San Mateo/Cristianitos Creek
Baseline Water Quality Monitoring
Subproject Data Report

Orange County Coastkeeper

August 25 2008

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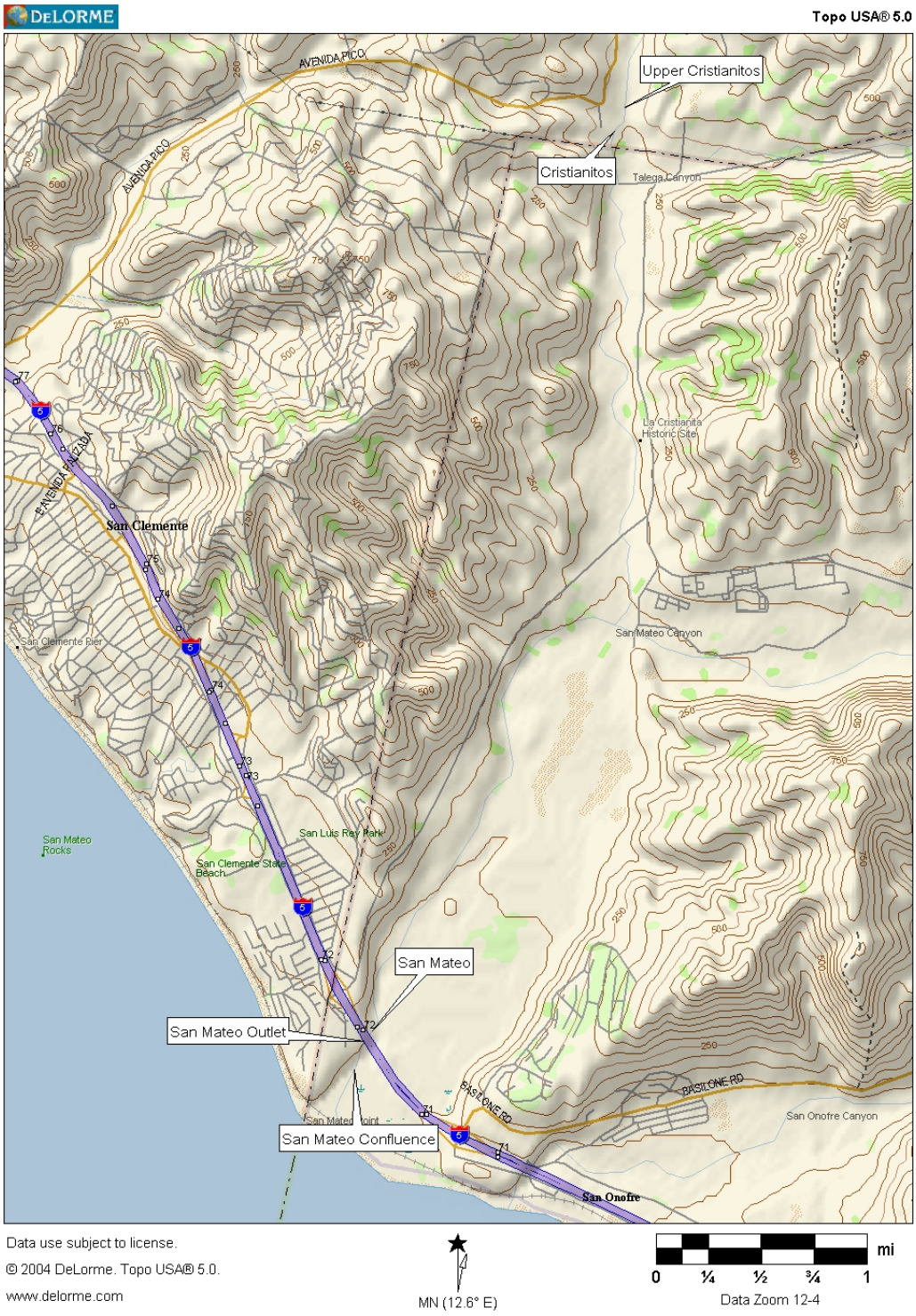
Project Map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Executive Summary

In 2006 Orange County Coastkeeper (OCCK) and Inland Empire Waterkeeper began researching the water quality of streams in the Cleveland National Forest to determine baseline water quality in light of the several major development projects proposed for the forest. After examining the data available, it became apparent that this data was insufficient to determine the baseline water quality in most of the streams. To fill this data gap, O.C. Coastkeeper developed a proposal to monitor water quality of the forest streams to document baseline conditions. In 2007, the Inland Empire Canyons Baseline Monitoring Project was funded for one year. The San Mateo Creek and Cristianitos Creek monitoring project was added as a sub project due to the impending development of the Foothill South Tollroad and the lack of data for these creeks.

The project began with the creation of a Technical Advisory Committee (TAC) made up of water quality experts from the Elsinore Valley Water District, the U.S. Forest Service, and the University of California Riverside. The TAC had the charge of reviewing the monitoring plan and Quality Assurance Project Plan (QAPP) to insure that the data collected was of sufficient quality to be used by the Regional Water Quality Control Boards and other entities for planning and permitting purposes. The next step for the San Mateo/ Cristianitos Creek project was to conduct a reconnaissance of the two creeks within the confines of San Onofre State Park (which affords the only public access to Cristianitos Creek and the lower reach of San Mateo Creek) to identify sampling sites and dry weather flow conditions. Eventually five sampling sites were identified, with two each on San Mateo and Christianitos Creeks and one stormdrain under the old highway 1 bridge.

Dry weather water samples were collected from all five sites during the one year duration of the project (wet weather samples were not collected due to hazardous conditions and lack of sufficient rain for significant flow) and analyzed for standard water quality parameters such as pH, temperature, conductivity, and dissolved oxygen. Additional analysis were run for nutrients and indicator bacteria. All of these tests were run in the field (standard parameters) or in the Coastkeeper lab (nutrients and bacteria) using state accepted methods. We also analyzed a subset of the samples for Total Suspended Solids, Hardness, Metals and Hydrocarbons. These tests were run by a contract lab, also using state approved methods. Sample collection began in July 2007 and was completed in June 2008.

After the samples were analyzed, the data generated was entered into an Excel spreadsheet. Each sample and the overall mean results were compared to the objectives for inland surface waters detailed in the San Diego Regional Board's Basin Plan. The Basin Plan objectives cover bacteria, ammonia, nitrate, phosphorus, dissolved oxygen and pH. The data for metals was compared to the California Toxics Rule criteria developed by the US EPA for California.

The results of the data analysis are mixed; the creeks are generally in good shape but they are beginning to show the impact of the land uses around them. The creeks do not meet

the basin plan objectives for ammonia and phosphate. All five sample sites exceeded the ammonia and phosphate objectives almost every time they were sampled. The exceedence for phosphate can explained by the fact that phosphate naturally occurs at high levels in Orange County waters. However, we do not have an explanation for the ammonia exceedence other than the fact that the ammonia objective in the San Diego Basin Plan is quite low. Bacteria also showed the effects that even limited development can cause for water quality. The two urban runoff sites, Cristianitos and the San Mateo Stormdrain outlet, had a higher number of exceedences (33% to 82% of samples exceeded single sample objectives) and higher average bacteria concentrations than the other three sites that are natural waters (0% to 33% of samples exceeded single sample objectives). The metals analysis metals showed that the only exceedences were at the Cristianitos site, where Cadmium, Nickel, and Selenium were in exceedence. This is not surprising, as urban runoff is a common source of metals. Twenty three of the twenty five tests run for Total Recoverable Hydrocarbons all came back with non-detects, which indicates that the creeks are not currently affected by Hydrocarbons.

Background

The San Mateo Creek watershed covers approximately 20 square miles of Orange and San Diego Counties, beginning in the Santa Ana Mountains and terminating at San Onofre State Beach just south of the city of San Clemente. Its headwaters are in the San Mateo Wilderness of the Cleveland National Forest, where it is a perennial stream. From there its course leads through the Camp Pendleton Marine Corps Base, where it becomes intermittent. The creek then springs back to the surface and becomes perennial just above the I-5 freeway, and forms an estuary at San Onofre Beach State Park. The upper reach of the stream is undisturbed wilderness and is critical habitat for wildlife, including steelhead trout. The lower section of the stream runs through an area of Camp Pendleton that has seen some disturbance from military operations and farming, but is largely undeveloped with the riparian habitat intact. This area is critical habitat to endangered species, including the pacific pocket mouse, arroyo toad, coastal California Gnatcatcher, and least Bell's vireo. The area below the I-5 freeway is estuarine, and the creek is blocked from discharge to the ocean by a sand berm that is broken during storm events. This area is critical habitat for the tidewater goby and many migratory waterfowl. Overall, the creek is part of one of the last largely undeveloped coastal watersheds in Southern California and is a critical component of a complex ecosystem.

Cristianitos Creek is the major tributary to San Mateo Creek. It begins in Orange County just south of Ortega Highway on Rancho Mission Viejo land, and continues through the Donna O'Neal Land Conservancy to Camp Pendleton. Here the creek forms the southern boundary of San Onofre State Park before it merges with San Mateo Creek near Cristianitos Road. The creek is intermittent in its lower reach. The Cristianitos Creek watershed has experienced some disturbance from cattle grazing, farming, military activities and urban runoff from nearby development. However, the watershed remains undeveloped and overall the ecosystem and riparian area is intact. This watershed is critical habitat to a wide range of wildlife and provides recreational opportunities to visitors.

Project Description

In 2006 Orange County Coastkeeper (OCCK) and Inland Empire Waterkeeper began researching the water quality of streams in the Cleveland National Forest. The project's goal was to determine baseline water quality in light of the many major development projects proposed for the forest. After examining the data available, Coastkeeper determined it was insufficient to determine the baseline water quality in most of the streams. To fill this data gap, Coastkeeper developed a proposal to monitor water quality of the forest streams to document baseline conditions. In 2007 the project was funded for one year of monitoring as the Inland Empire Canyons Baseline Monitoring Project. The San Mateo Creek and Cristianitos Creek monitoring project was added as a subproject, due to the impending development of the Foothill South Tollroad and the lack of data for these creeks.

Quality Control

Quality Control for the data developed by the project was maintained by adhering to the Inland Empire Canyons Baseline Monitoring Project Quality Assurance Project Plan developed for the larger project. The QAPP was created with the assistance of a Technical Advisory Committee (TAC), which included water quality experts from the Elsinore Valley Water District, the U.S. Forest Service, and the University of California Riverside. The TAC was responsible for reviewing and approving the QAPP to insure that the data collected was of sufficient quality to be used by the Regional Water Quality Control Boards and other entities for planning and permitting purposes.

Site Selection

The next step for the San Mateo/ Cristianitos Creek project was to conduct a reconnaissance of the two creeks within the confines of San Onofre State Park (which affords the only public access to Cristianitos Creek and the lower reach of San Mateo Creek) to identify sampling sites and document dry weather flow conditions. During our initial reconnaissance, perennial flow was identified at two selected sites:

- Cristianitos: at Cristianitos creek near the end of Avenida Pico (due to a steady flow of urban runoff from the Talega housing development)
- San Mateo: on San Mateo Creek just above the I-5 Freeway bridge, where a spring re-establishes perennial flow.

Eventually three other sites were added, one in Cristianitos Creek and two below the San Mateo spring site:

- Upper Cristianitos: above the urban runoff into Cristianitos creek (added after rain events established water in the creek)
- San Mateo Outlet: at an outlet under the old highway 101 bridge
- San Mateo Confluence: at the head of the estuary where two spring fed branches of San Mateo Creek converge (See Project map for site locations).

Site Name	Latitude	Longitude
Upper Cristianitos	33^{o} 27.357’	117^{o} 34.172’
Cristianitos	33^{o} 27.248’	117^{o} 34.228’
San Mateo	33^{o} 23.572’	117^{o} 35.418’
San Mateo Outlet	33^{o} 23.521’	117^{o} 35.470’
San Mateo Confluence	33^{o} 23.90’	117^{o} 35.508’
All coordinates are WGS 84		

Physical and Chemical Analysis

The parameters selected for the monitoring of San Mateo and Cristianitos creeks include nutrients and bacteria, and standard physical parameters including pH, conductivity dissolved oxygen, temperature and a visual observation of flow. Additionally, we selected TRPH (Total Recoverable Petroleum Hydrocarbons) and dissolved metals,

pollutants commonly associated with developed areas and roads.

Testing began at San Mateo and Cristianitos creeks in July 2007 and continued on a monthly basis, concluding in June 2008. The Upper Cristianitos site was monitored whenever water was present. The San Mateo Confluence site was added in October 2007 and monitored from then on. The San Mateo Outlet was monitored three times and discontinued, since we could not identify the source of water from the outlet, which was suspected to be the I-5 Freeway.

Site Visits

Location	Jul-5-2007	Aug-23-2007	Sep-27-2007	Oct-29-2007	Nov-20-2007	Jan-09-2008	Jan-27-2008	Mar-05-2007	Mar-28-2008	Apr-29-2008	May-28-2008	Jun-25-2008
San Mateo	X	X	X	X	X	X	X	X	X	X	X	X
Confluence				X	X	X	X	X	X	X	X	X
Outlet				X	X		X					
Chrisitianos		X	X	X	X	X	X	X	X	X	X	X
Upper Chrisitianos						X	X	X	X	X	X	

Analysis Methods

Temperature, pH, dissolved oxygen, and conductivity were measured in the field using pre-calibrated Oakton meters. Bacteria samples were run at the Coastkeeper office using the IDEXX method using colilert 18 reagent for Total Coliform and *E.Coli* and Enterolert reagent for Enterococci. Nutrient analysis was run at the Coastkeeper lab with a Hach colorimeter, using methods meeting the Inland Empire Canyons Baseline Monitoring Project QAPP requirements. Nitrate-Nitrogen samples were filtered through a .45µm filter and then tested using a variation of the cadmium reduction method detailed in Standard Method 4500-NO_3 E. This test has a range of 0.5-30 mg/l, a detection limit of 0.5mg/l and a standard deviation of 0.3 mg/l The Ammonia- Nitrogen samples were tested using a salicylate method adapted from Clin.Chim. 14 403 (1966). This test has a range of 0.02-0.5mg/l, a detection limit of 0.02 and a standard deviation of 0.02. The Orthophosphate test was done using a procedure equivalent to USEPA method 365.2 and Standard Method 4500-PE. This test has a range of 0.05-2.5 mg/l, a detection limit of 0.05mg/l and a standard deviation of 0.05 mg/l.

Testing for metals, hardness (as $CaCO_3$), Total Suspended Solids, and Total Recoverable Petroleum Hydrocarbons was done by Test America Labs using EPA method 6020 for metals, SM 2340B for hardness, and SM 2540D for TSS. Testing for TRPH was done using EPA method 418.1.

Data Results Discussion:

All data results are in a project database available from Orange County Coastkeeper on request.

Individual Parameters

- Water Temperature – The temperature of water affects aquatic life because most species can only thrive within a certain temperature range. Other factors, such as dissolved oxygen, can be affected by the temperature which in turn affects the rate of photosynthesis in aquatic plants. As temperatures increase, the quantity of dissolved oxygen in a water body will increase accordingly. Human intervention can affect temperature by removing canopy cover and building or removing water diversions along or in the streams, causing a rise in water temperature. The temperatures we measured were not at levels that would affect the beneficial uses of these streams.

- Dissolved Oxygen –Dissolved oxygen is necessary to sustain aquatic life. Dissolved oxygen shall not be less than 5.0mg/L in inland surface waters, as stated in the San Diego Regional Water Quality Control Board's (SWRCB) Basin Plan. The San Mateo site proved to be the only monitored site to have low levels of dissolved oxygen, with all of the measurements below the basin plan objective. These low dissolved oxygen levels are not surprising at this site as it is a spring and groundwater typically has low levels of dissolved oxygen.

- Conductivity– An estimate of the amount of dissolved solids in the water can be made by measuring conductivity. Dissolved solids include acids, minerals, salts and metals. Conductivity varies for many reasons but high conductivity may be an indicator of bigger problems. Conductivity over 1.0 ms/cm for fresh water can be a sign of problems. None of the sites tested for conductivity exceeded the acceptable limit.

- pH – pH is a measure of hydrogen ions that control the acidity and the alkalinity of the water. Most aquatic life can only survive within a narrow range of pH, thus it is important to monitor. The acceptable level for pH in the San Diego Basin Plan is between 6.5 and 8.6. The sample taken from Cristianitos creek on August 23, 2007 had a pH of 3.16, significantly lower (more acidic) than the recommended pH level of 6.5. All other monitoring dates and sites had pH levels within the acceptable levels.

- Orthophosphate – Orange County soils have naturally high levels of phosphate, phosphates also commonly enter water bodies through lawn and garden fertilizer with run-off or soil erosion. Increased phosphate concentrations can lead to increased growth of algae and plants, which then deplete dissolved oxygen in the water. The San Diego Basin Plan states that phosphates should not exceed 0.1mg/L in order to prevent plant nuisances in streams and other flowing waters. Phosphate levels exceeded the recommended set standard at all five sites. San Mateo, San Mateo Outlet, and Cristianitos had 100% exceedance; San Mateo Confluence and Cristianitos Upper had slightly less exceedance. The highest phosphate level of 2.75 mg/L was sampled at San Mateo Outlet on November 20, 2007.

- Nitrate-Nitrogen – Similar to phosphate, nitrate is a plant nutrient that usually enters water bodies through overuse of fertilizer. Excessive Nitrate promotes algal blooms and aquatic plant growth that can suffocate other life. The San Diego Basin Plan states that nitrate levels should not exceed phosphate levels by more than a ten to one ratio. None of the samples exceeded the standard.

- Ammonia-Nitrogen – Ammonia is another plant nutrient, the primary urban runoff sources are fertilizer and animal waste. Ammonia is an important chemical to monitor because it can accumulate to toxic levels and affect the metabolism of fish and other aquatic organisms. This toxin can also affect organisms at higher levels in the food chain. According to the San Diego Basin Plan, the discharge of wastes shall not cause concentrations of ammonia to exceed 0.025 mg/L in inland surface waters, enclosed bays and estuaries and coastal lagoons. All five monitoring sites exceeded the ammonia standard the majority of the time ranging from 75% (San Mateo) to 100% (San Mateo Outlet and Cristianitos Upper). San Mateo Confluence had an 85% exceedance and Cristianitos had a 93% exceedance of ammonia among all testing dates. San Mateo Outlet had the highest exceedance on November 20, 2007 with an ammonia level of 0.73 mg/L.While there are many exceedences of the ammonia standard it is important to note thet the basin plan states that the standard should nt be exceeded due to the discharge of wastes. Due to the undeveloped nature of these watersheds it is likely that the exceedences found are due to natural conditions.

- Turbidity/Total Suspended Solids (TSS) – Turbidity is attributable to suspended and colloidal matter, the effect of which is to disturb water clarity and diminish the penetration of light. High turbidity levels indicate a large amount of suspended particles in the water. Total Suspended Solids is the measurement of the amount of solid material in a sample. Particles can block sunlight and impede respiration and adversely affect photosynthesis, having a major effect on organisms. Additionally, high levels of turbidity create concern since suspended particles often carry pollutants. Natural turbidity varies from site to site but is generally below 100 NTU. If turbidity is above average, this may indicate erosion, nutrient loading, or excessive algae growth. Turbidity levels exceeding 100 FAU or TSS above 100mg/L fresh water would be considered abnormal and would be a level of concern. None of the sampled sites exceeded the limit for turbidity or TSS.

- Bacteria (*E. coli*, and Enterococcus) – High levels of these indicator bacteria imply a high probability of pathogens harmful to humans in the water. Total Coliform comes from a broad range of environmental sources including plants and animals. The presence of *E.coli* is an indicator of fecal contamination from warm-blooded animals and in some cases can cause severe illness. The water quality objective for *E.coli* in the San Diego Basin Plan for infrequently used areas is (recommended by the U.S. EPA) are 576 MPN/ 100mL (single sample) and 126 MPN/100mL (geomean). All monitored sites had some exceedences of the *E.Coli* standards. San Mateo had an 9% exceedance in *E.Coli*; San Mateo Outlet had a 33% exceedance in *E. Coli*; San Mateo Confluence had a 22% exceedence

in *E. Coli*; Cristianitos had a 27% exceedance in *E.Coli*; and Cristianos Upper had a 17% exceedance in *E. Coli*. San Mateo Outlet had the highest *E.Coli* exceedance on November 20, 2007 with an *E.Coli* level of 7,890.00 MPN/100ml. Enterococcus standards are low accepted levels, because the correlation between it and human pathogens is high. The accepted sample limits in the San Diego Basin Plan for infrequently used areas is (recommended by the U.S. EPA) are 151 MPN/100mL (single sample) and 33 MPN/100mL (geomean). Cristianitos Upper was the only site without exceedance in Enterococcus. San Mateo had an exceedance of 27%; San Mateo Confluence had an exceedance of 33%; and Cristianitos had and exceedance of 82%. The highest level of enterococcus was 2,419.20 MPN/100mL and was found at both San Mateo on October 29, 2007, and Cristianitos on August 23, 2007.

- Total and Dissolved Metals/Hardness- Metals are naturally occurring elements that are also have a variety of uses in many of the products that we use in a daily basis. Hardness is the measurement of Calcium Carbonate in water and is used to estimate the naturally occurring levels of metals in water. Elevated levels of metals (above natural concentrations) such as copper and zinc are often found in urban runoff and are harmful to aquatic life. The criteria used for metals were developed for California by the USEPA and are detailed in the California Toxics Rule (CTR). These criteria run on a sliding scale in relation to the hardness of the water. There were no exceedences of the CTR for metals at any of the sites although the sites composed of urban runoff (Cristianitos and San Mateo Outlet) had higher values than the other sites.

- Total Recoverable Hydrocarbons-Total Recoverable Hydrocarbons (TRPH) is used to identify the level of all hydrocarbons, this includes oil and grease, gasoline, asphalt residue and other compounds that are indicative of developed areas and automobile use. This measurement is a good indicator of the impact of development on a waterway. Except of the first sample taken from both the Cristianitos and San Mateo sites all samples had no detectable amounts of Hydrocarbons.

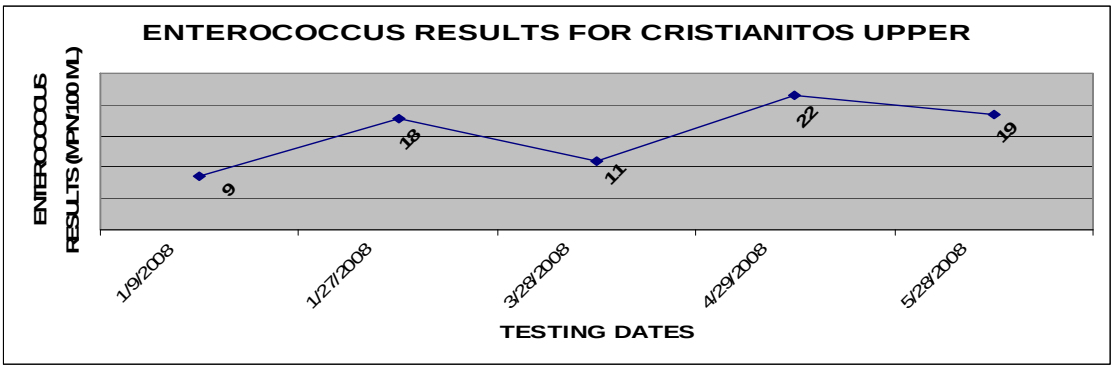
Site Comparisons

The sites selected for monitoring can be broken down into two basic categories for comparison; The first category is sites on each stream, San Mateo and Cristianitos. The second category is sites that are primarily comprised of urban runoff (Cristianitos and San Mateo Outlet) and sites that are primarily composed of naturally occurring water (upper Cristianitos, San Mateo, San Mateo Confluence). A discussion of the individual sites and then the two streams follows.

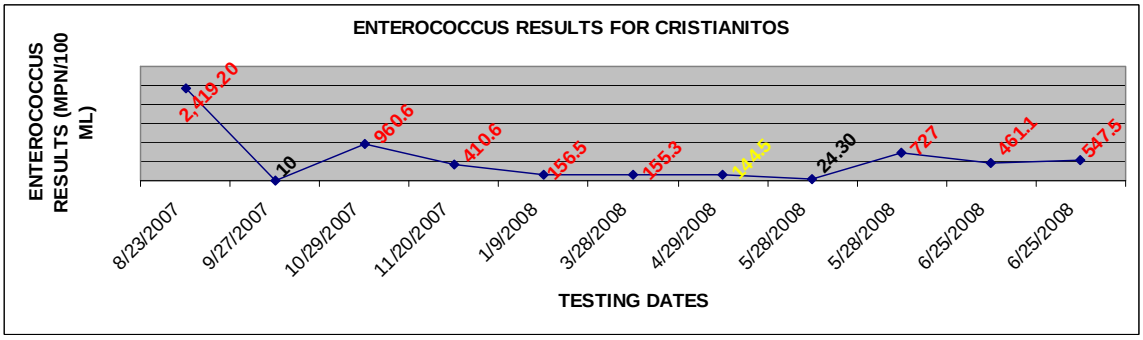
Cristianitos Creek Sites

Upper Cristianitos- This site is located on Cristianitos Creek near the end of Avenida

Pico upstream of the county detention basin. At this site the stream is intermittent (its natural state) with water present from October 2007 through May 2007. The water at this site meets all water quality standards except for ammonia and phosphate (which are exceeded at all of the project sites). This site has clear ponded water with very low flow. Other than ammonia, it exhibits all the characteristics of an undisturbed Orange County stream. Upper Cristianitos had the lowest concentrations of metals, bacteria and nutrients of all the sites tested, and had no exceedences of Enterococcus or metals.



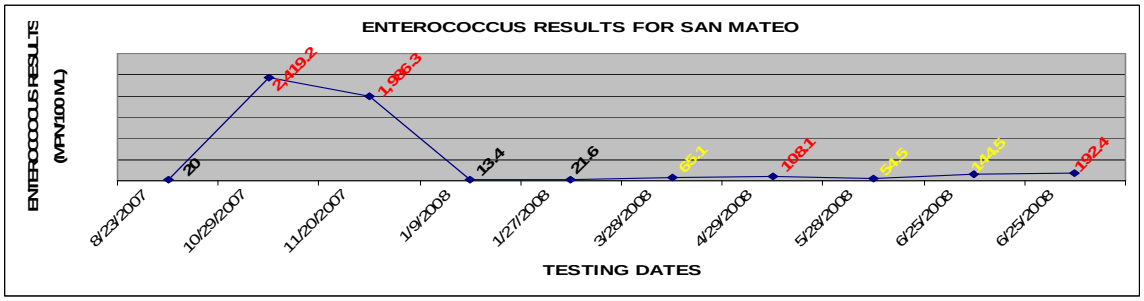
Cristianitos- This site is located near the end of Avenida Pico downstream from the county detention basin. At this site the creek receives a constant flow (the highest of all the sites) of urban runoff from the Talega housing development, which continues downstream from the site for about a quarter mile before infiltrating. This site had the highest percentage of exceedences of the bacteria objectives of all the sites with 82% of the Enterococcus exceeding basin plan objectives. Metals were also much higher here than at the Upper Cristianitos site with copper 433% higher and Zinc 675% higher. There were also exceedences of the metals objectives for Cadmium, Nickel, and Selenium. As with all the sites, samples from the Cristianitos site exceeded the ammonia and phosphate objectives almost every time. Nitrate levels were below basin plan standards but still four times higher than the Upper Cristianitos site.



San Mateo Creek Sites

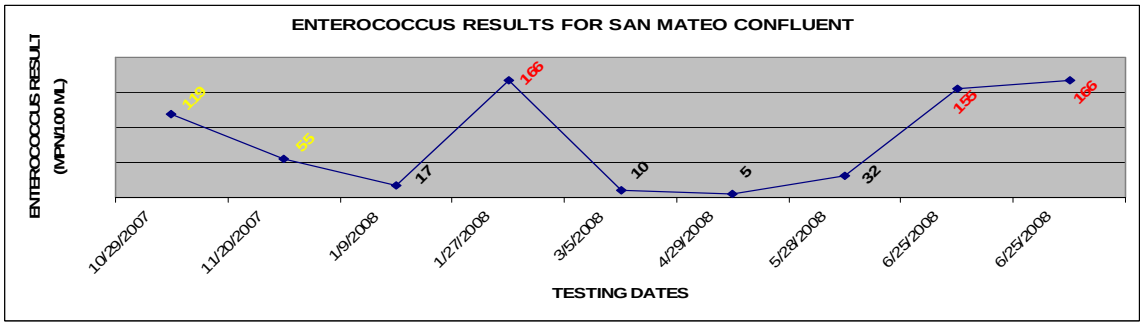
San Mateo- This site is located on San Mateo Creek just upstream of the I-5 freeway

bridge. This is the most upstream point where the creek springs back to the surface before flowing downstream to form the estuary. It has low levels of metals with no exceedences of CTR criteria and fairly low levels of bacteria with 27% of the Enterococcus samples exceeding basing plan objectives Dissolved oxygen is low at this site which is consistent with rising groundwater. Flow here is constant but quite low.



San Mateo Outlet- This site is located under the old highway 1 bridge on the north side. This was the only "stormdrain" we could find that drained into the creek near the I-5 freeway. The actual sampling site is about 20 feet above the creek bed at the end of the concrete apron from the stormdrain. We monitored it for three months while we tried to determine its source and then stopped after Caltrans refused to provide information on its source. While our testing of this site was limited, what we saw was not good. Enterococcus exceeded the basin plan objective in 67% of the samples. The 24 micrograms per liter of total copper measured was the highest of all the sites. pH was also the highest of all the sites. Luckily the dry weather flow here is very low, so the pollutant load this stormdrain contributes during dry weather is not large.

San Mateo Confluence- This site is located at the upstream end of the San Mateo estuary, where the creek begins to pond up behind the beach sand berm. The water here is ponded and there is no flow. There are many waterfowl in the area and it is wetland, not riparian, habitat. There are no exceedences of the metals criteria at this site. The Enterococcus exceedence is 33%, only slightly higher than the San Mateo spring site and much lower than the sites containing urban runoff. As with all the sites, ammonia and phosphate exceed the basin plan standards. Nitrate levels here are the highest of all the sites, but do not exceed basin plan standards.



Creek Comparisons

Both San Mateo Creek and Cristianitos Creek are intermittent streams with relatively

undeveloped and undisturbed watersheds. Both creeks receive some inputs of urban runoff during the wet and dry season, with Cristianitos Creek getting the most. While the urban flows into these creeks have a number of pollutants at levels that raise concern, the dry weather flows into the creeks are not currently at levels that have a substantial impact on their overall integrity.

San Mateo Creek at the sampling area has higher natural flow and a low dry weather input of urban runoff, so the water quality of this creek is still good overall. The dry weather urban runoff seems to be diluted enough by the base flow of the creek to maintain water quality downstream. However, the natural creek flow is low enough that if inputs of urban runoff were to increase substantially, it would affect the downstream estuary.

Cristianitos Creek at the sampling area has very low natural flow (and only during the wet season) and is receiving a relatively large amount of urban runoff from nearby homes. While the water quality of the creek is excellent above the urban flows, it rapidly deteriorates where the urban runoff makes up the majority of the creek water. The part of the creek dominated by urban runoff is highly impaired at the site we monitored. Luckily, the urban flow runs along a relatively short length of the creek before infiltrating, so the overall flow regime of the creek is intact. Any additional flows of urban runoff will have drastic consequences for this creek. As seen from the area affected by the Talega runoff, excessive flows from urban runoff can change the flow regime from intermittent to perennial and overwhelm the ability of the low natural flows to dilute the pollutants in urban runoff to acceptable levels.

Conclusion

Over the last year, O.C Coastkeeper has collected a sufficient amount of data from the five selected sites on Cristianitos and San Mateo Creeks to determine the dry weather water quality of these waterbodies. Overall, the water quality and flow regimes of both streams are good. Except for the sites that are entirely composed of urban runoff, the creeks have low levels of metals and bacteria, there is no substantial evidence of hydrocarbons, and their flow regimes are intact. Both creeks exceed the ammonia and phosphate objectives in the San Diego Basin Plan, most likely due to natural sources considering the consistently high number of exceedences at all sites. Nitrate levels are not currently at levels that are impacting the streams.

While both streams are able to maintain their integrity with the current stresses on their systems, it is clear from our monitoring that their current equilibrium could be easily overwhelmed by excessive volumes of water or pollutants from development in their watersheds.