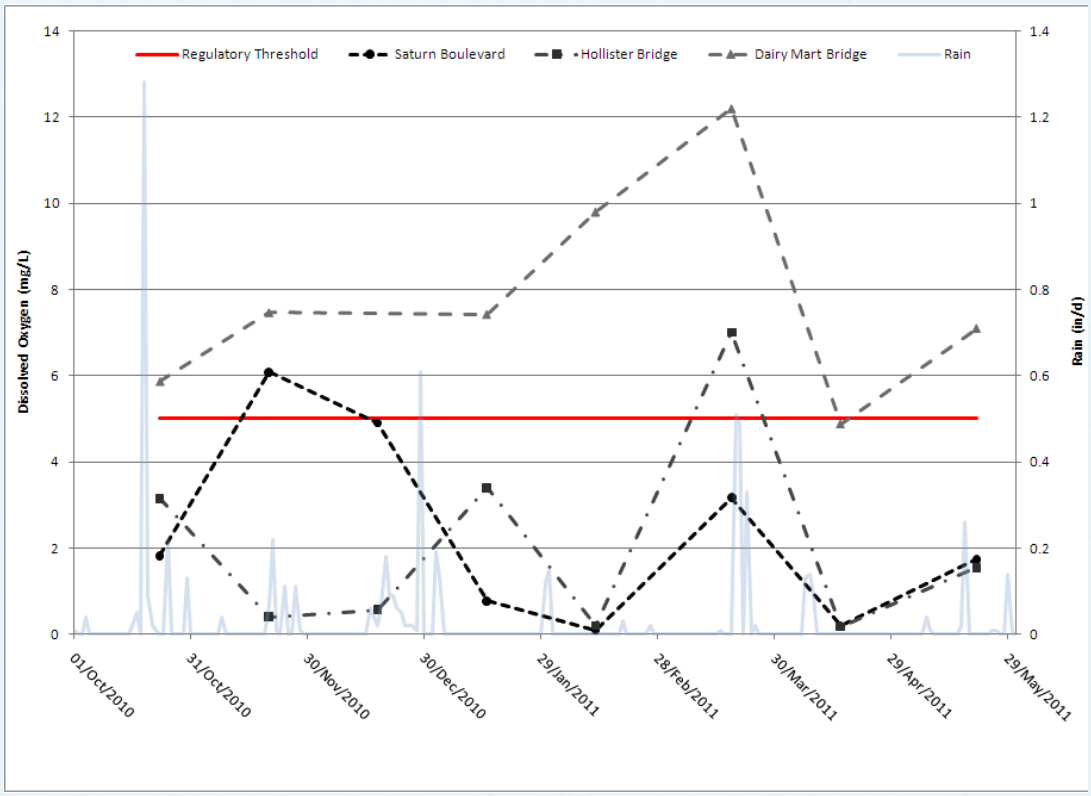


Figure 39. Concentration of dissolved oxygen in the Tijuana River during the rainy season of 2010-2011.

What are basic indicators? Coastkeeper measures four types of basic indicators: dissolved oxygen, temperature, pH and conductivity.

NUTRIENTS—NITRATES, AMMONIA AND PHOSPHORUS:

Key Trends in Coastkeeper dataset:

- The rainy season of 2010-2011 saw high levels of all three nutrients. In particular, phosphorus and ammonia concentrations were so high that their concentrations consistently exceeded the maximum concentration that our methods can detect.

- During the 2010-2011 rainy season, nitrate concentrations exceeded regulatory thresholds 50% of the time across all sites.

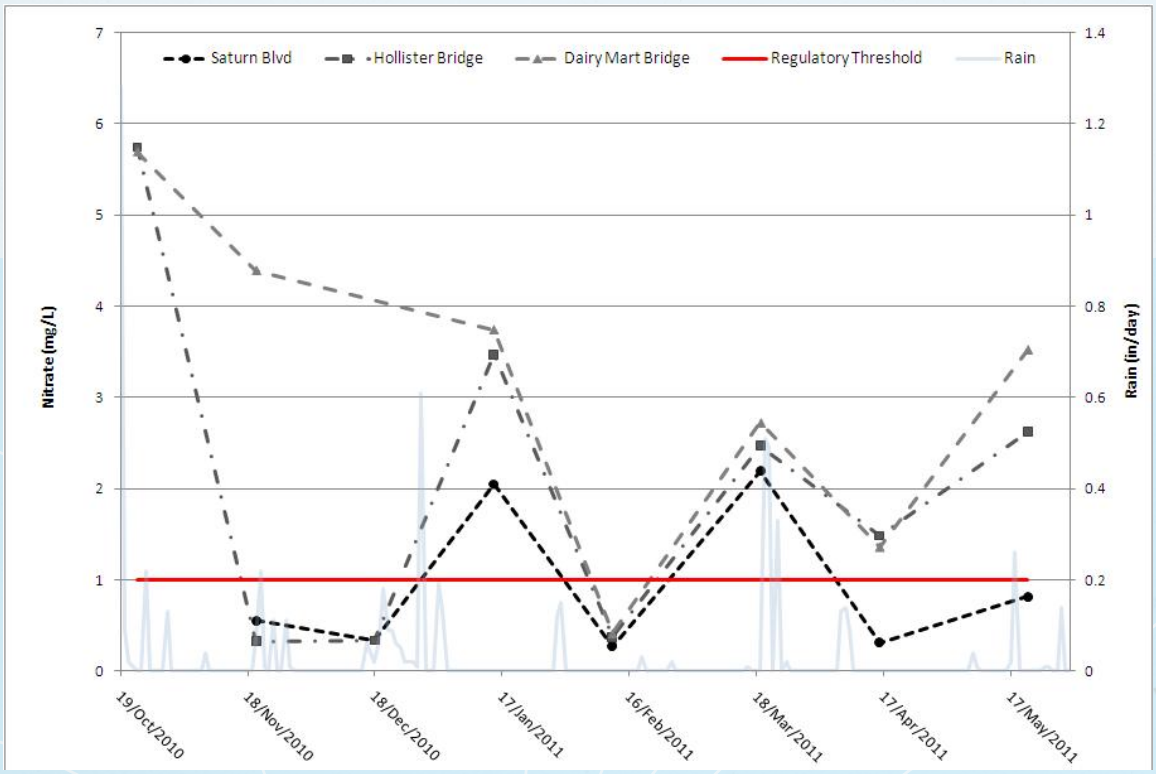


Figure 40. Concentration of nitrates in the Tijuana River for the rainy season 2010-2011.

What are nitrates? Nitrates are a form of nitrogen found in soil and water and are essential for plant growth. At high concentration nitrates can be toxic to wildlife[1] or cause excessive growth of photosynthetic organisms.

What is phosphate? Phosphate is a nutrient essential for plant growth and is one of the building blocks of DNA. It is the most biologically important form of phosphorus for aquatic systems. Too much phosphorus in water can cause rapid algal growth, called blooms or eutrophication, which can lead to decreased oxygen levels in creek water. In some instances this can cause fish kills or prevent other animals from thriving. It is commonly used in fertilizers. Other sources of phosphorus include human and animal waste (i.e., sewage), industrial wastes and soil erosion.

What is ammonia? Like nitrate, ammonia is another important part of the nitrogen cycle in ecosystems. It is a by-product of the metabolism of aquatic animals and is eventually converted into nitrate by bacteria. Manufacturers widely use it in fertilizers, household and industrial cleaners, plastics and explosives[1]. Ammonia is toxic to most aquatic life, especially at high pH.

FECAL INDICATOR BACTERIA – ENTEROCOCCUS & COLIFORM

Key Trends in Coastkeeper dataset:

- Coastkeeper's data indicates that the Tijuana River continues to show consistent problems with levels of bacterial indicators when the river is flowing.
- Enterococcus concentrations were always high (data not shown), showing exceedances of regulatory standards 94% of the time. *E. coli* concentrations fared slightly better, exceeding regulatory standards 89% of the time across all sites during the 2010-2011 monitoring season.

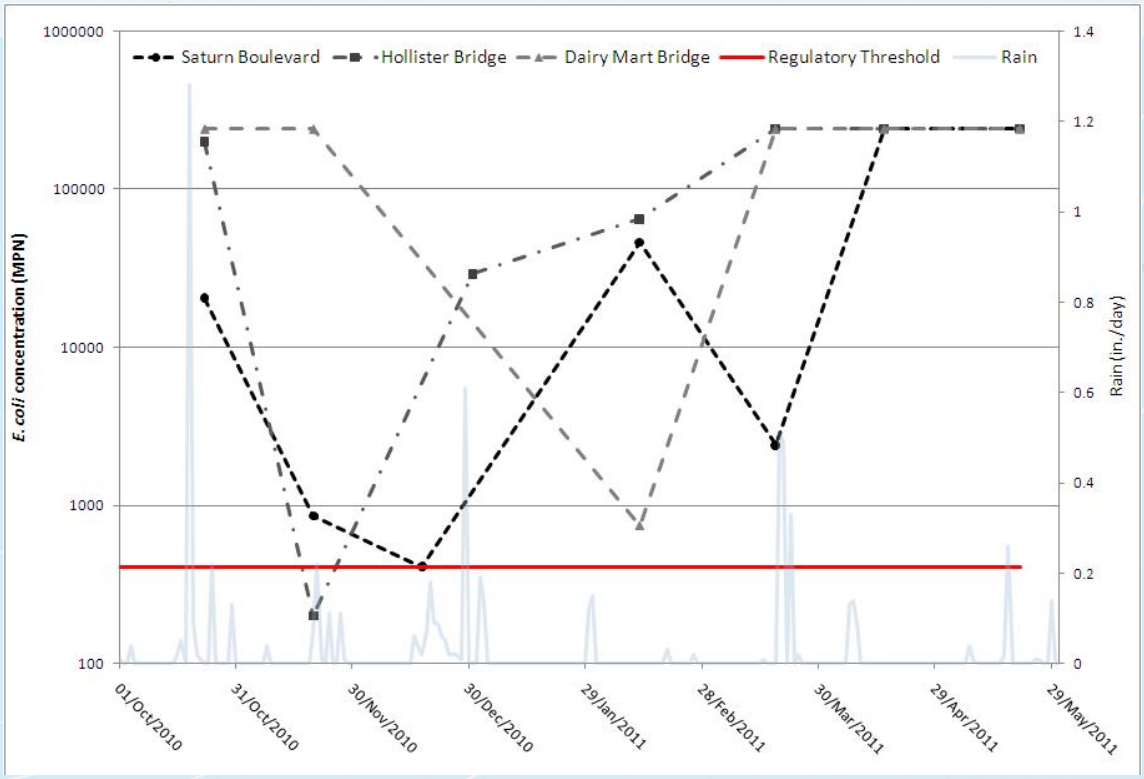


Figure 41. Concentrations of *E. coli* in the Tijuana River during the 2010-2011 rainy season. Not the scale difference from the other chapters.

What are fecal indicator bacteria? Fecal indicator bacteria are an indication of whether pathogens that can cause human illness are present in water. Coastkeeper measures three forms: Enterococcus, *E. coli*, and total coliform bacteria. *E. coli* is generally considered the best metric for evaluating freshwater. These bacteria and their associated pathogens can come from any warm-blooded animal such as the family dog, wild birds or humans. This poses significant management challenges.

DISSOLVED METALS

Key Trends in Coastkeeper dataset:

- Coastkeeper only began measuring dissolved metals in 2010. Figure 28 displays dissolved metal data for Coastkeeper's site at Hollister Bridge.
- All of the measured metals were far below Basin Plan thresholds and no exceedances were detected for any metals ‡.
- On average, the concentrations of dissolved metals tended to be highest at the Dairy Mart Bridge site, followed by the Hollister site and lowest at Saturn Boulevard.

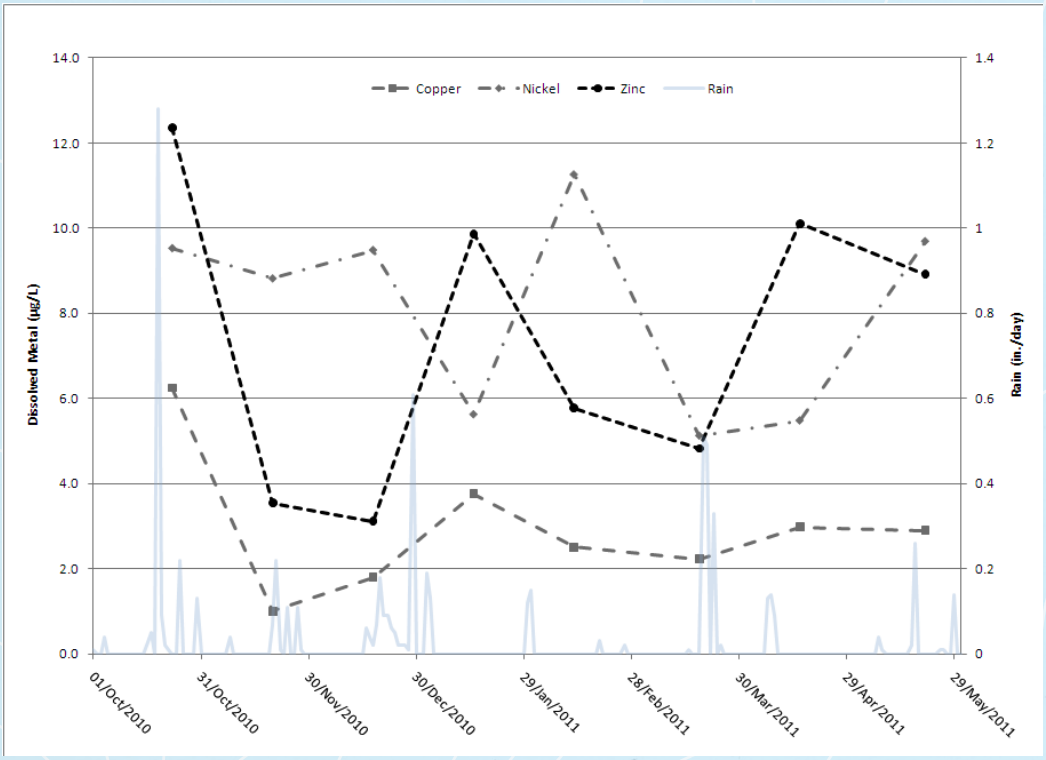


Figure 42. Concentrations of dissolved metals in the Tijuana River during the 2010-2011 rainy season.

What are dissolved metals? Dissolved metals can cause a wide range of negative impacts to aquatic organisms in creeks and the waters that they drain to—they can reduce growth, harm reproduction and, in high enough concentrations, can cause death. Urban runoff is a major conduit of metals into the creek. Higher concentrations of metals tend to originate in areas with more industrial and commercial activities, and dissolved metal concentrations tend to peak with the first flush of a rain storm.

‡ Regulatory Thresholds (Basin Plan Standards) for dissolved metals are as follows: Cadmium:>2.0 µg/L; Chromium >16 µg/L; Copper >80 µg/L; Lead >65 µg/L; Nickel>470 µg/L; Zinc >120 µg/L

TRASH

Key Trends in Coastkeeper dataset:

- Trash continues to be a major environmental problem in the Tijuana Watershed. Many community groups in the region focus on this watershed issue because the problem remains so challenging.
- Coastkeeper's Marine Debris Program collects trash at two to three sites in the Tijuana River for Coastal Cleanup Day. 354 volunteers collected over 11,000 pounds of trash from the U.S. side of the Tijuana River during these two Coastal Cleanup Day events.
- In 2010, volunteers collected approximately 37% more trash in 2010 than in 2009.

COASTAL CLEANUP DAY TOTAL:	2009	2010
Number of Sites	2	3
Miles Cleaned	2	3
Number of Volunteers	192	155
Pounds of Trash Removed	4,521	7,132

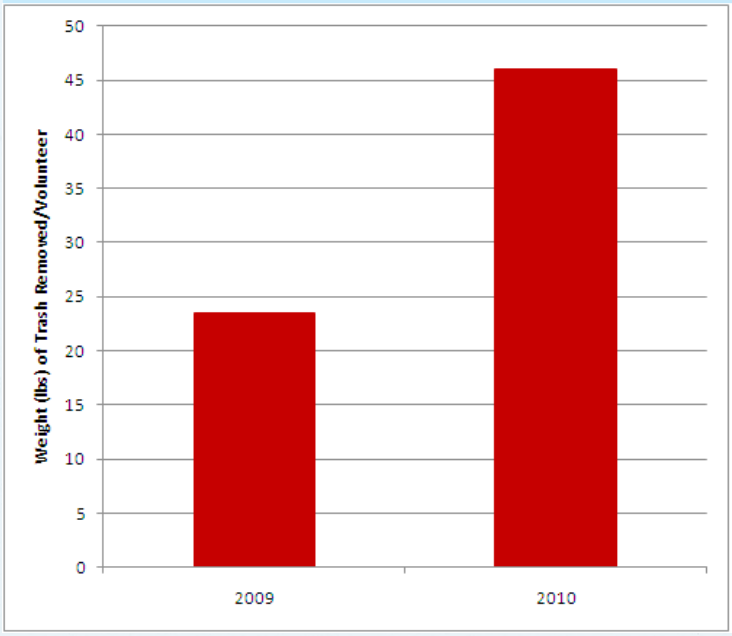


Figure 43. Total weight (lbs) of trash removed from the Tijuana River by volunteers during Coastal Cleanup Day in 2009 and 2010.

What is trash? In addition to being unsightly, trash can harbor pathogens, degrade wildlife habitat and contribute to flooding problems in creeks. Animals can ingest trash or become entangled in it, and it can eventually flow from our creeks to our beaches and the ocean.

Photo credit: Shannon Switzer

TECHNICAL RESOURCES

Coastkeeper is not the only entity that monitors water quality in the Tijuana River Watershed. If you are interested in learning more about other water quality monitoring programs, we encourage you to read the following technical resources:

TRNERR monitoring online portals

Tijuana Estuary Management Plan. http://www.trnerr.org/?page_id=552/

International Boundary Water Comission. http://www.ibwc.gov/

Southern California Coastal Ocean Observing System. http://www.sccoos.org/

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6. Clean Water Team Electrical Conductivity/Salinity Fact Sheet. Fact Sheet 3.1.3.0. *The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment 0, 2-6* (2004).

Coastkeeper's Water Quality Monitoring Program's volunteers collect samples on a monthly basis, rain or shine.

Our program puts boots on the ground to gather the data our region needs to better manage its watersheds. Coastkeeper's data collection is still in its initial phase. However, even with a short data set, we can make inferences about the status of our watersheds' water quality.

Coastkeeper's water quality data revealed a trend across the county's watersheds of problems with elevated concentrations of nutrients (ammonia, nitrate and phosphorus). In addition, several watersheds showed below healthy levels of dissolved oxygen. When there is too little oxygen in the water, organisms' ability to breath is impaired.

Our data also confirmed that creeks in the county contain high levels of fecal indicator bacteria in the water. The Regional Water Quality Control Board recently approved a cleanup plan for bacteria in our region's creeks and shorelines. Our dataset should be useful for tracking the success of the cleanup plan.

As Coastkeeper's Water Quality Monitoring continues to evolve, we will be able to analyze long-term trends in ambient water quality. This dataset will complement the monitoring work conducted by local governments. Taken together, these complementary datasets will help local regulatory agencies make more effective water quality management decisions.

Key Recommendations

1. Continue to build dataset

- Building a long-term dataset for all of our watersheds will help determine in what ways water quality is improving or declining. Continued monitoring at consistent sites will help identify long-term water quality trends.

- Continue to add important indicators to our dataset. Coastkeeper recently began collecting data on invertebrates that live in creeks and trash in our creeks. We will expand these two programs to add important information about the health of our creeks.

2. Connect water quality data to policy solutions

- Coastkeeper has long advocated for policies that will help restore water quality in our watersheds. Now we can leverage our data to inform our policy recommendations for this watershed.

- Stakeholders should use all available data, including Coastkeeper's, to develop biological goals for each watershed. This will help us understand whether our management activities are effective at making a healthier watershed.

3. Work with other stakeholders to identify effectiveness of watershed restoration efforts

- Community groups work tirelessly to restore habitat in our watersheds. Coastkeeper should work closely with these groups to monitor to what extent habitat restoration can improve water quality flowing through our county.

- Local governments and water quality agencies can benefit from our dataset – we should seek additional ways to connect our data with other on-going monitoring efforts.

OUR PROGRAM PUTS "BOOTS ON THE GROUND" TO GATHER THE DATA OUR REGION NEEDS TO BETTER MANAGE ITS WATERSHEDS.

Photo credit: Jackie Loza

Photo credit: Shannon Switzer

CARS, YARDS AND PETS: WAYS TO HELP KEEP OUR WATERSHEDS HEALTHIER

Our data show that nutrients are becoming a water quality problem in our region. You can help reduce how much nutrients like phosphorus or nitrogen get into our storm drains by practicing good watershed stewardship techniques in your yard. Avoid using chemical fertilizers on your lawn or garden. Get friendly with worms and learn how composting can help reduce how much waste you send to a landfill while giving you a natural and safer way to fertilize your lawn. If you do use chemical fertilizers, don't use them before rain; they will just flow into the storm drain. Minimize how much you water your lawn. Over watering wastes water and it carries fertilizer, pesticides and dirt into the storm drain system. Better yet, consider planting a rain garden with native plants in your yard. They need fewer chemical additives and use less water as well.

Your car is a source of storm water pollution. Help make your car creek friendly. Be on the lookout for oil leaks and when you change your oil, dispose of the used oil properly. Keep your car and creeks clean by taking your car to a local car wash instead of washing it in your driveway. Car wash centers capture and treat the wash water instead of sending it to the storm drains.

You may love Fido, but our creeks do not. When we do not clean up after our pets, their feces end up getting washed into our storm drains, into our creeks and out to our coast. Bacteria in pet waste contribute to water quality problems along our shorelines and creeks that ultimately put human health at risk. Remember, when you put a doggie treat in your pocket, also put a few extra bags for cleaning up after your dog.