#27 SL-27

City of Encinitas

June 9, 2004

Craig J. Wilson
Chief, TMDL Listing Unit
Division of Water Quality
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

313

WATER QUALITY DATA AND INFORMATION SUBMITTAL FOR PACIFIC OCEAN SHORELINE, SAN MARCOS HA (90451000)

Dear Mr. Wilson:

In Region 9, the Pacific Ocean Shoreline, San Marcos HA is listed impaired for bacteria indicators at Moonlight State Beach in Encinitas and considered a low priority. Moonlight State Beach is considered the "crown jewel" of Encinitas for tourist as well as residents. On Memorial Weekend alone, we received over 2,000 people per day at Moonlight State Beach. For this reason, the City of Encinitas applied for a grant from the State Water Resource Control Board (Clean Beach Initiative) to install an Ultraviolet Treatment Facility along Cottonwood Creek to reduce and/or eliminate beach postings. The project is a complete success. Based on the performance specifications we have successfully eliminated all bacteria and viruses, reduced beach postings and now have the ability to contain spills prior to any discharge onto the beach. The City is under contract with the State Water Board to maintain this facility for at least 20 years.

The City of Encinitas has taken a proactive stance to reduce bacteria, viruses and improve public health. As a component of the grant, the City has a commitment to collect bacteria samples on a weekly basis at four locations (enclosure) The City has received six awards for the Ultraviolet Treatment Facility:

- American Society of Civil Engineers – Award of Excellence - 2002
- American Public Works Association - Project of the Year Award – 2003
- Clean Water Champion – San Diego County - 2003
- Beach Buddies Award – National Resource Defense Council - 2003
- Consulting Engineering and Land Surveyors of California – Environmental Project of the Year 2004
- American Public Works Association - Technical Innovation Award – 2004

The Ultraviolet Treatment Facility has been operational since September 2002. Last year the treatment facility was only off-line 14 days due to rain. Another component of the Stormwater Program is our inspection program where we annually inspect businesses for Stormwater violations. This is considered our Source Protection Program where we educate, enforce and reduce pollutants from entering the waterways. With both programs in place the City feels we have successfully reduced and eliminated bacteria to the maximum extent practicable year round.

Bacteria in the surfzone has been reduced significantly since September 2002. The Heal the Bay Report Card has been giving Moonlight State Beach a "A" during the Dry Weather.

The City of Encinitas is committed to protecting water quality for a number of reasons from protecting public health to the economic value of keeping the beaches open during the peak season. In 2003, the City of Encinitas generated over $44,000,000 in annual beach revenue for the local businesses, State and local taxes, and hotel fees.

The City of Encinitas respectfully requests the State Water Resource Control Board remove Moonlight State Beach from the 303(d) list for Impaired Waters of the State.

If you have any questions please feel free to call, Katherine Weldon at (760) 633-2632.

Sincerely,

Katherine Weldon

Katherine Weldon
Program Administrator

Enclosures
CD disk

#27

2002 CWA SECTION 303(d) LIST OF WATER QUALITY LIMITED SEGMENT

Approved by USEPA: July 2003

SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD

REGION	TYPE	NAME	CALWATER WATERSHED	POLLUTANT/STRESSOR	POTENTIAL SOURCES	TMDL PRIORITY	ESTIMATED SIZE AFFECTED	PROPOSED TMDL COMPLETION
9	C	Pacific Ocean Shoreline, San Diequito HU	90511000					
				Bacteria Indicators		Low	0.86 Miles	
				Impairment located at San Dieguito Lagoon Mouth, Solana Beach.				
					Nonpoint/Point Source			
9	C	Pacific Ocean Shoreline, San Joaquin Hills HSA	90111000					
				Bacteria Indicators		Low	0.63 Miles	
				Impairment located at Cameo Cove at Irvine Cove Dr./Riviera Way, Heisler Park-North				
					Urban Runoff/Storm Sewers			
					Unknown Nonpoint Source			
					Unknown point source			
9	C	Pacific Ocean Shoreline, San Luis Rey HU	90311000					
				Bacteria Indicators		Low	0.49 Miles	
				Impairment located at San Luis Rey River Mouth.				
					Nonpoint/Point Source			
9	C	Pacific Ocean Shoreline, San Marcos HA	90451000					
				Bacteria Indicators		Low	0.5 Miles	
				Impairment located at Moonlight State Beach.				
					Nonpoint/Point Source			
9	C	Pacific Ocean Shoreline, Scripps HA	90630000					
				Bacteria Indicators		Medium	3.9 Miles	
				Impairment located at La Jolla Shores Beach at El Paseo Grande, La Jolla Shores Beach at Caminito Del Oro, La Jolla Shores Beach at Vallecitos, La Jolla Shores Beach at Ave de la Playa, Casa Beach (Childrens Pool), South Casa Beach at Coast Blvd., Whispering Sands Beach at Ravina St., Windansea Beach at Vista de la Playa, Windansea Beach at Bonair St., Windansea Beach at Playa del Norte, Windansea Beach at Palomar Ave., Tourmaline Surf Park, Pacific Beach at Grand Ave.				
					Nonpoint/Point Source			
9	C	Pacific Ocean Shoreline, Tijuana HU	91111000					
				Bacteria Indicators		Low	3 Miles	
				Impairment located from the border, extending north along the shore.				
					Nonpoint/Point Source			
9	R	Pine Valley Creek (Upper)	91141000					
				Enterococci		Medium	2.9 Miles	
					Grazing-Related Sources			
					Concentrated Animal Feeding Operations (permitted, point source)			
					Transient encampments			

City of Encinitas Mailing Address & Contact:

Kathy Weldon, Program Administrator
City of Encinitas
505 S. Vulcan Ave.
Encinitas, CA 92024-3699
kweldon@ci.encinitas.ca.us
Pacific Ocean Shoreline, San Marcos HA, 90451000, 0.5 miles

Enclosures:

Hardcopies:

- 2002 CWA Section 303(d) List of Water Quality Limited Segment
- Moonlight Beach Urban Runoff Treatment Facility Document
- APWA's Technical Innovation Award winner letter
- Moonlight Beach Urban Runoff Treatment Facility Quality Assurance Project Plan (QAPP)
- Aquionics Technical Information Sheet
- 2003 APWA Congress Presentation (PBS&J)
- Quarterly Status Reports 3-9 to State Water Resources Control Board
- Cottonwood Creek and Encinitas Creek Bioassessment Study
- UV Disinfection: Using New Technology for an Old Problem StormCon 2003 Presentation

CD:

- UV Facility Lab Data
- UV Facility Pictures (DSCF1106, System, & Telemetry)
- Pre-post Data
- Baseline Data
- CWO '02 Presentation (City of Encinitas)

Moonlight Beach Urban Runoff Treatment Facility

1 (Katherine Weldon[1]), REHS

[1] Storm Water Program Manager, City of Encinitas, 505 S. Vulcan Ave. ,Encinitas, California, 92024, kweldon@ci.encinitas.ca.us, Phone: (760)633-2632, Fax (760)633-2818

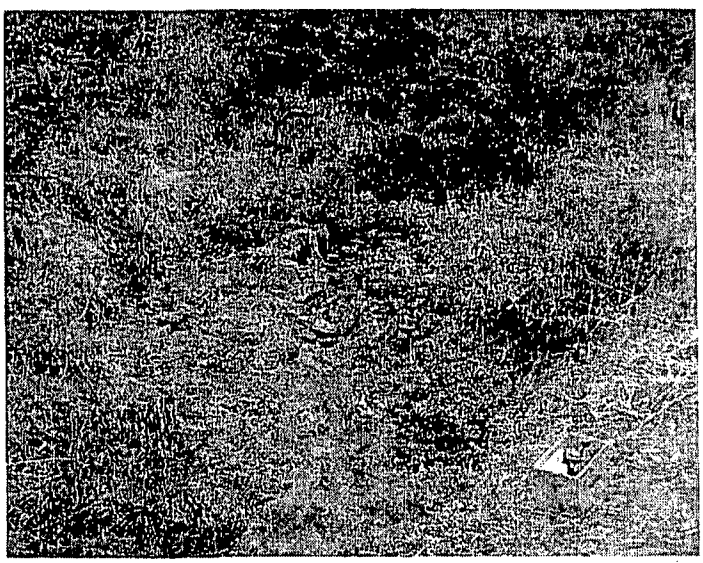
1.0 INTRODUCTION

Moonlight State Beach (Pacific Ocean) is the most popular coastal feature in the City of Encinitas and is one of North San Diego County's most famous recreation areas with over 2.5 million visitors in the year 2000. However, in the same year, there were over 90 days of beach postings/closures at Moonlight Beach, in addition to the year-round postings at the Cottonwood Creek outfall, which discharges onto the north shore of Moonlight State Beach. This number of postings/closures ranks fourth in San Diego County. Postings/closures negatively impact the coastal community that relies heavily on coastal tourism and recreation revenue. A recent study concluded that the economic value of the City of Encinitas beaches is $47 million per year. The Pacific Ocean at Moonlight State Beach is also listed by the State as an impaired water body for bacteria.

2.0 OVERVIEW OF WATERSHED

The Cottonwood Creek watershed, also referred to as Old Encinitas in City planning documents, is entirely within the jurisdictional boundary of the City of Encinitas. It is approximately three square miles (2,000 acres) and extends from the Encinitas Ranch Golf Course in the east to Moonlight Beach in the west. The watershed generally slopes gently westward towards the Pacific Ocean with the highest point at approximately 400 feet mean sea level (MSL) along the bluffs on the eastern boundary of the watershed. It is estimated that approximately ninety-five percent of the watershed is heavily urbanized including the largely commercial areas of old Encinitas.

Creek Flows



Cottonwood Creek is a perennial stream comprised of groundwater and urban runoff during the dry season. It also serves as a major storm drain channel for wet weather flows. The average dry weather flow has been approximated at 100 gallons per minute (GPM) near the mouth of Cottonwood Creek as it passes beneath Third Street. Continual flow monitoring was performed at this location for a one-week period in November of 2001 as part of a separate project. This monitoring measured an average dry-weather flow of approximately 65 GPM. No significant rainfall had occurred prior to the time of measurement. The flow data also indicated no diurnal pattern. A permanent flow monitoring station has been set up at 3rd and B, which indicates an average flow rate of 150 GPM. A strong diurnal pattern may be

indicative of urban runoff associated with early morning or evening over-irrigation. No diurnal pattern may suggest that groundwater makes up a significant portion of the creek flows. Groundwater expression on the slopes above the channel (along Highway 101) also suggests that groundwater is present in the creek (Pacific Southwest Biological Services 2000). However, at this point there is not enough data to make a firm determination of the amount of groundwater that contribute to creek flows.

Moving up the creek from the mouth, the flows taper off gradually. Most of the tributary flows at the upper sampling point had on the order of 5 GPM although the flow in Moonlight Creek is somewhat higher. At the eastern side of the watershed the creek dries up completely just below the new Encinitas Ranch development adjacent to Quail Gardens Drive. Other tributaries were also dry just upstream of their convergence with Cottonwood Creek. These include the open channel along the southeast side of Interstate 5 south of Encinitas Boulevard, located in the Requeza sub-basin, and Moonlight Creek along the west side of Interstate 5 north of Encinitas Boulevard. The other main tributary to Cottonwood Creek is the drainage along Encinitas Boulevard joining the Creek at the intersection of Encinitas Boulevard and Quail Gardens Drive. This tributary had very low flows where it daylights near the San Dieguito Union High School District Offices (SDUHSD), just west of Delphinium Street. Above that point the tributary is underground and the flow source can not easily be traced.

Water Quality

The City of Encinitas has monitored the dry weather water quality in the watershed for several years. In addition, the City, the State, and other nonprofit organization sample the water quality at Moonlight Beach at the mouth of Cottonwood Creek. This sampling often shows exceedences of enterococcus bacteria (failure to meet AB411 requirements). The City has determined that the source of bacteria is urban runoff from Cottonwood Creek. In addition to high bacteria levels, historical testing has shown high levels of nitrogen and ammonia in the creek.

The California Regional Water Quality Control Board (RWQCB) listed the Pacific Ocean at Moonlight State Beach near the outlet of Cottonwood Creek as 303(d) impaired by coliform bacteria, in accordance with the EPA Clean Water Act. Heal the Bay's Summer 2000 Beach Report Card™ gave Moonlight Beach an "F" based on risk of adverse health effects to humans. They name the cause as Cottonwood Creek. The typical cause of beach postings/closures is enterococcus bacteria exceedences in the ocean (failure to meet Assembly Bill 411 (Wayne, 1997) requirements. The City and State have determined that the source of these harmful bacteria is urban runoff in Cottonwood Creek. Cottonwood Creek drains a 2,000 acre, highly urbanized watershed. Typical dry weather flows near the mouth of Cottonwood Creek are estimated to be in the range of 150 gallons per minute (gpm). Recent water quality assessments indicate that the average enterococcus levels are approximately 1,500 CFU/100ml in Cottonwood Creek. Though the bacteria becomes diluted in the surf zone sampling area, the creek bacteria levels are over an order of magnitude higher

than AB 411 single-sample standards of 104 CFU/100ml for enterococcus. Several years of upstream best management practices (BMPs) and heavy enforcement of urban runoff regulations appear to have improved water quality in the creek. However, bacteria standards are consistently exceeded, and beach postings/closures continue to plague the beach. Thus, a more aggressive contaminant treatment system was proposed.

The County of San Diego will post the beach within one to four days when one bacteria sample exceeds a sample. For instance, if a fecal coliform sample exceeds the sample the data will not be available until 4 days later. There is no geometric mean analysis or comparison with the other bacteria data.

Land Use

The Cottonwood Creek watershed is primarily a suburban area with over half of its area designated as residential. It is estimated that the watershed is approximately 95 percent developed. The next largest land use category is transportation corridors, making up 18 percent of the area. Public/semi public areas make up 14 percent of the watershed, and parks/open space make up approximately 2 percent. Only seven percent is commercial and light industrial, and four percent agricultural. **Table 1** provides a breakdown of the land use within the watershed.

TABLE 1
SUMMARY OF COTTONWOOD CREEK WATERSHED LAND USE

Land Use Category	Percent of Watershed
Residential (low, medium and high density)	55
Right-of-way and Transportation Corridor	18
Public/semi-Public	14
Ecological Resource, Open Space, Park	2
General Commercial/Light Industrial	7
Agricultural	4
Total	100

There are jurisdictional wetlands within the watershed that have been professionally mapped. These include areas along Cottonwood Creek from Moonlight Beach to Highway 101, and along Cottonwood and Moonlight Creeks adjacent to Interstate 5, just north of Encinitas Boulevard.

3.0 Causes of Degradation

Cottonwood Creek is ninety-five percent urbanized. The creek is underground for the majority of the conveyance channel. Strips malls with gas stations, restaurants, grocery stores sit directly on top of the creek. Anyone with a hose can change the water quality in the creek and the beach. The upper watershed consists of nurseries and residential communities.

The City of Encinitas has been known as the Flower Capitol. With that claim to fame also comes an elevated nitrogen, ammonia and bacteria level. Growers characteristically use an abundant supply of water and have used their storm drains to discharge their waste stream. During numerous source control investigations the water quality evidence suggests pollutant loads generated from nurseries.

4.0 Source Control

The City of Encinitas has one of the most aggressive urban runoff programs in San Diego County. For years the City has investigated pollutant sources and methods for reducing beach closures at Moonlight Beach. Structural and nonstructural BMPs have been implemented throughout the watershed. Particularly, the City has issued hundreds of Notices of Violations to restaurants, gas stations, automotive and other businesses for storm water infractions. Two years of general source identification, upstream BMPs and enforcement within the watershed have improved water quality, specifically; testing has shown a decrease in turbidity, bacteria and pH.

The City has also performed an exhaustive water quality analysis along with a summary of Land Uses within the Cottonwood Creek watershed. Contaminate loading can be pinpointed to specific land uses within this watershed.

The City has also purchased a VAC-CON truck to vacuum debris out of the catch basin inlets. Each inlet has been cleaned out in order to reduce trash and debris from entering the storm drain conveyance channel. Site specific catchbasin inlets have also been retrofitted with filters to collect pollutants before they impact the water.

5.0 Location

The most important decision for the viability of the treatment facility was the choice of where the plant would be located. At 3rd and B Street, one block from the beach, is a sewer pump station. By locating the Urban Runoff Treatment Facility within an existing utility structure a number of aesthetics and environmental issues were eliminated. The community character was not a factor since the treatment facility is located within the footprint of an existing utility. A second consideration was how do we direct the flow from the creek without impacting the creek? This issue was resolved by drawing the water from an existing box culvert under 3rd Street and returning the flows into the box culvert.

6.0 Treatment Options Proposed

The City had a number of options to choose from for treating the creek water:

- Diverting to the sewer system
- Chemical Treatment i.e., chlorine
- Ozone generation
- Ultraviolet Treatment

After discussing each option in detail the most logical, cost effective and least land intensive option was ultraviolet treatment.

7.0 PROCESS OVERVIEW

Pump Station

Water is withdrawn from Cottonwood Creek and diverted to a five-foot diameter circular concrete wet well. Water is collected via five (5) 4-inch diameter screened openings, discharging into a common 4-inch diameter PVC pipe connected to the wet well. Two 7.5 horsepower float controlled submersible pumps (one duty and one standby), each rated at 150 GPM at 60 feet total dynamic head (TDH), delivers water to the UV treatment facility via a 4-inch PVC pipeline. A check valve on each pump discharge line prevents reverse flow into the wet well. The level in the wet well is monitored with an ultrasonic level transmitter. A slide rail system with lifting chains was provided to allow the pumps to be removed from service for maintenance or repair.

Basket Strainers

After pre-screening at the wet well intake, a second stage of screening is provided by two (2) 3-inch diameter PVC basket strainers connected in parallel. The baskets entrap unwanted material that has passed through the first stage of screening, thereby improving the performance of the dual media filtration system, and protecting the UV units from damage.

Dual Media Filtration System

After screening, water is filtered through two (2) 30-inch diameter dual media (sand and anthracite) pressure filters manufactured by Yardney Water Management Systems. The filters are operated in parallel. Water enters the filter at the top of each filter vessel and flows, under pressure, through the media where solid particulate and suspended organic and inorganic solids are removed. The filters operate at 15.3 gallons per minutes per square foot (GPM/sf) at the design flow rate of 150 GPM. Filters are backwashed periodically to remove trapped material. The parameters used to determine the need for backwashing include effluent turbidity, filter head loss (differential pressure), and elapsed time of operation. Water for backwashing is obtained from the City's potable system and is metered through a 2-inch propeller flow meter. Through the use of a three-way valve, the flow through each tank can be reversed, causing a turbulent expansion of the media and the flushing of entrapped particulate matter. The backwash system is sized for a 95 GPM rate at 40 psi. The backwash (waste wash water) flow is discharged to the sewer.

UV Disinfection System

The UV disinfection system consists of two (2) Aquionics GSA4 UV Disinfection Chambers and two (2) Power/Control Modules installed in series. Each GSA4 unit consists of a Type 316 stainless steel chamber with integral 4-inch inlet and outlet flanges. Each unit consists of four (4) low-pressure, high intensity (160VIK) UV lamps installed in high purity quartz sleeves and contains a motor driven automatic cleaning mechanism for wiping the sleeves and a temperature sensor to shut down the unit in the event of overheating due to no flow conditions. Each Disinfection Chamber is approximately 48-inches in length and 8-inches in diameter, with an

operational pressure rating of 100 psi (rated for 150 psi test pressure). The units weigh 77 pounds when dry, and 132 pounds when flowing full. The required electrical supply is 220 volts at 60 Hz, consuming 510 watts at full power. The units are mounted horizontally.

The GSA4 Power/Control Module is equipped with a main switch, manual wipe push button, and various alarms. When placed into operation, the UV lamps take five (5) minutes to warm up. The automatic lamp wiper mechanism operates on a timed cycle basis from an operator adjustable timer mounted in the UV chamber Power/Control Module.

Instrumentation and Controls
The entire system is operated from a single Allen-Bradley Micrologix 1500 programmable logic controller (PLC). The unit is equipped with an Allen-Bradley Panelivew-600 touch screen color display. System controls are set to shut the entire system down on three operating conditions: high level in the wet well, high pump discharge pressure, and high effluent turbidity.

Flow Metering/Control
The flow treated by the facility is metered downstream of the UV units with a GF Signet insertion paddlewheel flow meter. The flow rate is controlled with an electrically operated, modulating butterfly valve. The flow meter signal is input directly into the PLC program to allow Average Daily Flow Rate (GPM), Total Daily Volume (Gallons), and Total Monthly Volume (Gallons) to be continuously monitored. The treated flow is returned to Cottonwood Creek via a 4-inch PVC pipeline.

Water Quality Monitoring
Effluent from each UV disinfection chambers is monitored with a single Hach 1720D process turbidimeter. The range of the unit is 0-100 nephelometric turbidity units (NTU).

Piping and Valves
Schedule 80 PVC pipe and fittings were used to assemble the entire treatment system. PVC true union ball and butterfly valves were used throughout to provide isolation, shut-off, and control, as required.

Facility Enclosure
The entire UV disinfection facility was assembled as a package system by Clear Creek Systems, Inc., and installed by Falcon General Engineering Inc. of Vista, CA. The system is housed in a 24 foot long by 10 foot high by 10 foot wide steel prefabricated steel enclosure. The enclosure was painted sea foam green inside and out.

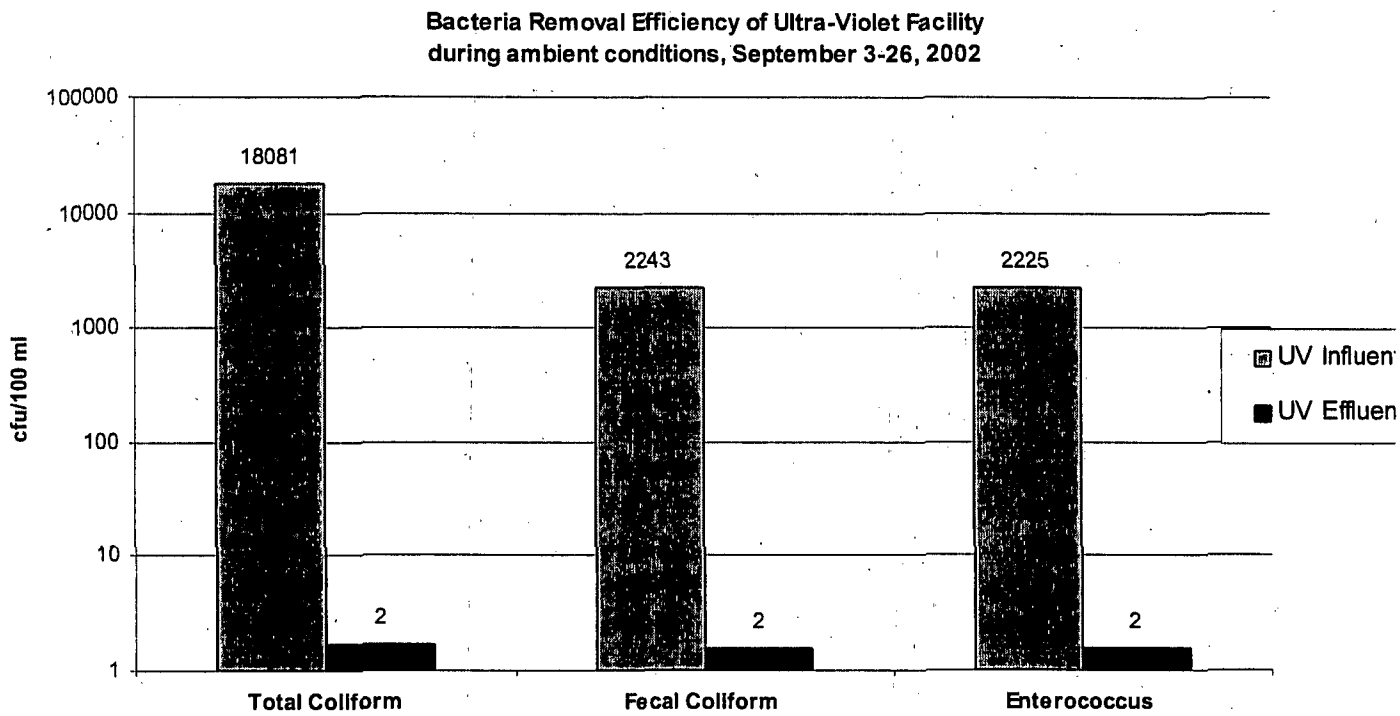
Design Criteria Summary
Key design criteria for the City of Encinitas facility are summarized in the table below:

City of Encinitas Moonlight Beach UV Disinfection Facility		
Description	Number	Design Values
Flow Rate	-	150 GPM
Wet Well	1	5 foot diameter
Submersible Pumps	2	7.5 horsepower each @ 150 GPM @ 60 feet TDH
Discharge Piping	-	4-inches
Basket Strainers	2	3-inch diameter
Dual Media Filtration System ½-inch x ¾-inch crushed rock 1.45 mm garnet 0.35 mm garnet 0.75 mm anthracite Filtration rate Backwash rate	2 - - - - - -	30-inch diameter 2.5 cubic feet 2.5 cubic feet 7.5 cubic feet 7.5 cubic feet 15.3 GPM/sf 75 GPM @ 40 psi 15.3 GPM/sf
UV Disinfection Chambers Construction Inlet and Outlet Size Lamps Size Pressure Rating	2 - - 4 - -	Aquionics GSA4 Type 316 SS 4-inches (flanged) 160VIK lamps 48-inches long x 8-inches diameter 100 psi (operational) 150 psi (test)
Controller	1	Allen-Bradley Micrologix 1500 PLC
Flow Meter	1	GF Signet insertion paddlewheel
Turbidimeter	1	Hach 1720D
Facility Enclosure	1	24 foot long x 10 foot high x 10 foot high painted steel

8.0 Construction Schedule

Contract awarded on April 10, 2002
Construction began on June 10th, 2002
Facility completed August 29th, 2002
Ribbon cutting ceremony September 20th, 2002

9.0 Monitoring Results



Biological Monitoring

The City hired a biological consultant, MEC Analytical Systems, Inc to prepare a biological report to characterize existing habitats, terrestrial wildlife and aquatic resources in the project area. Due to past practices it appears only species with moderate to high tolerance ranges survive.

10.0 Operation and Maintenance

San Elijo Joint Powers Authority and the City of Encinitas have taken over the Operations and Maintenance of the Urban Runoff Treatment Facility as of September 20, 2002. The City has been experiencing equipment failures due to the speed of the installation of the project. Each contractor and subcontractor has responded and replaced any malfunctioning unit. The system is under warranty for one year therefore, any malfunction is at the cost of the subcontractor.

The system has been set up to reduce the turbidity to the maximum extent practicable to help reduce the bacteria to the highest level. The cost to replace specific parts are as follows:

UV Lamp - $427.00
Quartz Sleeve - $419.00
O-Ring – (2 per sleeve) - $6.15
Wiper ring – (1 per sleeve) - $27.70
Ballast - $461.00
Multi-media chamber - $1,835.00

The multi-media chambers must be backwashed on a routine basis and therefore requires water to flush the chambers. The system can be set for a timed interval or by a differential pressure system. The water intake has increased the cost of the project until a pressure differential pressure system has been established.

11.0 Project Reflections

The overall project has been a true success. The City has reduced the bacteria levels entering the Pacific Ocean at Moonlight State Beach. The public can feel secure that their health has been protected to the maximum extent practicable.

Project improvements would include a better screening system needed to keep aquatic organisms out of the pumps and wet well. Plus, a improved 15% by-pass system still needs to be addressed. Richard Brady and Associates are designing a new by-pass system that will be in place by April.

12.0 Teamwork

This project was a complete success because of teamwork, cooperation and partnerships. We would like to acknowledge and thank the following agencies, companies environmental groups that made this possible.

Governor Gray Davis and the State Resources Control Board
Encinitas City Council – Mayor Christy Guerin, Deputy Mayor James Bond, Jerome Stocks, Maggie Houlihan and Dennis Holz
Contractor - Falcon General Engineering, Inc.
Construction Manager - Richard Brady and Associates
Contract Management - Ashford Engineering, Inc.
Operations and Maintenance - San Elijo JPA
UV Supplier - Clear Creek Systems
Project Designer - PBS&J
Biological Monitoring - MEC Analytical Systems, Inc.
Environmental Support – Baykeepers
City Staff – Kipp Hefner, Paul Hartman, Matt Chirdon, Kathy Weldon

www.apwa.net

April 16, 2004

Mr. James B. Rasmus, P.E., DEE
Program Manager
PBS&J
175 Calle Magdalena
Encinitas, CA 92024-3722

Dear Mr. Rasmus:

Congratulations! You have been selected as one of APWA's Technical Innovation Award winner for the year 2004. We are pleased to inform you of this honor and the American Public Works Association is proud to have you represent the public works profession and our association.

We are in need of three things from you at this point, which are as follows…

- ***Photographs*** - Send a 5x7 photograph, preferably color studio portrait. These photos will be used in our publications and other award promotional material. **DUE: July 1**
- ***Completed Plaque Information Form*** – This form which is enclosed will be sent to the engraver of your award. **DUE: May 1**
- ***Awards Recognition Ceremony Participation form*** – this form is enclosed and will inform us who will be accepting the award. **DUE July 1**

You are invited to receive this award recognizing your achievement at APWA's annual Awards Recognition Ceremony. This recognition ceremony will be held in conjunction with the 2004 International Public Works Congress and Exposition in Atlanta, Georgia. The ceremony is scheduled to be held on Monday, September 13, at 4:45 p.m. at the Georgia World Congress Center.

While the ceremony is held in conjunction with the APWA International Public Works Congress and Exposition, there are no associated fees for your participation in the reception. However, if you elect to fully participate in this informative and educational conference you or your designated representative will be responsible for any associated travel costs and registration fees. For additional information about the International Public Works Congress and Exposition and APWA please visit our website at www.apwa.net

Again, we extend our congratulations on your selection as the Technical Innovation Award winner! If you have any questions or need additional information, please do not hesitate to give either of us a call at 800-848-APWA.

Sincerely,

Lee Hawkins
Director of Awards & Recognition

Rhonda Wilhite
Awards Program Manager

cc: Katherine Weldon, Nominator
Patrick Thomas, Chapter President
Ann Burnett, Regional Director

Enclosures

American Public Works Association
2345 Grand Boulevard, Suite 500
Kansas City, MO 64108-2641
p: (816) 472-6100
p: (800) 848-APWA
f: (816) 472-1610

1401 K Street, NW, 11th Floor
Washington, DC 20005
p: (202) 408-9541
f: (202) 408-9542

THE MOONLIGHT BEACH URBAN RUNOFF TREATMENT FACILITY QUALITY ASSURANCE PROJECT PLAN

COMPLETED PLAN PREPARED BY:

Refer correspondance to:
Katherine Weldon
City of Encinitas
505 Vulcan Avenue, Encinitas, CA 92024
(760) 633-2632
kweldon@ci.encinitas.ca.us

Approvals:

Agency / Organization: Department of Fish and Game

Signature: Tamara Spear Date: _____

Agency / Organization: California State Parks

Signature: Diane Martinez Date: _____

Agency / Organization: San Elijo Lagoon Powers Authority

Signature: Gary Masters Date: _____

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APPENDICES

APPENDIX 1 ..... TURBIDITY CALIBRATION LOG

APPENDIX 2 .....FIELD DATA SHEETS

APPENDIX 3 .....MAP OF SAMPLE SITES

1. Distribution List

All water quality specialists will receive copies of this Quality Assurance (QA) plan, and any approved revisions of this plan. Once approved, this QA plan will be available to any interested party by requesting a copy from the City of Encinitas Storm Water Management staff.

2. Project Organization

2.1 City of Encinitas

The City of Encinitas Storm Water staff will monitor and assess the Cottonwood Creek for specific parameters to enhance the operation and maintenance of the Moonlight Beach Urban Runoff Treatment Facility and also to determine the die off rates of bacteria after the Treatment Facility.

2.2.1 **Management** - Katherine Weldon and Meleah Ashford (Storm Water Manager)
2.2.2 **Field Monitors** -Paul Hartman, Environmental Water Quality Specialist
2.2.3 **Data Managers** -Paul Hartman, Environmental Water Quality Specialist
2.2.4 **Quality Assurance Personnel** - Encina Wastewater Laboratories
2.2.5 **Technical Advisors** - Nancy Anson, Encina Wastewater Laboratory Manager, Jeff Parks, Encina Wastewater Laboratory Supervisor, Lisa Kay, MEC Consultants

3. Problem Definition/Background

3.1 Problem Statement

Moonlight State Beach in the City of Encinitas, San Diego County, is currently prone to numerous postings during dry weather periods due to high levels of bacteria. In the year 2000, the City experienced 93 posting days at Moonlight State Beach. Postings can negatively impact the coastal community that relies on tourism and beach-related recreation revenue. In a recent study conducted by Phillip King the economic value of the City of Encinitas beaches generates $47 million per year. The City and State have determined that the sources of these harmful bacteria are urban runoff through Cottonwood Creek, which discharges to the Pacific Ocean at Moonlight State Beach.

3.1.1. Mission and Goals

Mission

To protect public health by eliminating or reducing the risk of illness from urban runoff. To reduce or eliminate the need for beach postings.

Program Goals

The goals of the monitoring program are:

- Establish a baseline of bacterial data prior to construction
- Show trends of bacteria levels upstream of the treatment facility, immediately after the treatment facility, stormdrain outlet to the ocean, surfzone at Moonlight State Beach.
- Improve the operation and maintenance of the treatment facility

- Monitor for illicit discharges
- Document the effectiveness of the treatment facility
- Enhance the effectiveness of the treatment facility
- Show trends of bacterial levels decreasing in the surf zone

3.2 Intended Usage of Data

The data will be used by the Storm Water Management staff to determine the effectiveness of the Moonlight Beach Urban Runoff Treatment Facility. The data will also be a baseline of data points that will show trends over time at each location before and after the treatment facility goes on line. The monitoring of turbidity is intended to improve the operation and maintainance of the facility and maintain information on illicit discharges.
A strong database has been established of bacterial levels prior to the construction of the treatment facility, therefore, additional monitoring will demonstrate the expected improvements in the creek and Pacific Ocean.

Data will be compiled and maintained at the City of Encinitas. The information will be shared with the State Water Resources Control Board, the San Diego Regional Water Quality Control Board, and upon request to other state, federal, and local agencies and organizations.

4. Project/Task Description

4.2 General Overview of Monitoring

Table 4.1 Summary of Monitoring Design

Parameter	Type of monitoring	Frequency of monitoring
Turbidity	F	W
Bacteria	P	W

Type: F: field analysis, P: sample only, send to outside professional lab;
Frequency: W: weekly, M: monthly, S: seasonal, X: irregular

All of the water quality data will be compared to the Regional Water Quality Control Board Basin Plan and AB411 Standards for Ocean Monitoring.

This QA plan addresses water quality objectives for the following parameters:

- Turbidity
- Total Coliform Bacteria
- *Fecal* Coliform
- Enterococcus Bacteria

4.2. Project Timetable

Table 4.2 identifies the schedule of major activities associated with this project.

Table 4.2 Project Schedule

Activity	Date
Conduct baseline monitoring	On-going since 1999
Enhance monitoring to weekly	August 2002

Urban Runoff Treatment Facility Completed	September 2002
Monitor daily at outlet of Treatment Facility	September 2002
Reduce to weekly sampling	October 2002
Enhance data entry	August 2002
Calibration and quality control sessions for Lab	State Certified Laboratories – Once a year
Quality Control session for samplers	Once a month throughout the project
Sample twice per month	October 2003

5. Data Quality Objectives

This section identifies how accurate, precise, complete, comparable, sensitive and representative our measurements will be.

Data quality objectives are summarized in Tables 5.1 to 5.2

Table 5.1. Data Quality Objectives for Conventional Water Quality Parameters

Parameter	Method/ range	Units	Detection Limit	Sensitivity *	Precision	Accuracy	Completeness
Turbidity	S.M. 2130B	NTUs	0.01	0.01	± 2%	± 2%	90%

Table 5.2. Data Quality Objectives for Biological Parameters

Parameter	Method/ range	Units	Detection Limit	Sensitivity	Precision	Accuracy	Completeness
Total Coliform Bacteria	S.M. 9222B	cfu/ 100ml	1	Dilution dependent	Duplicates within 95% confidence limits	Positive standard within ½ of an order of magnitude	95%
Fecal Coliform	S.M. 9222D	cfu/ 100ml	1	Dilution dependent	Duplicates within 95% confidence limits	Positive standard within ½ of an order of magnitude	95%
Entero-coccus Bacteria	S.M. 9230C	cfu/ 100ml	1	Dilution dependent	Duplicates within 95% confidence limits	Positive standard within ½ of an order of magnitude	95%

5.1. Accuracy

5.1.1. Chemical and Physical Parameters

Accuracy describes how close the measurement is to its true value. Accuracy is the measurement of a sample of known concentration and comparing the known value against the measured value. The accuracy of physical measurements will be checked by the States certified laboratory program.

5.1.2. Biological Parameters

Encina Wastewater Authority is a State Certified Laboratory that participates in the ELAP program performed by the State (ELAP #1441). Accuracy for bacteria will be determined by analyzing a positive control sample twice annually. A positive control is similar to a standard, except that a specific discreet value is not assigned to the bacterial concentrations in the sample. This is due to the fact that bacteria are alive and capable of mortality and reproduction. Instead of a specific value, an approximate target value of the bacterial concentration is assigned to the sample by the laboratory preparing the positive control sample.

5. 2. Comparability

Comparability is the degree to which data can be compared directly to similar studies.

5. 3. Completeness

Completeness is the fraction of planned data that must be collected in order to fulfill the statistical criteria of the project.. There are no statistical criteria that require a certain percentage of data. However, it is expected that 80% of all measurements could be taken when anticipated. This accounts for adverse weather conditions, safety concerns, and equipment problems.

We will determine completeness by comparing the number of measurements we planned to collect compared to the number of measurements we actually collected that were also deemed valid.

5. 4. Precision

5.4.1. Chemical and Physical Parameters

The precision objectives apply to duplicate and split samples taken as part of a QC session or as part of periodic in-field QC checks. Precision describes how well repeated measurements agree.

5.4.2. Biological Parameters

Precision for bacterial parameters will be determined by having the same analyst complete the procedure for laboratory duplicates of the same sample. At a minimum this should be done once per day, or run duplicates on a minimum of 5% of the samples if there are over 20 samples run per day. The results of the duplicates should be within the confidence limits supplied by the manufacturer.

5. 5. Representativeness

Representativeness describes how relevant the data are to the actual environmental condition. Problems can occur if:

- Samples are taken in a stream reach that does not describe the area of interest (e.g. a headwaters sample should not be taken downstream of a point source),
- Samples are taken in an unusual habitat type (e.g. a stagnant backwater instead of in the flowing portion of the creek),
- Samples are not analyzed or processed appropriately, causing conditions in the sample to change (e.g. water chemistry measurements are not taken immediately).

Representativeness will be ensured by processing the samples in accordance with Section 10, 11 and 12, by following the established methods, and by obtaining approval of this document.

5. 6. Method Detection Limit and Sensitivity

The Method Detection Limit is the lowest possible concentration the instrument or equipment can detect. This is important to record because we can never determine that a pollutant was not present, only that we could not detect it. Sensitivity is the ability of the instrument to detect one concentration from the next. Detection Limits and Sensitivities are noted in Tables 7.1–7.2

6. Certification

The Water Quality Specialist for the City of Encinitas performs dry-weather,wet-weather and stormdrain monitoring programs and is a trained specialist in the field. The sampler holds a Laboratory Analyst Grade II – CWEA Certification.

Laboratory Certification Programs

The EWA laboratory obtained certification/registration with the State of California Department of Health Services on February 1, 1991. (Certificate No.: 1441)

The fields of testing for which this laboratory has been certified/registered under the California Laboratory Improvement Act of 1988 are: microbiology of drinking water and wastewater, wastewater inorganic chemistry, nutrients and demand, and toxic chemical elements in wastewater (Fields of Testing 1, 16, 17)

The EWA laboratory participates in the EPA-DMR QA Laboratory Performance Evaluation Studies each year now administered by private contractors. When the results were received, the Quality Assurance Officer discusses them with the analysts that performed the tests. A file is maintained that contains these results as well as a summary of analytical problems, if any, that were discovered and how they were corrected. Analytical results are submitted in the WP series for all chemical and biological parameters for which we are currently certified.

The laboratory participates in the California Water Environment Association program for voluntary certification of laboratory technologists. All current laboratory personnel are currently certified. (See Table 1.1 , EWA Laboratory Organizational Chart.)

7. Documentation and Records

All field results will be recorded at the time of completion, using the field data sheets (see Appendix 2). Data sheets will be stored in hard copy form at the location specified in Section 5.2. Field data sheets and electronic copies are archived for three years from the time they were collected.

8. Sampling Process Design

8.1 Rationale for Selection of Sampling Sites

Sampling sites are indicated on the map in Appendix 3. The following criteria were evaluated when choosing sampling locations:

- Shows water quality characteristic of upper watershed, at the treatment facility and downstream of the facility.
- Evaluate the effectiveness of the treatment facility
- Background data is abundant
- Access is safe
- Sample can be taken in the main creek current or where homogeneous mixing of water occurs
- Sample is representative of the part of the water body of interest
- Location complements or supplements historical data
- Demonstrate a reduction of bacteria in the surfzone

8.2 Sample Design Logistics

The Water Quality specialist will sample every Monday at the approved sampled sites. Once the Moonlight Beach Urban Runoff Treatment Facility is completed a sample valve will be available to take samples after the treatment and before the water commingles with the creek.

8.2 Sampling Locations

a) Upstream of intake – 3rd & B Street – East side of box culvert
b) Immediately downstream of discharge point – 3rd & B Street – West side of box culvert
c) Beach – Stormdrain outlet
d) Beach – Mixing Zone

9. Sampling Method Requirements

9.1 Standard Methods (9060 A., 9060 B.)

Collect samples for microbiological examination in plastic bottles that have been cleaned in the detergent free dish washer, given a final rinse in deionized water and sterilized as directed in the section on sterilization.

Collect a grab sample of creek water weekly from the designated sampling location. Do not touch the sample bottle. Leave 1 inch of head space in the bottle to allow for mixing prior to analysis. Keep the sample bottle closed until you are ready to fill it. Fill the container without rinsing and replace the cap immediately. Use an iced cooler for storage of the samples during transport to the laboratory.

Samples should be analyzed within 6 hours of collection. Analyses are usually begun within 30 minutes of receipt in the laboratory. If not, they are refrigerated and processed within two hours. Occasionally it is necessary to refrigerate samples for longer than 6 hours before analysis. In such instances, samples will be analyzed as soon as possible after receipt and within a maximum of 24

hours. The collector will sample from the creek edge so that the water body is not disturbed from wading. All samples are taken approximately in mid-stream, at least one inch below the surface. If it is necessary to wade into the water, the sample collector stands downstream of the sample, taking a sample upstream. If the collector disturbs sediment when wading, the collector will wait until the effect of disturbance is no longer present before taking the sample.

The following table describes the sampling equipment, sample holding container, sample preservation method and maximum holding time for each parameter.

Table 9.1 Sampling Method Requirements

Parameter	Sample Bottle	Preferred / Maximum Holding Times
Conventional Parameters		
Turbidity	plastic bottle	immediately / store in dark for up to 24 hr.
Biological Samples		
Bacteria	sterile plastic sampling bottle	Refrigerate to 4 degrees C in the dark; deliverd to the lab within 4 hours, start analysis within 6 hours

10. Sample Handling and Custody Procedures

10.1. Sample Handling

Identification information for each sample will be recorded on the field data sheets and on the labels of the containers (see Appendix 2) when the sample is collected. Each sample will be labeled with the waterbody name, sample location, sample number, date and time of collection, sampler's name, and method used to preserve sample (if any).

10.2. Custody Procedures

When samples are transferred from the Water Quality Specialist to an outside professional laboratory, a Chain of Custody form will be used. This form identifies the waterbody name, sample location, sample number, date and time of collection, sampler's name, and method used to preserve sample (if any). It also indicates the date and time of transfer, and the name and signature of the sampler and the sample recipient. When quality control checks are performed by a professional lab, their samples will be processed under their chain of custody procedures with their labels and documentation procedures.

10.3. Disposal

Encina Wastewater Authority will sterilize and manage the disposal of the bacterial samples per the established codes.

11. Analytical Methods Requirements

All methods used are from the Standards Methods for the Examination of Water and Wastewater 18th Edition.

Table 11.1 outlines the methods to be used, any modifications to those methods, and the appropriate reference to a standard method.

Table 11.1 Analytical Methods for Water Quality Parameters

Parameter	Method	Modification
Turbidity	Nephelometric S.M. 2130 B	none
Total Coliform Bacteria	S.M. 9222 B	none
Fecal Bacteria	S.M. 9222 D	none
Enterococcus Bacteria	S.M. 9230 C	none

11.1 Standard Total Coliform Membrane Filter Procedure (Standard Method 9222 B.)

This method is used to measure coliform density. It is applicable to the examination of saline waters when used in conjunction with the enrichment technique described in this method.

Parallel testing in this laboratory with the multiple-tube procedure has demonstrated that 80% of membrane filter test results fall within the 95% confidence limits of multiple-tube completed test results.

This method has been preferentially selected for coliform determinations involving public health and safety since it yields numerical results more rapidly than the multiple-tube procedure.

*1. **Apparatus***

a. Sterile, disposable petri dishes, 60 x 15 mm and reusable agar trays for multiple analyses
b. Membrane filters, presterilized, individually wrapped, 47 mm diameter with 0.45 um pore size
c. Sterile filtration unit - filter base and funnel
d. Ultraviolet sterilization unit
e. Filter manifold and vacuum flask
f. Sterile forceps, ethanol
g. Sterile erlenmeyer flasks
h. Hot plate/stirrer
i. Drummond pipette-aid dispenser, sterile pipettes
j. Sterile inoculating loops
k. Sterile absorbent pads
l. Hach, 2 mL sterile packets LTB broth
m. Bunsen burner
n. Incubator, maintained at 35.0° C. +or- 0.5° C.
o. Magnification lamp and counting device

2. *Media*

a. LTB Broth packets, presterilized and supplied by Hach Co.

b. m-ENDO LES Agar: To rehydrate, weigh 25.5 grams of media into a heat sterilized erlenmeyer flask. Add 500 ml nanopure water, 10 ml absolute alcohol, and a stir bar to the flask. Cover the flask with foil. Stir rapidly to suspend media and prevent scorching. Heat suspension to boiling to dissolve completely. Caution: This media rises rapidly in the flask with boiling and will boil over if not removed from the heat source immediately. Bring the suspension to a boil twice before allowing to cool.

Sterilize nalgene agar trays by rinsing with absolute alcohol and allowing the residue to evaporate to dryness. Slowly pour the cooled agar over the bottom of the tray to a depth of 1/4 inch or alternatively use the pipette-aid to dispense 4 ml media in each 60 x 15 mm presterilized petri dish. Eliminate surface bubbles from the liquefied agar surface by touching them with a hot inoculating loop. Do not move trays or plates until agar has completely solidified. Keep atmospheric disturbances at a minimum during this period. Remove large trays to the 35° C. incubator uncovered to allow surface moisture to evaporate for at least 10 minutes. pH a portion of the media and record the result.

b. Cover and store trays or plates inverted, inside plastic bags in the refrigerator for no longer than two weeks or until no longer useable. The pH of the agar should be 7.2 +or- 0.2.

3. *Procedure*

a. Use sterile forceps to place a membrane filter on the porous plate of the receptacle. Carefully place a matched funnel unit over the receptacle and lock it in place.

b. Filter 100 ml of a well mixed sample shaken 25 times. It is recommended that sand and algal clumps be allowed to settle out of the well mixed sample (5 seconds settling) before measuring filtration volumes. Any unused sample should be stored at 4° C. until a preliminary determination of countability can be made. (usually within 20 hours) Although not generally recommended, filtration of a smaller volume of a highly contaminated sample may be performed at that time.

c. With the filter still in place, rinse the funnel and the cylinder with three 20 ml portions of sterile dilution water. Using sterile forceps that have been dipped in ethanol, flamed and cooled, transfer the filter with a rolling motion avoiding entrapment of air to the selected medium.

Procedure: Enrichment Technique

a. Preparation for this technique must begin prior to filtration. Place a sterile absorbent pad in the bottom of each 60 x 15 mm petri dish. Cut open a Hach LTB pillow packet and squeeze the liquid contents onto the pad. Number the plates, cover with lids and incubate for 15 minutes at 35° C.

b. Roll the filter paper onto the LTB broth soaked pad and preincubate without inverting at 35° C. for 1.5 to 2.0 hours.

c. After preincubation, remove the enrichment culture from the incubator and using sterile forceps, lift the filter from the pad. Place it with a rolling motion onto the surface of the m-Endo agar plate. Incorrect placement of filter is at once obvious because patches of unstained membrane indicate entrapment of air. If this occurs, reseat the filter on the agar surface.

d. Cover and invert the dish or tray and incubate for 20 to 22 hours at 35° C.

4. Definition

All bacteria that produce a red colony with a metallic sheen within 24 hours incubation at 35° C. on an ENDO type medium are considered members of the coliform group. The sheen may cover the entire colony, or may appear only in a central area, or on the periphery.

5. Counting

a. Use the fluorescent magnifying lamp and a hand tally to count colonies. Use the grid marks on the surface of the filter to track position. Count all discreet sheen producing colonies and total the cfu/100 ml. Count each filter twice when numbers exceed 10 per filter.
b. Try holding the agar bed at various angles incident to the light source to be sure you are counting all fluorescing colonies.
c. You may want to refrigerate cultures with high background counts for 30 to 60 minutes before counting to deter the spread of confluence while aiding sheen discernment.
d. Organisms from undisinfected sources may produce sheen in 16 to 18 hours which subsequently may fade. Be sure to check colony development early in the day and monitor periodically for potential changes.
e. Do not report results as "To Numerous to Count" (TNTC). Instead, refilter a smaller volume of the original sample.
f. All Samples are to be read within a 22-24 hour period.

6. Calculation of Coliform Density

For specific rules regarding counting of colonies, refer to Standard Methods 9222 B.,6.

7. Coliform Verification

a. Verify colonies on a quarterly basis from a known positive source. Pick 10 discrete sheen colonies from the surface with a sterile needle and test for lactose fermentation by transferring to lauryl tryptose broth tubes and incubating for 24 or 48 hours at 35° C.
b. Transfer growth from the positive tubes to BGB broth tubes and incubate for 24 to 48 hours at 35° C. Record results as % positives.
c. For receiving water samples verify 10 % of the colonies when samples are in excess of 50 cfu/100ml

11.2 Standard Fecal Coliform Membrane Filter Procedure (Standard Method 9222 D.)

Parallel testing in this laboratory with the multiple-tube procedure has demonstrated that 80% of membrane filter test results fall within the 95% confidence limits of multiple-tube test results with EC medium.

This method has been preferentially selected for fecal coliform determinations involving public health and safety since is yields numerical results more rapidly than the multiple-tube procedure.

1. Apparatus

a. Water Bath, maintained at 44.5° C. +or- 0.2° C.
b. Sterile, disposable petri dishes, 60 x 15 mm and reusable agar trays for multiple analyses
c. Sterile filtration unit - filter base and funnel
d. Ultraviolet sterilization unit
e. Filter manifold and vacuum flask
f. Sterile forceps, ethanol
g. Sterile erlenmeyer flasks
h. Hot plate/stirrer
i. Drummond pipette-aid dispenser, sterile pipettes
j. Sterile inoculating loops
k. Bunsen burner
l. Magnification lamp and counting device
m. Membrane filters, presterilized, individually wrapped, 47 mm diameter with 0.45 micron pore size

2. Media

a. m-FC medium: To rehydrate, weigh 26 grams of media into a heat sterilized 1000 ml erlenmeyer flask. Add 500 ml nanopure water and a stir bar to the flask. Cover the flask with foil. Stir rapidly to suspend media and prevent scorching. Heat to boiling to dissolve completely. Add 5 ml of a 1% solution of rosolic acid in 0.2 N NaOH. Continue heating for one minute. Do not sterilize by autoclaving. Cool to 50° C. For most samples m-FC medium may be used without the 1% rosolic acid addition, provided there is no interference with background growth. Such interferences may be expected in storm water samples collected during the first runoff (initial flushing) after a long dry period.
b. Sterilize nalgene agar trays by rinsing with absolute alcohol and allowing residue to evaporate to dryness.
c. Slowly pour the cooled agar over the bottom of the tray to a depth of 1/4 inch or alternately use the pipette-aid to dispense 4 ml media in each 60 x 15 mm persterilized petri dish. Eliminate surface bubbles from the liquefied agar surface by touching them with a hot inoculating loop. Do not move trays or plates until the agar has completely solidified. Keep atmospheric disturbances to a minimum during this period. Remove large trays to the 35° C. incubator uncovered to allow surface moisture to evaporate for at least 10 minutes. pH a portion of the media and record the result.
d. Cover and store the trays or plates inverted, inside plastic bags in the refrigerator for no longer than two weeks or until no longer useable.

The pH of the agar should be 7.4 +or- 0.2 at 25° C.

3. Procedure

a. Use sterile forceps to place a membrane filter on the porous plate of the receptacle. Carefully place a matched funnel unit over the receptacle and lock it in place.

b. Filter 100 ml of a well mixed sample shaken 25 times. It is recommended that sand and kelp be allowed to settle out of the well mixed sample (5 seconds settling) before measuring filtration volumes. Any unused sample should be stored at 4° C. until a preliminary determination of countability can be made. (usually within 20 hours) Although not generally recommended, filtration of a smaller volume of a highly contaminated sample may be performed at that time.

c. With the filter still in place, rinse the funnel and the cylinder with three 20 mL portions of sterile dilution water. Using sterile forceps that have been dipped in ethanol, flame dried and cooled, transfer the filter with a rolling motion avoiding entrapment of air to the selected medium. Incorrect placement of the filter is at once obvious because patches of unstained membrane filter indicate entrapment of air. If this occurs, reseat the filter on the agar surface.

d. Cover and invert the dish or tray and place in water bath for 24 hours at 44.5° C.

4. Definition

Colonies produced by fecal coliform bacteria on m-FC media are various shades of blue. Pale yellow colonies may be atypical. Nonfecal colonies are gray to cream-colored.

5. Counting

a. Use the fluorescent magnifying lamp and a hand tally to count colonies. Use the grid marks on the surface of the filter to track position. Count all discreet blue colonies and total the cfu/100 ml. Count each filter twice when numbers exceed 10 per filter.
b. Pale yellow colonies may be verified for gas production in mannitol at 44.5° C.
c. All Samples are to be read within a 22-24 hour period.

6. Calculation of Fecal Coliform Density

Compute the density of sample quantities that produced MF counts within the desired range of 20 to 60 fecal coliform colonies. This density range is more restrictive than the 20 to 80 total coliform range because of larger colony size on m-FC medium. Calculate fecal coliform density as directed in Standard Methods Section 9222 B.,6. Record densities as fecal coliforms per 100 ml.

7. Fecal Coliform Verification

a. Verify colonies monthly from a known positive source. Pick 10 discrete sheen colonies from the surface with a sterile needle and test for lactose fermentation by transferring to lauryl tryptose broth tubes and incubating for 24 or 48 hours at 44.5° C.
b. Transfer growth from the positive tubes to EC broth tubes into a water bath for 24 to 48 hours at 44.5° C. Record results as % positives.

11.3 Enterococcus Membrane Filter Procedure (Standard Method 9230 C.)

The enterococci portion of the fecal streptococcus group is a valuable bacterial indicator for determining the extent of fecal contamination of recreational surface waters. Studies at marine and fresh water bathing beaches have indicated that swimming associated gastroenteritis is related directly to the quality of the bathing water and that enterococci are the most efficient bacterial indicator of water quality. Accordingly, in 1990 the State Water Resources Control Board revised the California Ocean Plan to include regular monitoring for enterococcus.

This method is used to measure coliform density weekly at five onshore sampling station locations and monthly at fifteen near shore station locations.

This membrane filter method for enumerating enterococci is modified and simplified by eliminating the esculin test (EIA substrate) and decreasing the incubation period from 48 hours to 24 hours. Indoxyl-ß-D- glucoside is substituted for esculin in the primary medium. Comparison testing of Method 9230 C. and this modification are documented in the abstract prepared by A.P. Dufour of the U.S. Environmental Protection Agency.

1. Apparatus

a. Incubator, maintained at 41.0° C. +or- 0.5° C.
b. Autoclave
c. Sterile, disposable petri dishes, 60 x 15 mm and reusable agar trays for multiple analyses.
d. Membrane filters, presterilized, individually wrapped, 47 mm diameter with 0.45 um pore size
e. Sterile filtration unit - filter base and funnel
f. Sterile forceps, ethanol
g. Ultraviolet sterilization unit
h. Filter manifold and vacuum flask
i. Hot plate/stirrer
j. Drummond pipette-aid dispenser, sterile pipettes
k. Sterile inoculating loops
l. Magnification lamp and counting device
m. Thermometer, mercury type, 0.5° increments or less.

2. Media

a. m-E agar: To rehydrate the medium, suspend 7.12 grams in 100 ml nanopure water in a 250 ml erlenmeyer flask. Add a stir bar and heat to boiling to dissolve completely. Cover the flask with foil and autoclave for 15 minutes at 15 lbs. pressure (121° C.) Cool to 50° C.
c. Nalidixic Acid solution: Use a 20 ml vial and small stir bar to dissolve 1.666 grams nalidixic acid in 20 ml nanopure water that has 1.33 ml 10N NaOH added to it.
d. Indoxyl-ß-D Glucoside solution: Weigh 75 mg Indoxyl-ß-D Glucoside into a sterile 60 x 15 petri dish. Add 0.5 ml nanopure water and 0.5 ml 200 proof ethanol. Swirl gently to dissolve.
e. Triphenyl tetrazolium chloride: Weigh 0.002 grams TTC into a small weigh boat.
f. When the autoclaved m-E media has cooled, add the Indoxyl-ß-D Glucoside solution from the petri dish. Swirl to mix. Add 0.3 ml nalidixic acid solution and the 0.002 grams TTC. Swirl to mix again. The media is now ready to plate.
g. Sterilize nalgene agar trays by rinsing with absolute alcohol and allowing the residue to evaporate to dryness.
h. Slowly pour the cooled agar over the bottom of the tray to a depth of 1/4 inch or alternatively use the pipette-aid to dispense 4 ml media into each 60 x 15 petri dish. Eliminate surface bubbles from the liquefied agar by touching them with a hot inoculating loop. Do not move trays or plates until agar has completely solidified. Keep atmospheric disturbances to a minimum during this period. Remove large trays to the 35° C. incubator uncovered to allow surface moisture to evaporate for at least 10 minutes. pH a portion of the media and record the result.

i. Cover and store the trays or plates inverted, inside plastic bags in the refrigerator for no longer than two weeks or until no longer usable.

The pH of the agar should be 7.1 +or- 0.2 at 25° C.

3. Procedure

a. Use sterile forceps to place a membrane filter on the porous plate of the receptacle. Carefully place a matched funnel unit over the receptacle and lock it in place.
b. Filter 100 ml of a well mixed sample shaken 25 times. It is recommended that sand and kelp be allowed to settle out of the well mixed sample (5 seconds settling) before measuring filtration volumes.
c. With the filter still in place, rinse the funnel and the cylinder with three 20 mL portions of sterile dilution water. Using sterile forceps that have been dipped in ethanol, flamed and cooled, transfer the filter with a rolling motion avoiding entrapment of air to the selected medium. Reseat the filter if necessary to insure full surface contact.
d. Cover and invert the dish or tray and incubate for 24 hours at 41.0° C.

4. Definition

All bacteria that produce a gray colony with a blue halo within 24 hours of incubation are considered enterococcus. These colonies are more visible from the underside of the plate.

5. Counting

Use the fluorescent magnifying lamp and hand tally to count colonies. Use the grid marks on the filter to track position. Count each filter twice when numbers exceed 10 per filter. All Samples are to be read within a 22-24 hour period.

6. Calculation of Enterococci Density

For specific rules regarding counting of colonies, refer to Standard Methods 9222 B.,6.

11.4 Verification Procedure Enterococcus (Standard Method 9230 C.,5.)

Verification testing of enterococci is performed quarterly on 10 selected colonies from m-E agar plates. Percent false positives are recorded.

1. Apparatus

a. Screw cap culture tubes
b. Incubator, maintained at 44.5° C.
c. Incubator, maintained at 35.0° C.
d. Inoculating needles and loops
e. Auto pipetter for dispensing media
f. Gram stain reagents as described in the Completed Test

2. Culture Media

a. Brain Heart Infusion Broth (Difco 0037-02, BBL 11058)

Rehydrate 37 grams of brain heart infusion broth in 1 liter of nanopure water. Dispense 8 to 10 ml volumes in screw-cap tubes. Screw caps loosely to allow for venting during autoclaving. Autoclave at 121° C., 15 lbs. pressure for 15 minutes. When media has cooled tighten caps and refrigerate. Store no longer than 3 months. Measure and record pH.

The pH of the media should be 7.4 +or- 0.2 at 25.0° C.

b. Brain Heart Infusion Broth with 6.5% NaCl

Rehydrate broth as directed above and dissolve 60.0 grams NaCl/L in the medium. Stir with heat to dissolve. Dispense and autoclave as above. Measure and record pH.

The pH of the media should be 7.4 +or- 0.2 at 25.0° C.

c. Brain Heart Infusion Agar (Difco 0418-02, BBL 11064

Rehydrate 52.0 grams agar in 1000 ml nanopure water. Use an erlenmeyer flask which is larger than the desired volume of media to be made. Heat to boiling with stirring until ingredients are dissolved. Dispense 10 to 12 ml media in screw-cap tubes. Screw caps loosely to allow for venting during autoclaving. Autoclave at 121° C., 15 lbs. pressure for 15 minutes. Allow tubes to cool and agar to solidify at an angle by resting the screw cap end of each tube on a 10 ml pipette that has been secured to the counter top with tape. Once cooled, tighten caps and refrigerate for no longer than 3 months. Measure and record the pH of the media.

The pH should be 7.4 +or- 0.2 at 25° C.

d. Bile Esculin Agar (BEA) (Difco 0879)

Rehydrate 64.5 grams BEA in 1000 ml nanopure water. Use an erlenmeyer flask which is larger than the desired volume of media to be made. Heat to boiling with stirring until ingredients are dissolved. Dispense, autoclave and prepare slants after sterilization as above. Measure and record pH.

The pH should be 6.6 +or- 0.2 at 25.0° C.

3. Procedure

a. Using a sterile inoculating needle, transfer a loop full of material from the centers of at least 10 well isolated typical colonies into a BHI broth tube and onto a BHI agar slant. Incubate broth tubes for 24 hours and slants for 48 hours at 35.0° C.

b. After 24 hours incubation, transfer a loop full of material from each BHI broth tube to:

1. Bile Esculin agar and incubate at 35.0° C. for 48 hours.
2. BHI broth and incubate at 45.0° C. for 48 hours.
3. BHI broth with 6.5% NaCl and incubate at 35.0° C. for 48 hours.

c. After 48 hours incubation, transfer a loop full of material from each BHI agar slant to:

1. A prepared gram stain slide for gram stain analysis.
2. A clean glass slide for catalyze testing. Add a few drops of 3% hydrogen peroxide to the smear on the slide. The appearance of bubbles constitutes a positive catalyze test and indicates the colony is **not** a member of the fecal streptococcus group.

4. Interpretation of Results

Growth of catalyze-negative, gram-positive cocci on bile esculin agar at 35.0° C. and in brain-heart infusion broth at 35.0° C. verifies that the colony is of the fecal streptococcus group. Growth at 45.0° C. and in 6.5% NaCl broth at 35.0° C. indicates that the colony belongs to the enterococcus group.

11.5 Turbidity (Standard Methods 2130 B (Nephelometric Turbidity Units)

Interferences

Dirty glassware, rapidly settling coarse sediments, the presence of air bubbles and the effects of vibrations that disturb the surface visibility of the sample will give false results.

1. Apparatus

a. Hach Model 2100P Turbidimeter

Range:	0-1000.0 NTU
Sensitivity:	± 1% of reading or, ± 0.01 NTU
Light Source:	Tungsten-filament lamp
Sample Cell:	60mm x 25mm; threaded vial with screw cap.
Accuracy:	± 2% of reading
Response Time:	6.0 seconds to reach equilibrium.
Calibration:	Formazin Standard

2. Reagents

a. Prepared standards are available for purchase from the Hach Co. The set of Primary Formazin standards (Hach StablCal Cat. # 26621-00) include the following: <0.1 NTU, 20 NTU, 100 NTU, 800 NTU.

3. Procedure

a. Meter calibration check:

1. Check calibration daily with the 0-10 NTU Gelex secondary standard and record value in the daily turbidity log.
2. Place the light shield over the cell holder and verify that the readout is -00.
3. Place the Gelex secondary standard into the cell holder with the dot on the ampule aligned with the raised mark on the spill ring. Cover with the light shield.

4. Verify that the readout is within ±2% of the calibrated known value.

b. Meter calibration schedule:

1. Check meter calibration quarterly (Mar., Jun., Sept., Nov.) with the commercially available Hach StablCal standards.
2. With the instrument warmed up and the cell holder empty, place the light shield over the cell holder opening.
3. Adjust the Z (zero) control to obtain a display of -00.
4. Place the sample cell containing the formazin standard in the instrument and cover with the light shield.
5. Follow the manufacturer's instructions for calibration which is located in laboratory equipment file no.1508.
6. At the completion of the calibration procedure, place the Gelex standard of appropriate range in the cell holder.
7. Read and record the value on the daily turbidity log.
8. The Primary (formazin) standards are to be used for calibration on a quarterly basis at a minimum. A schedule for calibration is posted on the turbidimeter itself and is to be performed in March, June, September, and December.
9. The secondary(Gelex) standards are read once per week throughout the year as part of the laboratories in-house QA/QC program.

c. Turbidity measurements:

1. Pour a well mixed sample into a clean sample cell.
2. Wait for bubbles to dissipate.
3. Insert the cell into the cell holder and cover.
4. Read the turbidity of the sample after 15 seconds from the digital display.

4. Calculation

Report turbidity readings as follows:

Turbidity Range NTU	**Report to the nearest NTU**
0 - 1.0	0.05
1 - 10	0.1
10 - 40	1
40 - 100	5
100 - 400	10
400 - 1000	50

12. Microbiological Quality Control

12.1. WATER

Standard Methods 9050 B., Table 9020:I

Prepare culture media and reagents in nanopure water that has been tested and found free from traces of dissolved metals, ammonia, and chlorine. The pH of the water supply should be between 5.5 and 7.5 and the conductivity should register less than 2 umhos/cm at 25

degrees centigrade. The nanopure water system is tested on a monthly basis to verify that it is meeting these requirements. A heterotrophic plate count is performed weekly on the system to verify that there are < 1000 colonies/mL. Deionization cartridges are replaced every four months or as needed after review of water quality results.

12.2. MEDIA USE AND STORAGE

Standard Methods 9050 A., 9050 C.

Because culture methods depend on properly prepared media, use the best available materials and techniques. For quality control, use commercially prepared media and follow the directions for rehydration as stated on the label. Order media in quantities that last no longer than one year. Record the dates received and opened on the bottle. Discard media that are caked, discolored, or show other signs of deterioration.

Use opened bottles of media within 6 months after opening or the manufacturer's expiration date. Record the opened and expiration dates on the label of the container. Discard any open bottles of media after six months or opened media exceeding the manufacturers expiration date. Store dehydrated media in tightly closed containers in the dark at less than 30 degrees centigrade in an atmosphere of low humidity.

Media Preparation

Standard Methods 9020 B.,3.,h.,1)

Prepare media in containers that are at least twice the volume of the medium being prepared. Stir media while being prepared, particularly while heating. To avoid scorching, insure that all media is suspended in solution before applying heat. Agars tend to boil over rather quickly and require continual attendance. Identify and date prepared media. Confirm that the pH of broth and agar media after sterilization meets the manufacturers specifications and record results. Examine the media for unusual color darkening or precipitation. Discard the batch if anything appears to be out of the ordinary.

Media Sterilization

Standard Methods 9050 A.,3.

After rehydrating a medium, dispense to promptly to culture vessels and sterilize within 2 hours. Do not store nonsterile media.

Sterilize all media, except broth's with other specifications, in an autoclave at 121 degrees centigrade for 15 minutes. When the pressure returns to zero, remove media from autoclave and cool quickly to avoid decomposition of sugars by prolonged exposure to heat. To permit uniform heating and rapid cooling, pack materials loosely. The maximum elapsed time for exposure of broth's to any heat (from time of closing loaded autoclave to unloading) is 45 minutes.

Check the effectiveness of each run by using a steam sterilization load record card or tape. Record the date, start time, end time, operator and number of items on each card. Use indicating tape on each rack of broth media prepared. Include type, date prepared and expiration.

Media Holding Times

Standard Methods 9020 B.,3.,h.,4) Table 9020:IV

Agars may be sterilized and stored refrigerated for future use but may be re-melted only once for this purpose. Temper melted agars in a water bath at 46 degrees centigrade until use but hold no longer than 3 hours.

Liquid media in fermentation tubes, if stored at refrigeration temperatures, may dissolve sufficient air to produce, upon incubation at 35 degrees centigrade, a bubble of air in the inverted vial. Discard any broth tubes in this condition. Evaporation may take place upon storage. Discard any tubes with an evaporation loss exceeding 1 mL. Color changes may occur in media containing dyes. Discard this media also.

Seal prepared agar plates in plastic bags and refrigerate to retain moisture. Discard if growth appears on the surface of the agar, if excessive drying cracks the agar surface or if their is a color change with time.

Prepare all media in amounts that are expected to be used within the holding time limits given in Standard Methods 18th ed. Table 9020:IV, page 9-9.

Medium	Holding Time
Membrane filter (MF) broth in screw cap flasks at 4° C	96 Hours
MF agar in plates with tight fitting covers at 4° C	2 weeks
Agar or broth in loose –cap tubes at 4° C	1 week
Agar or broth in tightly closed screw-cap tubes at 4° C	3 months
Poured agar plates with loose-fitting covers in sealed plastic bags at 4° C.	2 weeks

Media Quality Control
Standard Methods 9020 3.,h.,5)

Maintain a complete record including lot number and expiration dates of each batch of media prepared with the initials of preparer, type of media, date, volume made, tare weight of media, pH before and after autoclaving, sterility checks and positive and negative growth checks. For the sterility check, a blank plate must be placed in the incubator overnight. The positive and negative growth checks are the following:

	Positive Control	**Negative Control**
Total Coliform	Escherichia Coli	Staphylococcus aureus
Fecal Coliform	Escherichia Coli	Enterobacter aerogenes
Enterococcus	E. faecalis	Escherichia Coli

Analytical Quality Control
Standard Methods 9020 B.,4.

For quality control on membrane filter procedures, colony verification is performed quarterly. For each type of test conducted i.e. total coliform, fecal coliform and enterococcus, 10 positive colonies are subjected to the appropriate test procedure. Refer to the individual methods which follow this section for a detailed discussion of verification test methods.

In addition, for membrane filter tests, the sterility of the media, membrane filters, rinse water, glassware and equipment is verified at the end of each series of samples using sterile water as the sample.

For quality control on multiple-tube dilution tests or MPN, 10 positive samples from one source are subjected to the completed test quarterly.

For multiple tube procedures, the sterility of the media, makeup water and glassware is tested by subjecting a representative portion of each batch to incubation at an appropriate temperature for 24 to 48 hours and observing for growth.

12.3. EQUIPMENT INSTRUMENTATION AND QUALITY CONTROL

Standard Methods 9020 B., 2.

Thermometers are calibrated semiannually against certified NBS thermometers. Temperature corrections are applied are recorded daily with temperature logs located on the doors of the incubators and the logs are kept on file. Balances are calibrated quarterly against certified Class S weights. pH meters are standardized each day with two standard buffers. Media dispensing apparatus are checked for accuracy at the start of each volume change. At least one liter of deionized water is pumped through the dispenser after each use. The temperature of the hot air oven, refrigerator, freezer and incubators are monitored daily.

Items sterilized, temperature, pressure and run time are monitored and recorded with each autoclave run. The operating temperature of the autoclave is checked weekly with a minimum/maximum thermometer. The timer is checked against a stopwatch on a monthly basis as well. Heat indicating tape is used to identify materials that have been sterilized. Steam sterilization load record cards are used to document the performance of each run.

On a monthly basis Test the performance of the autoclave by using the Raven Biological Laboratories, Prospore Ampoules that contain a population of *Bacillus stearothermophilus* spores. Instructions for use is the following:

Place one Prospore Ampoule into the sterilizer for a 12-15 minute cycle. After sterilization cycle place one control ampoule and the ampoule that was sterilized into an incubator for 24 hours at 55°C. Positive growth is evident by either turbidity and/or a color change from purple to or toward yellow. Record results on the autoclave steam sterilization load record worksheet.

Ultraviolet sterilization lamps are tested quarterly with plate count agar pour plates and cleaned or replaced if necessary. A dark field Quebec-type colony counter providing 1.5 diameters of magnification is used for heterotrophic plate counts and a fluorescent light source with magnifying lens is used to count colony forming units on membrane filters.

Membrane filters are purchased individually wrapped and presterilized from manufacturers that provide certification statements with each lot. They report retention, pore size, flow rate, sterility, pH percent recovery and limits for organic and inorganic extractables. Each lot is further inspected during testing to insure that water diffuses uniformly through the filters and that the ink grid is nontoxic. Certification statements are kept on file in the laboratory for each lot of filters.

Sample bottles are checked for sterility on a batch basis. After a batch of bottles are washed and autoclaved one bottle is tested for sterility by pouring 10 ml sterile Tryptic Soy

Broth into a randomly selected presterilized bottle, incubating at 35 degrees centigrade for 24 hours and examining the broth solution for turbidity or any other signs of growth.

12.4. MATERIALS QUALITY CONTROL

Standard Methods 9040

Rinse water for the membrane filter procedure is prepared weekly on the same day the filtrations are performed. It is prepared in two liter batches by adding 10.0 ml of magnesium chloride solution and 2.5 ml of stock phosphate buffer solution to each 2 liter bottle of deionized nanopure water. This is then autoclaved for one hour and cooled in an iced sink bath before use. 100 ml of this sterile buffered water are filtered and incubated with each type of analysis to confirm sterility.

Sterile dilution water is prepared in a similar manner and subsequently dispensed into milk dilution bottles to provide 99 ml or screw cap tubes to provide 9.0 ml after autoclaving for 15 minutes. This water is stored refrigerated in closed containers for no longer than 3 months.

Stock phosphate buffer is prepared in a heat sterilized 250 ml volumetric flask. 8.5 grams of potassium dihydrogen phosphate are dissolved in 150 ml nanopure water inside the flask. (pH approx. 4.4) 5.2 ml of 10 normal sodium hydroxide are then added to the flask to bring the solution to the proper pH and the flask is brought to volume with nanopure water. A small portion of this solution is then removed and pH of 7.2 is verified on a pH meter. The initial pH and quantity of 10 normal sodium hydroxide to add were determined on a separate solution under nonsterile conditions.

Magnesium chloride solution is prepared by weighing 40.6 grams of magnesium chloride 6 hydrate directly into a sterile plastic screw cap bottle. 500 ml of nanopure water are measured using a sterile cylinder and added to the bottle. Both this and the phosphate buffer solution are stored refrigerated for no longer than 6 months. Discard when buffer solutions show signs of turbidity or growth.

Glassware is sterilized for a minimum of 2 hours in the 180 degree centigrade oven. Plastic ware is sterilized in an autoclave at 121 degrees centigrade, 15 lbs. pressure for 15 minutes. Membrane filter assemblies are sterilized in an ultraviolet sterilizer for at least 2 minutes prior to running each set of samples. Time elapsed between sample sets does not exceed 30 minutes. Contaminated materials, broth media and agars are sterilized for 30 minutes prior to disposal.

12.5. RECORDS

Standard Methods 9020 B.,5.

The following information is recorded for each sample analyzed in the laboratory; date, time of sampling, initials of sample collector, identification of sample, time of analysis, initials of person performing the analysis, analytical method used, raw data and the calculated results of the analysis. Records remain on file in the laboratory for at least five years.

Types of Controls and Frequency of Use

a) Replicate Samples

The precision of an analytical method is determined by running at least 10% of the sample load in duplicate. If samples require a preparatory procedure prior to instrumental analysis, then the duplicate samples are carried through the entire preparatory procedure.

b) Spiked Samples

The accuracy of an analytical method is determined by running spiked samples for at least 10% of the sample load. If samples require a preparatory procedure prior to instrumental analysis, then the spiked samples are carried through the entire preparatory procedure. The spiked sample concentration must fall within the calibration range of the instrument for the spike to be considered valid.

Samples analyzed for alkalinity, hardness, BOD, residual chlorine, oil and grease, pH, turbidity, settleable solids, suspended solids, volatile solids, and dissolved oxygen are not spiked for practical reasons.

c) Reagent Blanks & Instrument Blanks

The reagent blank consists of laboratory pure water containing all of the reagents utilized in the analytical procedure. The reagent blank is prepared in the same manner as the samples and is processed through all of the analytical steps of the routine chemical procedure.

Instrument blanks are used to determine if there is instrument contamination due to sample carry over. The absorbance reading for the instrument blank must remain below the detection limit for each analyte of interest or the sample absorbance must be greater than ten times the instrument blank absorbance.

Instrument blanks are analyzed as part of the initial method calibration and periodically throughout the sample run to document the absence of baseline drift.

d) External Reference Samples

Reference samples are purchased from several commercial manufacturers. Fisher Scientific, RTI, Inc. and Environmental Resource Associates currently supply all of the laboratory's needs for quality control samples. These samples are analyzed with each analytical run to verify the accuracy of calibration standards and to assist in the identification of a possible "out-of-control" event. They are analyzed immediately following the calibration standards. If acceptance criteria, supplied by the manufacturer, are not met the instrument is re-calibrated before beginning the analytical run.

e) Stock standards for metals analyses are obtained from commercial manufacturers and certified as to concentration by lot number. Stock solutions for all other inorganic parameters are made up by the analysts from the appropriate reagent grade chemical specified in the procedure. Specifics of solution preparation are logged into the stock standard log book.

Stock standards are utilized to make working standards of lower concentrations which are then utilized to make calibration standards for the analytical run. The

holding periods of stock standards, working standards, and calibration standards for the different analyses are provided in Table 4.1.

Stock standards, working standards, and calibration standards are prepared and standardized in accordance with the method procedure. Usually, working standards and calibration standards are prepared from the stock the day of the analytical run.

Calibration standards are run at the onset of each day's analysis and a single calibration standard is repeated at the end of the run to verify stability of the calibration curve. The number of calibration standards used varies with each type of analytical run. The number of standards used is summarized by parameter in Table 4.2.

Acceptance Criteria for Quality Control Samples

The use of quality control samples and reference materials is of little value in maintaining overall analytical quality control unless the laboratory has established acceptance criteria for these samples. Quality control samples falling outside of these criteria serve as flags to signal that the data are suspect and that the analyses must be rerun.

a) Replicate and Spiked Samples

The established acceptance limits for duplicate and spike samples for all analyses performed at the EWA laboratory are provided in Table 4.3. Limits are presented for wastewater matrices and less stringent acceptance limits are provided for low level duplicate concentrations. A sample is considered low level if it contains a concentration less than 10 times the detection limit. All of the acceptance limits listed are at least as stringent as those specified by the EPA for wastewater.

All analysts must insure that their spike and duplicate data fall within the stated acceptance ranges. Any sample results collected between duplicates or spikes which are unacceptable must be reviewed with the Quality Assurance Officer. A review of the analytical procedure is conducted including the possibility of matrix interferences. If the sample can not be rerun due to exceeded holding times or lack of sufficient sample volume or weight, then the data must be qualified as suspect when reported to the regulatory agency.

b) Reagent Blanks

Reagent blank values must remain less than 10 times the value detected in the sample for each analytical procedure. If the analyst notices an increase in the absorbance reading of the reagent blank which is approaching the values found in the samples, the analytical run is suspended until the source of the increase can be identified and corrected.

c) External Reference Samples

Recoveries of external reference samples must fall within the acceptance limits provided with the true values. If the external reference sample is prepared in the laboratory, acceptance limits are assigned after 20 consecutive determinations are

made by a single analyst. The results are recorded on a Shewart mean chart, modified to record percent recovery, and the acceptance values are calculated.

d) Check Samples

The results of check sample analyses must fall within the acceptance criteria provided with the samples. The acceptance criteria usually represent the 95% confidence interval obtained from a group of reputable laboratories that have previously analyzed the samples.

Table 12.1 Acceptance Limits For Spike And Duplicate Samples

Parameter	Spike Recovery (%)	Duplicate Precision	
		High (%)	Low (%)
Metals	80-120	15	25
Anions	80-120	15	20
Nutrients	80-120	15	20
Other Inorganics	80-120	15	20

Duplicate precision is calculated as the percentage of the difference divided by the mean. Low level refers to concentrations less than 10 times the detection limit. High level refers to concentrations greater than 10 times the detection limit.

Field/Laboratory Blanks:. For bacterial analysis performed at a group's facility, a laboratory blank will be performed for each sampling/analysis event. (see Table 14.1)
Replicate Samples: Replicate samples are two or more samples collected at the same time and place. When there are only two replicates then these are referred to as duplicates. Duplicate samples will be collected as soon as possible after the initial sample has been collected, and will be subjected to identical handling and analysis. For bacterial analysis lab duplicates will be run at least once per sampling day, and when there are more than 20 samples run per day then there will be a minimum 5% of the samples analyzed in duplicate.

Split Samples: Twice a Year, split spiked samples (standards) will be analyzed as part of the Quality Control Session. The split standard is one sample, containing a known concentration of an analyte, that is divided equally into two or more sample containers.

For turbidity using the dual tube (JTU) method, split field samples will be analyzed as part of the Quality Control Session. The laboratory receiving the split sample will analyze it using the nephelometric method, even though these results are not strictly comparable to the visual JTU comparators. The results of turbidity using the two methods will be plotted to determine if there is a linear correlation. If this correlation is significant, then it will be used to estimate and compare results of the turbidity tubes with nephlometric results. The Technical Advisory Committee for all groups will use the product-moment correlation coefficient (r) to determine the adequacy of the correlation.

For bacteria, split field samples or split positive controls will be analyzed by

Standardization of Instruments and Procedures: At the Quality Assurance Sessions the temperature measurements will be standardized by comparing our thermometers to a NIST-certified or calibrated thermometer in ice water and ambient temperature water. All meters (pH, conductivity, oxygen) will be evaluated at the Quality Assurance Session using standards provided with the assistance of a professional laboratory and/or the technical advisors. For

oxygen meters the standard will be distilled water saturated with oxygen. The Winkler kits for dissolved oxygen will be checked by standardizing the sodium thiosulfate solution in the test kit, and/or by comparing the entire kit to a saturated oxygen standard. Instructions for checking the sodium thiosulfate are included in the test kit. (Additional reagents and glassware must be purchased separately however.) If the result is unsatisfactory, as indicated in the instructions, the sodium thiosulfate and/or other reagent will be discarded and replaced with new reagents.

Continuous Monitoring Devices: Should continuous monitoring devices be used for any parameters then such devices must be calibrated and deployed according to the manufacturer's specifications and field confirmation will be performed using replicate sampling (for laboratory analysis) or standardized instruments. For example, there is the possibility of using in-situ continuous monitoring devices for flow or temperature measurements. Confirmations using a flow meter or a standardized field thermometer will be perfomed at the time of deploying and retrieving the device. This will serve to determine the accuracy of the continuous monitoring device.

Table 12.2 summarizes the quality control regimen.

Table 12.2 Summary of Quality Control Requirements

Parameter	Blank	Duplicate Sample	Split Sample to lab	QC session
Water quality				
Turbidity	daily	5% or a minimum of once a year	twice a year	twice a year
Biological Parameters				
Total Coliform and *E. coli* Bacteria	daily	5% or a minimum of once per day	twice a year	twice a year
Enterococcus Bacteria	daily	5% or a minimum of once per day	twice a year	twice a year

13. Instrument/Equipment Testing, Inspection and Maintenance

13.1 Instrument Monitoring and Maintenance Logs

The operating temperatures of incubators, water baths, hot air ovens, and refrigerators are checked daily and recorded. Adjustments or service calls are made when required. Calibration checks of the laboratory's analytical balance are performed quarterly by laboratory staff with Class S weights. Balances are calibrated annually by contract and certification statements are maintained on file. All thermometers in the laboratory's incubators and drying ovens are checked annually against NBS traceable thermometers and correction factors are documented and kept on file in the quality assurance instrument calibration file.

A separate log book is maintained for routine maintenance as well as any repair work required. The format analysts use for these logs is presented in Appendix E.

In addition, calibration records are maintained on a daily basis for the pH meters. The laboratory turbidimeter is calibrated weekly with Hach Gelex turbidity standards and quarterly with Hach Formazin standards with records being kept on file. The dissolved oxygen meter is also calibrated on a daily basis and these records appear in the BOD workbook.

13.2. Turbidity

Nephelometers: Meters and tubes should be checked for cleanliness and proper operation. The tubes should not be smudged or scratched.

14. Instrument Calibration / Standardization and Frequency

Instruments will be calibrated and reagents checked against standards accordingly to the following schedule. Standards will be purchased from a chemical supply company or prepared by (or with the assistance of) a professional laboratory. Calibration records will be kept in the maintenance log at the headquarters location (described in Section 5.2.) where it can be easily accessed before and after equipment use. Calibrations that are performed by monitors in the field are recorded on the field data sheets, also archived at the headquarters. The frequency of calibration is described in Table 14.1.

Table 14.1 Instrument Calibration and Frequency

Conventional Water Quality Parameters		
Equipment Type	**Calibration Frequency**	**Standard or Calibration Instrument Used**
Turbidity meter (nephelometer)	Every sampling day Quarterly	Gelex secondary standards StablCal Formazin Primary Standards

15. Inspection/Acceptance Requirements

The Quality Assurance Officer maintains an internal quality control program of check sample submittals. Check samples for a variety of constituents are submitted during a formalized evaluation process at the end of each new employees probationary period. They cover all parameters analyzed by each individual. Results are reviewed with each analyst and a summary report is filed in their personnel file. If results are unacceptable, that individual will discontinue running the analysis until proficiency can be demonstrated for that parameter.

The Quality Assurance Officer maintains a file of all check samples with true values and acceptance limits. These are utilized when an analytical run is suspect to provide further assistance in characterizing potential problem areas. The true value for the check sample must be duplicated in the run before the results are reported.

16. Data Acquisition Requirements

16.1 Professional Analytical Data

Only certified analytical laboratories or academic laboratories (with approval of State and/or Regional Board staff) will be used for quality assurance checks and analysis of field samples.

17. Data Management

Data will be entered into a spreadsheet (MS Excel) or a database (MS Access) in a way that will be compatible with EPA's STORET and the Regional WQCB's database guidelines. Following initial data entry the data coordinator will review electronic data, compare to the original data sheets and correct entry errors. After performing data checks, and ensuring that data quality objectives have been met, data analysis will be performed.

18. Assessment and Response Actions

Assessment and response actions will be managed by the Stormwater Staff.

19. Reports

Quarterly reports will be completed for evaluation by the State Water Resources Control Board.

20. Data Review, Validation and Verification

20.1 Determination Of Out-Of-Control Analyses

Use of Control Charts

The laboratory uses control charts for all parameters where a sufficient quantity of samples are collected to make their use effective and practical. Because at least 20 pieces of quality control information are necessary to construct a control chart, initial monitoring cannot be performed in this manner. Until sufficient data is collected, acceptance limits are established as referenced on **Table 4.3.** These acceptance limits are generally much broader than those developed from control charts. As the technician becomes more practiced at a specific analytical method, the acceptance limits continue to gradually decrease. The control charts developed by an analyst who has been performing the same task for several years usually establish acceptance limits of 95 to 105%.

a) Types of Control Charts

The laboratory uses two different types of control charts to monitor duplicates and spikes. The Shewart mean chart modified to percent recovery is utilized to monitor spiked samples. This procedure is referenced in the EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories, 1972. This same type of chart is used to monitor recoveries of quality control check samples that are run with each analysis.

The Shewart range chart is utilized to monitor duplicate samples. Since precision is a function of concentration, efforts are made to maintain separate Shewart charts for high and low concentration levels.

Upper and lower warning and control limits are calculated using the first 20 pieces of control data. The analyst plots these limits on blank paper and then enters the next set of 20 data points. The previously calculated control limits are used to determine acceptability of each subsequent run. The procedure is repeated as an iterative process.

In 1999 the laboratory purchased a computer software program called Control Chart Pro and eventually all QC charts will be stored on the computer, no longer requiring a hardcopy of the charts.

Defining an Out-of-Control Analyses

An analysis is out-of-control whenever a quality control sample or parameter falls outside the acceptance limits. Quality control parameters are evaluated for their acceptability with each run either according to established acceptance limits or on a control chart basis. Control charts are effective in determining trends in accuracy and variability caused by changes in methodology, analyst, or analytical method.

a) Criteria Used

Quality control charts must follow the criteria set forth in the previous section. (Section 4)

b) Approaches to Control Chart Interpretation

The control charts signal an out-of-control situation whenever one of the following situations is observed:

- One or more points fall outside the upper or lower control limit
- Two or more consecutive points fall outside the warning limit
- Seven or more consecutive points fall above or below the mean
- Seven or more consecutive points are increasing or decreasing

If any of the above situations are observed, the analyst reports immediately to the Quality Assurance Officer and the cause of the increased variability is investigated, corrected and documented prior to analyzing any more samples.

Responding to an Out-of-Control Event

It is important to have an operational system in the laboratory for recognizing out-of-control events as soon as they occur so that the appropriate action can be taken to bring the analysis back into control. This insures that no data are reported from a period when the analysis was out-of-control.

a) Roles and Responsibilities

The analyst has the primary responsibility for verifying that all daily QC parameters fall within the acceptance limits before submitting data for review. Review at the analyst level enables most errors to be caught immediately. All of the quality control parameters are reviewed for compliance with the acceptance criteria and the calculations on the raw data forms are checked for errors. If the initial review reveals that acceptance criteria have been exceeded, the analyst notifies the Quality Assurance Officer before continuing with subsequent analyses.

The check of daily QC parameters indicates immediate problems with the data but trends are only evident on the control charts. The analyst is responsible for reviewing the control charts to identify trends, which may not be evident from a spot check. Any trend thus identified is discussed with the Quality Assurance Officer and appropriate corrective action is taken.

b) Defining Suspect Samples

Sample data is considered suspect if sandwiched between unacceptable duplicates or spikes or if the data are from an analytical run that had an unacceptable calibration curve or an external reference sample out of the expected range. Sample data is also considered suspect if the reagent blank has substantially increased beyond normal range and sample values are no longer clearly distinguishable from the blank.

The control charts indicate suspect data if any of the out-of-control characteristics outlined in Section 5.2 are present on the chart. In this situation, all data analyzed between duplicates or spikes, which are unacceptable by the chart criteria will be suspect. If only one external reference sample is analyzed and the acceptance criteria is not met, all samples analyzed during the run will be suspect.

c) Assuring That Suspect Data Are Properly Reported

The ultimate responsibility of the Laboratory Supervisor to insure that suspect data is reported as such and that any evidence documenting this assumption is reported to the regulatory agency. The Laboratory Supervisor performs periodic system audits to insure that this program is functioning properly.

d) Corrective Actions

If the calibration fails, the analyst must determine whether the problem lies with the preparation of the standard, the reagents, or an instrument malfunction. This is usually determined by comparison of the calibration data with historical records.

If calibration appears acceptable, but some or all of the duplicate and spiked samples are unacceptable, the analyst must determine whether there is a matrix problem interfering with the analysis. If matrix interference is suspected the analyst must determine the most appropriate method of alleviating the interference. This may be accomplished by dilution of the sample, modification of preliminary sample preparation or digestion steps, choosing an alternate wavelength or using the method of additions.

If an unacceptable result is obtained on a check sample, the run is reviewed by the analyst and the Quality Assurance Officer. If no apparent cause of error is found, a second check sample from a different source may be run to determine if the error occurred during preparation of the check sample or the check sample has degraded over time.

If an out-of-control event is indicated by a shift or trend on a control chart, the following possible explanations are investigated:

1. A shift in the mean of the percent recovery chart could be caused by incorrect preparation of a standard or reagent, contamination of the sample, incorrect instrument calibration, instrument component deterioration such as lamp failure, analyst error, dirty glassware or mistakes in sample preparation.

2. A trend of the mean upward could be caused by deterioration of the standards or an increase in the extraction efficiency.

3. A trend of the mean downward could be caused by concentration of the standard due to evaporation, deterioration of reagents, a decrease in the extraction efficiency or instrument component failure.

4. Increased variability could be caused by switching to a different analyst, deviation from the procedure or using a different method.

5. A shift in the mean or increased variability can be caused by a sample load of an unusual matrix. If this is the case, the analysis will not be considered out-of-control but the situation will be documented and data reported as suspect.

Documenting an Out-of-Control Event

When an out-of-control event occurs, each analyst reports it immediately to the Laboratory Supervisor. A preliminary investigation is initiated at that time. Usually the preliminary investigation will identify the problem and the proper corrective action is taken. The run is repeated and compliance is achieved. If the preliminary investigation can not resolve the problem, the Laboratory Supervisor reviews the actions taken during the preliminary investigation and the results obtained. The Laboratory Supervisor then develops a course of action for a follow-up investigation which begins immediately. Analytical runs are discontinued until the problem is resolved. Samples are sent to a contract laboratory during the time of the investigation. This allows time to make any necessary equipment repairs, purchase new standards, reagents or glassware and/or retrain personnel. Analysis does not resume until all quality control criteria are met. The Laboratory Supervisor maintains complete documentation on all events of this nature.

APPENDIX 1. Turbidity Calibration Log

Calibration Log for Hach 2100P Turbidimeter				
		Secondary Standard Values		
Analyst	Date	0-10 NTU	0-100 NTU	0-1000 NTU

APPENDIX 2. Field Screeing Data Sheet

Site ID: **Moonlight UV Monitoring**

TB Page: **1147 B6**

Date / Time:

Field Personnel:

Field Data Sheet

GENERAL CONDITIONS

Light	Sunny	Overcast	Partly Cloudy
Last Rain	> 72 hours	< 72 hours	< 3 hours
Precipitation	None	< 0.1"	> 0.1"

Site Map

SITE DESCRIPTION

Location	Cottonwood Creek				
Observed Land Use	**Residential**	**Commercial**	Industrial	Open	Other
Conveyance Type	Manhole	**Outfall**	**Open Channel**	Other	
Construction	**Concrete**	Steel	Rock/ Rip Rap	**Natural**	Other

DISCHARGE ESTIMATION

Flowing Creek or Box Culvert*			**Filling a Bottle or Known Volume***			**Flowing Pipe***	
Width	ft		Volume	mL/gal		Diameter	ft
Depth	ft		Time to Fill	sec		Depth	ft
Velocity (measured)	ft/sec					Velocity	ft/sec
Flow	cfs		Flow	cfs		Flow	cfs

Flow Observed? **Yes** / No / Ponded

Evidence of overland flow near sampling site? Yes / No

OBSERVATIONS

Site Photo

Physical

Odor	None	Rotten Eggs	Chemical	Sewage	Other
Color	None	Brown (Silty)	White (Milky)	Gray	Other
Clarity	Clear	Transparent	Slightly Cloudy	Opaque	Other
Floatables	None	Trash	Bubbles/Foam	Oily/Rainbow	Other
Deposits	None	Sediment	Colored	Oily	Other

Biological

Fauna	None	Insect	Benthic Invert	Fish	Reptile	Bird	Mammal
Flora	None	Algae	Non-native	Wetland	Canopy	Excess?	Yes / No

WATER SAMPLING

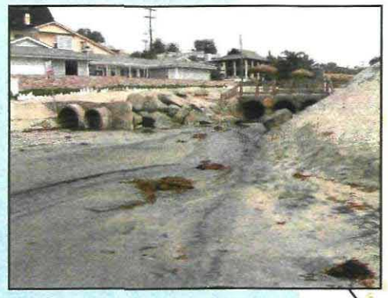
Field Screening Sample Collected? Yes / No **Analytical Lab Sample Collected?** Yes / No

Field Screening	Turbidity		NTU						
Laboratory Analysis**	Total Coliform		CFU/ 100 mls	Fecal Coliform		CFU/100 mls	Enterococcus		CFU/100 mls

COMMENTS / NOTES

Completed By: _____ Date: _____

APPENDIX 3. Map of Sampling Sites



B Street

3rd Street

101

1 Upstream
2 Downstream
3 Outlet
4 Surf Zone
Ultra Violet Treatment Facility
Storm system nodes
Storm drains
Stream
Contours

city of encinitas

Moonlight Ultra Violet Facility Monitoring Locations

Date of Map Production:
May 13, 2002

By Frank McDermott, GIS

N

1 inch equals 200 feet
Projection: California State Plane, Zone 6
Datum: NAD83

G:\gis1\home02\engr\storm\Ultra Violet 11x17.mxd

AQUIONICS
World Leader in Ultraviolet Technology

UV Facility – assumed at 25 mJ/cm² based on kill rate of 5 log.

TECHNICAL INFO

UV GERMICIDAL DOSE *
REQUIRED FOR A 90% REDUCTION RATE OF VARIOUS MICRO-ORGANISMS

BACTERIA & DOSE			
Aeromonas	5	Micrococcus luteus	10-26
Agrobacterium tumefaciens	4-5	Micrococcus lysodeikticus	23
Bacillus anthracis(Spores)	9	(M: Lutens, Phosphate, Buffer)	
Bacillus anthracis	4-5	Micrococcus piltoniensis	6-8
Bacillus enteritidis	4	Micrococcus radiodurans	20-21
Bacillus megaterium(Veg)	1-2	Micrococcus shaeroides	10-16
Bacillus megaterium(Spores)	1-4	Mycobacterium tuberculosis	6.2
Bacillus mesentericus Fascus	6	Neisseria catarrhalis	4-5
Bacillus mesentericus Fascus(Spores)	9	Proteus vulgaris	1-4
Bacillus paratyphosis	3-4	Pseudomonas aeruginosa	5-6
Bacillus prodigiosus	1	Pseudomonas flourescens	3-4
Bacillus pyocyaneus	4	Phytomonas tumefaciens	4.4
Bacillus stearothermophilus(Spores)	60-180	Rhodospirillum rubrum	5-6
Bacillus subtilis	6-8	Salmonella enteritidis	4-8
Bacillus subtilis(Spores)	5-12	Salmonella paratyphi(Enteric Fever)	3-6
Bacillus subtilis Sawamura	7	Salmonella typhimurium	5-8
Bacillus subtilis Sawamura(Spores)	11	Salmonella typhosa(Typhoid Fever)	1-6
Bacterium coli	5-6	Sarcina lutea	20-26
Branhamella catarrhalis	3-4	Serratia marcescens	1-3
Campylobacter jejuni	5	Shigella dysenteriae(Dysentery)	1-4
Clostridium botulinum	12	Shigella flexneri(Dysentery)	1-2
Clostridium tetani	4.9	Shigella paradysenteriae	1-3
Corynebacterium diptheriae	2-4	Shigella sonnei	2-3
Dysentery bacilli	2-3	Spirillium rubrum	4-5
Eberthella typhosa	1-3	Staphylococcus albus	2-3
Escherichia coli in air	1-3	Staphylococcus aureus	2-3
Escherichia coli in water	5-6	Staphylococcus faecalis	4-5
Fusobacterium nucleatum	1-3	Staphylococcus haemolyticus(A)	6-7
Legionella bozemanii	2	Staphylococcus haemolyticus(D)	2-9
Legionella dumoffii	3	Staphylococcus lactis	6.2
Legionella gormanii	2-3	Streptococcus pyogenes	2-3
Legionella longbeachae	1-2	Streptococcus salivarius	2
Legionella micdadei	1-2	Streptococcus viridans	2
Legionella pneumophila	2-5	Staphylococcus lactis	6.2
Leptospira canicola(Infectious Jandice)	3	Tuberculosis bacillus	10
Leptospira spp(Infectious Jaundice)	2-3	Vibrio cholerae	6-7
Listeria monocytogenes	8	Vibrio comma	3-4
Micrococcus candidus	6-7		

*dose in (mJ/cm^2) at 254 nm

21 KENTON LANDS ROAD ♦ ERLANGER, KY 41018 ♦ P: 859.341.0710 ♦ T: 800.925.0440 ♦ F: 859.341.0350 ♦ WWW.AQUIONICS.COM
HALMA GROUP COMPANY

ALGAE	DOSE
Blue Algae	300-600
Green Algae	300-600
Chlorella Vulgaris(Algae)	14

FISH DISEASE	DOSE
Chilodonella cyprini	1000
Cryptocaryon irritans	800
Fungi(Typical)	24
Ichtyophthirus(WhiteSpot)	40
Ichtyophthirus spp	100-336
Infectious Pancreatic necrosis(IPN)	60
Oodinium ocellatum	35
Paramecium spp	200
Saprolegnia(Fungal Disease)	13
Saprolegnia spp	10-35
Sarcina lutea	27
Trichodina nigra	159
Trichodina spp	35
Viral Hemorrhagic septicaemia(VHS)	10

MOLD SPORES	DOSE
Aspergillis amstelodami(Meat)	66-70
Aspergillus flavus	40-100
Aspergillus glaucus	44
Aspergillus niger(Bread)	44-132
Cladosporidium herbarum(Cold Sores)	30-70
Fungi from Manure, Soil, etc.	120
Fusarium	25-35
Mucor mucedo(Meat,Fat,Bread,Cheese)	50-70
Mucor racemosus A/B	17
Mucor ramosissimus	17
Olpidium	<35
Oospara lactis	5
Penicillium chrysogenum	30-50
Penicillium digitatum	29-100
Penicillium expansum	13
Penicillium roqueforti	13
Phytophtora	<35
Pythium	<35
Rhizopus nigricans	110-200
Scopulariopsis brevicaulis(Cheese)	30-80
Verticullium	<35

PROTOZA	DOSE
Acanthamoeba castellanii	40
Giardia lamblia(Cysts)	63-100
Giardia muris	100-110
Nematode Eggs	31-51
Paramecium	64-110

VIRUSES	DOSE
Adenovirus 3	1-2
Bacteriophage(E. Coli Virus)	2-3
Coxsackie Virus A9	12
Coxsackie Virus B1	15-16
Coxsackie Virus B5	7
Echovirus I	11
Echovirus II	12
Hepatitis A	4
Hepatitis B Virus	3-11
Infectious Hepatitis Virus	5-8
Influenza	2-4
Poliovirus(Poliomyelltis)	3-7
Poliovirus I	7-11
Poliovirus II	12
Poliovirus III	10
Reovirus I	15-16
Rotavirus SA 11	7-8
Tobacco mosaic Virus	240

YEAST	DOSE
Bakers Yeast	4
Brewers Yeast	10
Common Yeast Cake	6
Gunger Yeast	19
Pichia	35
Saccharomyces carlsbergensis	10
Saccharomyces cerevisiae	6
Saccharomyces ellipsoideus	4-6
Saccharomyces sake	8-9
Saccharomyces species	8
Saccharomyces turpidans	9
Saccharomyces uvarum	3-4
Saccharomyces willianus	34
Torula sphaerica(Milk & Cream)	2-3
Yeast (Average)	4-6

City of Encinitas

April 10, 2003

Ms. Laura Peters
State Water Resources Control Board
Loans and Grants Branch
P.O. Box 944212
Sacramento, CA 94244-2120

SUBJECT: QUARTERLY STATUS REPORT – INVOICE #3
MOONLIGHT BEACH URBAN RUNOFF TREATMENT FACILITY
CITY OF ENCINITAS

Dear Ms. Peters:

This letter serves to provide the status of the Moonlight Beach Urban Runoff Treatment Facility as required by the State of California Water Resources Control Board Contract Agreement No. 01-076-550-0. This report is the third quarterly report for the project covering the period between September 1 through November 30, 2002.

Task 1: Project Management and Administration

The tasks completed during this phase include city staff and consultant time for oversight and management of the UV treatment facility. At least five staff personnel from the City of Encinitas, Ashford Engineering, and PBS&J were assisting with the ongoing management of this project. Activities included meetings and correspondence regarding the facility startup. The City also hosted a Ribbon Cutting Ceremony for the facility on September 20th, 2002. This event was held at Moonlight State Beach and included guests from the Governor's office, Pete Silva of the State Regional Water Quality Control Board, County Supervisor Pam Slater, State Representative Howard Wayne, and representatives from Senator Bill Morrow's office. See Attachment A.

In addition, Ms. Katherine Weldon presented a paper to the California and World Oceans '02 Conference in Santa Barbara October 27 – 30th, 2002. A copy of the paper can be found on the Internet at the following address:

www.ci.encinitas.ca.us/city_services/Eng/engcappro.htm

Task 2: Federal, State, and Local Permits

No permits were required during this phase of the project.

Task 3: Quality Assurance Project Plan

Complete.

Task 4: Pre-Design Report

Complete.

Task 5: Construction Document

Complete.

Task 6: Construction

The UV Treatment facility began operation on August 29th, 2002. Therefore, most of the start-up and initial operations of the facility were conducted during this quarter. Mechanical equipment was tested and adjusted where necessary. Punch-list items were identified, reviewed, and resolved. Meetings were held with the contractor (Falcon Construction) and the construction manager (Brady and Associates) to work through several issues that arose during the initial start-up. These issues included bulbs burning out, wet well gauges and inflow weirs requiring adjustments, and excessive back-flushing of the multimedia filters.

Task 7: Sampling & Monitoring

Water Quality Monitoring

Post-construction monitoring began on September 3, 2002. Initial bacteria monitoring included sampling and testing at least daily at four locations (see Figure 1) for one week. Thereafter, the sampling frequency was reduced to daily through October and weekly beginning in November. Over 40 samples for Total/Fecal/Enterococcus were evaluated during this quarter. Results of this monitoring are shown in tabular form in Tables 1 through 4. The effectiveness of the UV Treatment facility is approximately 99 percent as shown in Figure 2.

In addition to bacteria testing, turbidity testing was performed at the influent of the faculty. A turbidity meter (Hach 1720D) was designed into the facility for continuos monitoring. Side-by-side testing was performed to calibrate the inline meter. Side-by-side testing was performed with a portable meter (Hach 2100). Turbidity of the influent water was found to generally be in the range of 2 and 10 ntu. This level of turbidity allows for good penetration of the UV rays.

Monitoring was also performed as requested by the Regional Water Quality Control Board to show that the facility does introduce pollutants. Water quality testing was performed on a large suite of parameters upstream and downstream of the facility when it was operation. The results of these tests are summarized in Attachment B.

Beach Closures and Postings

During the period between September 1 and November 30, 2002, the Department of Environmental Health reported no beach closures or postings.

Task 8: Operations and Maintenance

Facility Operation

The UV Treatment facility began operation on August 29, 2002. The facility is designed to operate during dry flows only. Wet weather causes high turbidity in the creek, which causes the

filters to clog and reduces the effectiveness of the UV filters because the light can not penetrate into the water. In addition, the pumps are designed for estimated dry season flows and would be overcome by high flows. During this reporting period, the facility was off-line during the following periods:

- November 8 – 9th, 2002 – shut down for anticipated rain (nearby rain gauge recorded .05 inches of rain).
- November 27 – December 2nd, 2002 – shut down for anticipated rain (nearby rain gauge recorded .18 inches of rain).

The facility was operational during the remainder of the time even though a few small rain events (.05 or less) occurred. On the average the facility is running at approximately 150 gallons per minute (GPM).

Facility Maintenance

Because the facility was in a start-up condition during this period minimal ongoing maintenance was performed, including cleaning of influent screens, weirs, and basket filters. Automatic backwashing of the multimedia filters also occurred. The backwash liquids discharge into the sewer system.

Task 9: Reports

During this quarter, progress reports were written as well as a Technical Report to the Regional Water Quality Control Board (see Attachment B).

Conclusion

During this period the facility began operation. Based on influent and effluent water quality data at the facility, approximately a 99 percent reduction of bacteria was achieved. In addition, there were no beach postings at Moonlight State Beach during the reporting period.

If you should have any questions or comments regarding this progress report, please do not hesitate to call at (760) 633-2632.

Sincerely,

for Katherine Weldon
Stormwater Program Manager

enclosures

City of Encinitas

September 4, 2003

Ms. Laura Peters
State Water Resources Control Board
Loans and Grants Branch
P.O. Box 944212
Sacramento, CA 94244-2120

SUBJECT: QUARTERLY STATUS REPORT – INVOICE #4
MOONLIGHT BEACH URBAN RUNOFF TREATMENT FACILITY
CITY OF ENCINITAS

Dear Ms. Peters:

This letter serves to provide the status of the Moonlight Beach Urban Runoff Treatment Facility as required by the State of California Water Resources Control Board Contract Agreement No. 01-076-550-0. This report is the fourth quarterly report for the project covering the period between December 1, 2002 through February 28, 2003.

Task 1: Project Management and Administration

The tasks performed during this phase include city staff and consultant time for oversight and management of the UV treatment facility. City staff and Ashford Engineering assisted with ongoing management of this project. Activities included coordinating meetings and correspondence regarding the facility contracts and operations during the winter months.

Task 2: Federal, State, and Local Permits

Complete.

Task 3: Quality Assurance Project Plan

Complete.

Task 4: Pre-Design Report

Complete.

Task 5: Construction Document

Complete.

Task 6: Construction

The fourth quarter was primarily during the winter months when there was a significant amount of rainfall and the facility was mostly not in operation. However, punch-list items were still being

identified, reviewed, and resolved. Meetings were held with the contractor (Falcon Construction) and the construction manager (Brady and Associates) to work through several issues that arose during this quarter. These issues included bulbs burning out, pressure differential gauge, turbidity meter, and rainwater leaking into the facility.

Task 7: Sampling and Monitoring

Water Quality Monitoring

Water quality sampling was performed on a weekly basis during this period. However the facility was only in operation for a short period during for operational testing purposes. A summary of the monitoring performed is shown in Table 1, attached. The sampling locations are shown in Figure 1, attached.

Beach Closures and Postings

During the period between December 1, 2002 through February 28, 2003, the Department of Environmental Health reported no postings due to high bacteria. Because of rain events, general advisories were in place for much of the time. The beach was closed for two periods due to sewage overflows (February 6 through February 9, 2003, and February 25 through 28, 2003). The treatment facility is not designed to treat sewage overflows, however, the treatment facility was in operation during the February 6 through 9 event. Because the sewage overflow was small, the treatment facility was able to treat a significant amount of the spill. The facility was off-line during the February 25 through 28 event because of wet weather.

Task 8: Operations and Maintenance

Facility Operation

During wet weather the facility is shut down because it is designed to operate during dry flows only. Wet weather causes high turbidity in the creek, which causes the filters to clog and reduces the effectiveness of the UV lamps because the light can not penetrate into the water. In addition, the pumps are designed for estimated dry season flows and would be overcome by high flows. During this reporting period, the facility was off-line during the following periods:

- December 1, 2002 through January 22, 2003 – Facility was taken off-line for an extended period due to wet weather.
- February 10 through February 28, 2003 – Facility was taken off-line for an extended period due to wet weather.

The facility was only operational for 18 days in order to test several of the facility systems. Several meetings were held to address operational issues that had come up during operations in the previous period. These meetings resulted in the repair and maintenance of several systems.

Facility Maintenance

During facility operation the facility was inspected weekly by City of Engineering staff and daily by San Elijo Joint Powers Authority staff who are on-site to maintain the Sewer Pump station. Ongoing maintenance was performed, including cleaning of influent screens, weirs, and basket filters. Automatic backwashing of the multimedia filters also occurred and required adjusting to

maintain adequate pressure and flow in the system. The backwash liquids are discharged into the sewer system.

Task 9: Reports

No reports were written during this period.

Conclusion

During this period the facility was only in operation for a short period for system testing. During the time the facility was operational, and based on influent and effluent water quality data at the facility, approximately a 99 percent reduction of bacteria was achieved. In addition, there were no beach postings due to high bacteria at Moonlight State Beach during the reporting period.

If you should have any questions or comments regarding this progress report, please do not hesitate to call at (760) 633-2632.

Sincerely,

Katherine Weldon

Katherine Weldon
Stormwater Program Manager

enclosures

City of Encinitas

September 4, 2003

Ms. Laura Peters
State Water Resources Control Board
Loans and Grants Branch
P.O. Box 944212
Sacramento, CA 94244-2120

SUBJECT: QUARTERLY STATUS REPORT – INVOICE #5
MOONLIGHT BEACH URBAN RUNOFF TREATMENT FACILITY
CITY OF ENCINITAS

Dear Ms. Peters:

This letter serves to provide the status of the Moonlight Beach Urban Runoff Treatment Facility as required by the State of California Water Resources Control Board Contract Agreement No. 01-076-550-0. This report is the fifth quarterly report for the project covering the period between March 1, 2003 through May 31, 2003.

Task 1: Project Management and Administration

The tasks performed during this phase include city staff time for oversight and management of the UV treatment facility. City staff performed ongoing management of this project. Activities included coordinating meetings and correspondence regarding the facility contracts and operations during the winter months. On May 30th, 2003, the City attended an awards ceremony, where the Moonlight Beach Urban Runoff Treatment Facility received the American Society of Civil Engineer's "2002 Award of Excellence". A presentation and poster session was given on the treatment facility. A copy of the award is attached.

Task 2: Federal, State, and Local Permits

Complete.

Task 3: Quality Assurance Project Plan

Complete.

Task 4: Pre-Design Report

Complete.

Task 5: Construction Document

Complete.

Task 6: Construction

No construction work was performed on the facility during this period.

Task 7: Sampling and Monitoring

Water Quality Monitoring

Water quality sampling was performed on a weekly basis during this period. However the facility was not in operation for this first month of the reporting period. A summary of the monitoring performed is shown in Table 1, attached. The sampling locations are shown in Figure 1, attached.

Beach Closures and Postings

No beach postings occurred during operation of the treatment facility. However, during the period between March 1, 2003 through May 31, 2003, the Department of Environmental Health reported one postings due to high bacteria between the period of April 18 an 22, 2003. Over the four-day period prior to April 18th the City received 2.2 inches of rainfall and the treatment facility was not in operation. The facility was brought online on April 20th as soon as possible after the rain event and when flows had subsided and cleared up.

The beach was closed for four periods due to sewage overflows (March 16 through 20, April 2 through 4, April 15 through 18, and April 22 through24, 2003). The treatment facility is not designed to treat sewage overflows, however, it was in operation during the April 22 through 24 event. Because the sewage overflow was small, the UV facility was able to treat a significant amount of the spill.

Task 8: Operations and Maintenance

Facility Operation

During wet weather the facility is shut down because it is designed to operate during dry flows only. Wet weather causes high turbidity in the creek, which causes the filters to clog and reduces the effectiveness of the UV lamps because the light can not penetrate into the water. In addition, the pumps are designed for estimated dry season flows and would be overcome by high flows. During this reporting period, the facility was off-line during the following periods:

- March 1, 2003 through April 6, 2003 – Facility was taken off-line for an extended period due to wet weather.
- April 10 through April 20, 2003 – Facility was taken off-line for due to wet weather.
- May 2 through May 5, 2003 – Facility was taken off-line for due to wet weather.

Several meetings were held to address operational issues that had come up during operations in the previous period. These meetings resulted in the repair and maintenance of several systems. A training session was conducted by Clear Creek Systems personnel for City and San Elijo JPA staff to go over operational issues; specifically system operation, shut-down, and start-up procedures. A second training session was conducted by Aquanautics, Inc. (UV bulb providers) for City and San Elijo JPA personnel on the operation and maintenance of the UV bulbs.

Facility Maintenance

During facility operation the facility was inspected weekly by City of Engineering staff and daily by San Elijo Joint Powers Authority staff who are on-site to maintain the adjacent Sewer Pump station. Ongoing maintenance was performed, including cleaning of influent screens, weirs, and basket filters. Intake screens were periodically clogged by excess algae growth due to the warm weather. Automatic backwashing of the multimedia filters also occurred and required adjusting to maintain adequate pressure and flow in the system. The backwash liquids are discharged into the sewer system.

Task 9: Reports

Quarterly reports were prepared during this reporting period.

Conclusion

The treatment facility was brought on-line after an extended period of shut-down for the wet season. During the time the facility was operational, and based on influent and effluent water quality data at the facility, approximately a 99 percent reduction of bacteria was achieved. In addition, there were no beach postings due to high bacteria at Moonlight State Beach when the facility was on-line during the reporting period. Operation and maintenance of the facility was ongoing and operational training occurred. The City was awarded the American Society of Civil Engineer's "2002 Award of Excellence" for the Moonlight Beach Urban Runoff Treatment Facility.

If you should have any questions or comments regarding this progress report, please do not hesitate to call at (760) 633-2632.

Sincerely,

Katherine Weldon

Katherine Weldon
Stormwater Program Manager

enclosures

City of Encinitas

February 12, 2004

Ms. Laura Peters
State Water Resources Control Board
Loans and Grants Branch
P.O. Box 944212
Sacramento, CA 94244-2120

SUBJECT: QUARTERLY STATUS REPORT – INVOICE #6
MOONLIGHT BEACH URBAN RUNOFF TREATMENT FACILITY
CITY OF ENCINITAS

Dear Ms. Peters:

This letter serves to provide the status of the Moonlight Beach Urban Runoff Treatment Facility as required by the State of California Water Resources Control Board Contract Agreement No. 01-076-550-0. This report is the sixth quarterly report for the project covering the period between June 1, 2003 through August 31, 2003. As of August 28th, 2003, the treatment facility has been in operation for one year.

Task 1: Project Management and Administration

The tasks performed during this phase include city staff time for oversight and management of the UV treatment facility. City staff performed ongoing management of this project. Activities included coordinating meetings and correspondence regarding the facility contracts and operations. In June the City received a "Clean Water Champion" award from San Diego County at the 2003 Clean Water Summit on June 20, 2003. Also in August, the City of Encinitas received the Beach Buddies Award in the 13th annual beach water quality report from NRDC (Natural Resources Defense Council). One of the main reasons for this award was the installation of the UV treatment facility.

Task 2: Federal, State, and Local Permits

Complete.

Task 3: Quality Assurance Project Plan

Complete.

Task 4: Pre-Design Report

Complete.

Task 5: Construction Document

Complete.

Task 6: Construction

No construction work was performed on the facility during this period.

Task 7: Sampling and Monitoring

Water Quality Monitoring

Water quality sampling was performed on a weekly basis during this period. A summary of the monitoring performed is shown in Table 1, attached. The sampling locations are shown in Figure 1, attached.

Beach Closures and Postings

Two beach posting events occurred during the period between June 1, 2003 through August 31, 2003. Department of Environmental posted Moonlight Beach due to elevated bacteria on June 3, 2003 when the treatment facility was on-line. The posting was removed within 24 hours based on further water quality testing (June 3 samples indicated 10 cfu/100ml enterococcus levels). During this posting, the UV facility appeared to be operating well, therefore the source of the bacteria was likely not the creek, but related to ocean conditions (i.e., kelp rack or birds). The beach was posted again on August 22 and 23, 2003. However, these postings were just after a rain event and were within the 72-hour General Advisory period following a rainfall event. Encinitas received 0.23 inches of rain on August 21st and the treatment facility was taken off-line between August 21st and 22nd on account of the anticipated rains.

There were not beach closures due to sewage overflows during the reporting period.

Task 8: Operations and Maintenance

Facility Operation

The facility is operational for most of the reporting period. It was off-line during the following periods for maintenance and rain events:

- July 9 through July 10, 2003 – Facility was taken off-line for maintenance of the multimedia filters.
- July 30 through August 1, 2003 – Facility was taken off-line for due to wet weather.
- August 21 through August 22, 2003 – Facility was taken off-line for due to wet weather.

Facility Maintenance

During operation the facility was inspected weekly by City of Engineering staff and daily by San Elijo Joint Powers Authority staff who are on-site to maintain the adjacent Sewer Pump station. Several meetings were held to address maintenance issues that resulted in the repair and maintenance of several systems. During this period, UV sensors were replaced, the wet well was cleaned, the multimedia filter was serviced due to clogging, electrical systems were adjusted, and UV bulbs were replaced.

Ongoing maintenance was also performed, including cleaning of influent screens, weirs, and basket filters. Intake screens were periodically clogged by excess algae growth due to the warm weather. Automatic backwashing of the multimedia filters also occurred and required adjusting to maintain adequate pressure and flow in the system. The backwash liquids are discharged into the sewer system.

Task 9: Reports

During this reporting period, Katherine Weldon, City of Encinitas Clean Water Program Manager, presented the following presentations on the treatment facility:

- July 29th, 2003 - "UV Disinfection: Using New Technology for an Old Problem", 2003 StormCon Conference, San Antonio, Texas.
- August 26th, 2003 – "UV Disinfection Reduces Bacteria in Urban Runoff at Moonlight Beach", 2003 APWA Congress, San Diego, California.

Conclusion

The treatment facility has now been in operation for one year. It was operating for most of the reporting period (approximately 90 percent). During the time the facility was operational, and based on influent and effluent water quality data at the facility, approximately a 99 percent reduction of bacteria was achieved. There was one beach postings due to high bacteria at Moonlight State Beach when the facility was on-line during the reporting period. Water quality monitoring and maintenance of the facility was routinely conducted.

The City of Encinitas made two presentations on the treatment facility; one at the 2003 StormCon Conference and one at the 2003 APWA Congress. Both presentations were well received. In addition, the City received two awards for the project; the 2003 Clean Water Summit "Clean Water Champion" award from San Diego County's Project Clean Water and the NRCD "Beach Buddies Award".

If you should have any questions or comments regarding this progress report, please do not hesitate to call at (760) 633-2632.

Sincerely,

Katherine Weldon

Katherine Weldon
Stormwater Program Manager

enclosures

City of Encinitas

February 12, 2004

Ms. Laura Peters
State Water Resources Control Board
Loans and Grants Branch
P.O. Box 944212
Sacramento, CA 94244-2120

SUBJECT: QUARTERLY STATUS REPORT – INVOICE #7
MOONLIGHT BEACH URBAN RUNOFF TREATMENT FACILITY
CITY OF ENCINITAS

Dear Ms. Peters:

This letter serves to provide the status of the Moonlight Beach Urban Runoff Treatment Facility as required by the State of California Water Resources Control Board Contract Agreement No. 01-076-550-0. This report is the seventh quarterly report for the project covering the period between September 1, 2003 through November 30, 2003.

Task 1: Project Management and Administration

The tasks performed during this phase include city staff time for oversight and management of the UV treatment facility. City staff performed ongoing management and administration of this project. Activities included administering contracts, and coordinating meetings and correspondence regarding the facility contracts and operations.

Task 2: Federal, State, and Local Permits

Complete.

Task 3: Quality Assurance Project Plan

Complete.

Task 4: Pre-Design Report

Complete.

Task 5: Construction Document

Complete.

Task 6: Construction

During this period the City contracted with the construction management consultant to prepare As-Built drawings of the UV Facility plans.

Task 7: Sampling and Monitoring

Water Quality Monitoring

Water quality sampling was performed on a weekly basis during this period. A summary of the monitoring performed is shown in Table 1, attached. The sampling locations are shown in Figure 1, attached.

Beach Closures and Postings

One beach posting events occurred during the period between September 1, 2003 through November 30, 2003. Department of Environmental Health posted Moonlight Beach due to elevated bacteria between October 25 and 28, 2003 when the treatment facility was on-line. The initial posting was based on San Diego County Department of Environmental Health sampling and reopening was based on City of Encinitas sampling. Sampling performed by the City on October 22nd and 23rd indicated slightly elevated influent bacteria and high turbidity levels, however, mixing zone samples were measured at enterococcus levels of 28cfu/100ml, well below AB411 standards of 104.

During this period the Cedar and Paradise fires were burning and the area was experiencing a "red tide". Although the fires would not have effected the Cottonwood Creek area, region-wide effects may have been occurring. There is also a possibility that bacteria could have been present because of the red tide. Decay of red tide algae and associated die-of of aquatic life has been associated with the presence of bacteria as indicated in the following quote from Heal the Bay News, Wednesday, September 17, 2003, *Red Tide — What's Going On?! "Although not all red tides are harmful to humans, they do significantly, yet temporarily, alter the ocean environment where they occur. During a phytoplankton bloom, the organisms grow quickly and significantly reduce the amount of sunlight that is able to penetrate to the ocean bottom. In addition, metabolic wastes (feces) build up from the zooplankton and fish that feed on the abundant phytoplankton. Bacteria then break down this matter using up much of the water's oxygen in the process. Overall, this produces a light and oxygen reduced environment in the local area of the red tide."* http://www.healthebay.org/news/2003/09_17_redtide.asp

There were not beach closures due to sewage overflows during the reporting period.

Task 8: Operations and Maintenance

Facility Operation

The facility is operational for most of the reporting period. It was off-line for approximately 15 days during the following periods because of rain events:

- September 2 and 3, 2003 - Facility was taken off-line for due to wet weather.
- October 31 through November 3, 2003 – Facility was taken off-line for due to wet weather.
- November 3 through 4, 2003 – Facility was taken off-line for due to wet weather.
- November 6 through 14, 2003 – Facility was taken off-line for due to wet weather.

Facility Maintenance

During operation the facility was inspected weekly by City of Engineering staff and daily by San Elijo Joint Powers Authority staff who are on-site to maintain the adjacent Sewer Pump station. Few operational issues came up during the reporting period. Ongoing maintenance was also performed, including cleaning of influent screens, weirs, and basket filters. Intake screens were periodically clogged by excess algae growth due to the warm weather. The influent pipes and wet well were cleaned. Automatic backwashing of the multimedia filters also occurred and required adjusting to maintain adequate pressure and flow in the system. The backwash liquids are discharged into the sewer system.

Task 9: Reports

During this reporting period, the City prepared progress reports for the facility and a meeting for recognition by Baykeeper for the City's pollution control efforts, primarily the UV facility.

Conclusion

The treatment facility has now been in operation for over one year. It was operating for most of the reporting period (nearly 85 percent of the time). During the time the facility was operational, and based on influent and effluent water quality data at the facility, approximately a 99 percent reduction of bacteria was achieved. There was one beach posting due to bacteria levels at Moonlight State Beach when the facility was on-line during the reporting period which was likely ocean related. Water quality monitoring and maintenance of the facility was routinely conducted.

If you should have any questions or comments regarding this progress report, please do not hesitate to call at (760) 633-2632.

Sincerely,

Katherine Weldon

Katherine Weldon
Stormwater Program Manager

enclosures

City of Encinitas

June 4, 2004

Ms. Laura Peters
State Water Resources Control Board
Loans and Grants Branch
P.O. Box 944212
Sacramento, CA 94244-2120

SUBJECT: QUARTERLY STATUS REPORT – INVOICE #8
MOONLIGHT BEACH URBAN RUNOFF TREATMENT FACILITY
CITY OF ENCINITAS

Dear Ms. Peters:

This letter serves to provide the status of the Moonlight Beach Urban Runoff Treatment Facility as required by the State of California Water Resources Control Board Contract Agreement No. 01-076-550-0. This report is the seventh quarterly report for the project covering the period between December 1, 2003 through February 29, 2004.

Task 1: Project Management and Administration

The tasks performed during this phase include city staff time for oversight and management of the UV treatment facility. City staff performed ongoing management and administration of this project. Activities included administering contracts, and coordinating meetings and correspondence regarding the facility contracts and operations.

Task 2: Federal, State, and Local Permits

Complete.

Task 3: Quality Assurance Project Plan

Complete.

Task 4: Pre-Design Report

Complete.

Task 5: Construction Document

Complete.

Task 6: Construction

During this period the City contracted with the construction management consultant to prepare As-Built drawings of the UV Facility plans.

Task 7: Sampling and Monitoring

Water Quality Monitoring

Water quality sampling was performed on a weekly basis during this period while the facility was operating. A summary of the monitoring performed is shown in Table 1, attached. The sampling locations are shown in Figure 1, attached. During this quarter, a bioassessment survey was performed to look at the biologic health of the creek after the UV Facility was installed. The assessment looked at the benthic macroinvertibrate community composition and quantified an Index of Biotic Integrity (IBI) upstream and downstream of the UV Facility. The IBI is a multimetric index based on the cumulative value of seven biological parameters, such as percent non-insect taxa and percent tolerant individuals. The report indicates that the upstream and downstream reaches of the creek are very similar in benthic macroinvertibrate community composition. However, even though the IBI's were all in the poor range (as it has been historically), the IBI was substantially higher downstream of the facility as compared to upstream. A copy of the report is presented in Attachment 1 to this report.

Beach Postings

One beach posting occurred during the quarterly period between December 1, 2003 through February 29, 2004. Department of Environmental Health (DEH) posted Moonlight Beach between December 11th through 15th, 2003 (four days) due to elevated bacteria based on a sample collected on December 10th. The City performed follow up testing the next day (December 11th) that showed bacteria levels below AB411 criteria. However, DEH would not consider this data because the samples were collected after 11:00 am (a new protocol that they have developed to compensate for natural UV kill). DEH performed follow-up testing two days later (December 12th) that also showed bacterial levels below AB411 criteria. However, because of the delay between the lag time between sampling and obtaining laboratory results (24 hours), and the occurrence of the weekend (December 13th and 14th), the advisory was not lifted until the following Monday, December 15th. Furthermore, it should be noted that DEH was sampling at the mixing zone rather than 75' down current. This was because our precautionary signs were not posted because of a local maintenance program. Table 2, attached, summarizes the sampling and posting.

During this period, the UV facility was operating properly. On December 10th UV sampling performed by the City indicated that the facility was reducing bacteria levels to below 4 cfu/100ml. This sampling was performed on same day as DEH (December 10th) also indicated elevated bacteria levels at the creek mouth, however, it was noted that there were 200 birds and a heavy seaweed wrack line at the creek mouth.

Although, it is not clear what the source of the bacteria was during this period, it appears that the source was near the mouth of Cottonwood Creek. The City believes that the source may have been a combination of the birds and rotting seaweed (wrack line) at the mouth of the creek. In addition, the City believes that the beach should not have been posted over the weekend. Data was available to DEH that indicated that the bacteria levels at the beach were safe. In fact, we believe that this posting should have been for one day only.

Moonlight Beach was closed on February 15th and 16th due to a sewage overflow during the reporting period. The sewer overflow was due to lateral blockage caused by grease in a private lateral.

Task 8: Operations and Maintenance

Facility Operation

The facility is operational for most of the reporting period. It was off-line for approximately 15 days during the following periods because of rain events:

- December 23rd through January 7th, 2004 - Facility was taken off-line for wet weather.
- January 19th, 2004 – Facility was taken off-line due to high turbidity (system was back-flushed to clean out sediment).
- February 2nd through 6th, 2004 – Facility was taken off-line due to wet weather.
- February 17th through March 6th, 2004 – Facility was taken off-line due to wet weather.

Facility Maintenance

During operation the facility was inspected weekly by City of Engineering staff and daily by San Elijo Joint Powers Authority staff who are on-site to maintain the adjacent Sewer Pump station. Few operational issues came up during the reporting period. Ongoing maintenance was also performed, including cleaning of influent screens, weirs, and basket filters. The effluent lines were replaced. Automatic and manual backwashing of the multimedia filters also occurred. The backwash liquids are discharged into the sewer system.

Task 9: Reports

During this reporting period, the City prepared progress reports for the facility and a meeting for recognition by Baykeeper for the City's pollution control efforts, primarily the UV facility.

Conclusion

The treatment facility has now been in operation for over one year. It was operating for most of the reporting period (nearly 85 percent of the time). During the time the facility was operational, and based on influent and effluent water quality data at the facility, approximately a 99 percent reduction of bacteria was achieved. There was one beach posting due to bacteria levels at Moonlight State Beach when the facility was on-line during the reporting period which was likely ocean related. This posting lasted for four days, however, we believe this posting should have only lasted for one day. Water quality monitoring and maintenance of the facility was routinely conducted.

If you should have any questions or comments regarding this progress report, please do not hesitate to call at (760) 633-2632.

Sincerely,

Katherine Weldon

Katherine Weldon
Stormwater Program Manager

enclosures

June 4, 2004

Ms. Laura Peters
State Water Resources Control Board
Loans and Grants Branch
P.O. Box 944212
Sacramento, CA 94244-2120

SUBJECT: QUARTERLY STATUS REPORT – INVOICE #9
MOONLIGHT BEACH URBAN RUNOFF TREATMENT FACILITY
CITY OF ENCINITAS

Dear Ms. Peters:

This letter serves to provide the status of the Moonlight Beach Urban Runoff Treatment Facility as required by the State of California Water Resources Control Board Contract Agreement No. 01-076-550-0. This report is the seventh quarterly report for the project covering the period between March 1, 2004 through May 31, 2004.

Task 1: Project Management and Administration

The tasks performed during this phase include city staff time for oversight and management of the UV treatment facility. City staff performed ongoing management and administration of this project. Activities included administering contracts, and coordinating meetings and correspondence regarding the facility contracts and operations.

Task 2: Federal, State, and Local Permits

Complete.

Task 3: Quality Assurance Project Plan

Complete.

Task 4: Pre-Design Report

Complete.

Task 5: Construction Document

Complete.

Task 6: Construction

During this period the City contracted with the construction management consultant to prepare As-Built drawings of the UV Facility plans. The as-built drawings are now complete and waiting for City review.

Task 7: Sampling and Monitoring

Water Quality Monitoring

Water quality sampling was performed on a weekly basis during this period while the facility was operating. A summary of the monitoring performed is shown in Table 1, attached. The sampling locations are shown in Figure 1, attached.

Beach Postings

One beach posting occurred during the quarterly period between March 1, 2004 through May 31, 2004. Department of Environmental Health (DEH) posted Moonlight Beach between May 13th through 15th (three days) due to elevated bacteria based on samples collected on April 12th. Encinitas retested the following two days, April 13th and 14th. The mixing zone and 75' (left) were clean for both sampling events. DEH would not accept our data on the first day since we sampled after 11:00am (a new protocol that they have developed to compensate for natural UV kill). Our samples were taken after 11:00am because we were not notified of the elevated bacteria levels until after 11:00am. The posting was removed based on the second resampling results. We believe that this posting event should have only been two days.

During this period, the UV facility was operating properly. Sampling at the UV Facility on April13th indicated effluent enterococcus values from the facility were at <4 cfu/100ml, the enterococcus levels at Cottonwood Creek mouth were 150 cfu/100ml, and enterococcus levels at the mixing zone were 12 cfu/100ml. We understand from the County DEH that the enterococcus levels at 75' (left) from the creek mouth were on the order of 2,000 cfu/100ml. Therefore, we do not believe the source of elevated bacteria was Cottonwood Creek. DEH did note that there were approximately 50 birds on the beach when they sampled.

There were no beach closures due to sewage overflows during the reporting period.

Task 8: Operations and Maintenance

Facility Operation

The facility is operational for most of the reporting period. It was off-line for approximately 7 days during the following periods because of rain events:

- March 1st through 6, 2004 - Facility was taken off-line due to wet weather.
- May 17th through 19th 2004 – Facility was taken off-line due to high turbidity

Facility Maintenance

During operation the facility was inspected weekly by City of Engineering staff and daily by San Elijo Joint Powers Authority staff who are on-site to maintain the adjacent Sewer Pump station. Few operational issues came up during the reporting period. Ongoing maintenance was also performed, including cleaning of influent screens, weirs, and basket filters. Some of the special maintenance that occurred included, adjusted backwashing cycle timing, adjusting the ballcheck valves, replaced two UV lamps, and shock-treated the multi-media filters to increase their effeciency. Automatic and manual backwashing of the multimedia filters also occurred. The backwash liquids are discharged into the sewer system.

Task 9: Reports

During this reporting period, the City prepared progress reports for the facility.

Conclusion

The treatment facility has now been in operation for over a year and a half. It was operating for most of the reporting period (nearly 95 percent of the time). During the time the facility was operational, and based on influent and effluent water quality data at the facility, approximately a 99 percent reduction of bacteria was achieved. There was one beach posting due to bacteria levels at Moonlight State Beach when the facility was on-line during the reporting period which was likely ocean related. Water quality monitoring and maintenance of the facility was routinely conducted.

During this period the14th Annual Beach Report Card was issued by *Heal the Bay* for the period of April 2003 to March 2004. Moonlight beach received an "A" for the Dry season, a "B" for the AB411 period (April 2003 – October 2003), and a "B" during the Wet season. Last year's overall grade was a "B", which is a significant improvement from the two previous grades of "F" and "D" reflecting the success of the UV Facility.

If you should have any questions or comments regarding this progress report, please do not hesitate to call at (760) 633-2632.

Sincerely,

Katherine Weldon

Katherine Weldon
Stormwater Program Manager

enclosures

Cottonwood Creek and Encinitas Creek Bioassessment Study

Draft Report

Prepared For:

City of Encinitas
505 Vulcan Avenue
Encinitas, California 92024

Prepared By:

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2433 Impala Drive
Carlsbad, California 92008

December 2003

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Appendix A – Site Photographs

1.0 INTRODUCTION

MEC Analytical Systems, Inc. (MEC) was contracted by the City of Encinitas to assess the ecological health of Cottonwood Creek through an assessment of benthic macroinvertebrate community structure. Two stream reaches on Cottonwood Creek, located upstream and downstream of a water purification facility, were sampled before and after the installation of the facility to assess the possible effects the treated water may have on the benthic community. Another reach on Encinitas Creek was also sampled. MEC biologists followed the sampling and analysis protocols of the California Stream Bioassessment Procedure (CSBP) (Harrington 1999), a standardized procedure developed for California that was adapted from the U.S. Environmental Protection Agency (EPA) Rapid Bioassessment Protocols (Barbour et al. 1999).

The CSBP provides an enumeration of a stream's benthic invertebrate community, and also assesses the quality and condition of its physical habitat. Utilizing species specific tolerance values and community species composition, numerical biometric indices are calculated, allowing for comparison of relative habitat health of streams. This information may be used to identify ecological trends and aid analyses of the appropriateness of water quality management programs or to assess the impacts of point source and non-point source contributions to a waterbody. Invertebrates reside in streams for periods ranging from a month to several years, and have varying sensitivities to ecological stress. By assessing the invertebrate community structure of a stream, a realistic, long-term measure of stream habitat health and ecological response is obtained. This may complement monitoring programs that focus on chemical and bacteriological water quality parameters that provide a measure of habitat conditions only at the moment sampling occurs. The addition of bioassessment to water quality monitoring programs gives a more comprehensive indication of the effects of ecological impairments.

This report presents the complete results from the stream bioassessment survey conducted in October 2003. The data includes a taxonomic listing of all benthic macroinvertebrates identified in the surveys, and calculation of the biological metrics listed in the CSBP. Additionally, calculation of the Index of Biotic Integrity (IBI) for all monitoring reaches is included, with a comparison between the October 2003 survey and the May 2002 survey.

2.0 MATERIALS AND METHODS

A general description of the methods incorporated in the sampling program is presented below. MEC personnel adhered to the protocols of the CSBP (Harrington 1999) as closely as practicable, and this document may be referenced for more detailed procedural information.

2.1 Sampling Sites

Cottonwood Creek was initially assessed in April, 2001 by Bill Isham of MEC to determine a suitable sampling site that would meet objectives for the San Diego County Regional Monitoring Program. One monitoring reach was identified between Highway 101 and 3rd Avenue along B Street in Encinitas, upstream of the proposed water purification facility. A second monitoring

reach was located downstream of 3rd Avenue and downstream of the proposed water purification facility. The sites were designated CC-E-US (Cottonwood Creek-Encinitas, Upstream) and CC-E-DS (Cottonwood Creek-Encinitas, Downstream). Both of these monitoring reaches were sampled again in October 2003, after the water purification facility became operational. These sites will be referred to in this report as the "upstream" and "downstream" sampling sites, or monitoring reaches. Another monitoring reach was established on Encinitas Creek near the Levante Street overcrossing, which was designated as ENC-GVR.

The locations of the monitoring reaches are shown in Figure 2.1. Three samples were taken at each monitoring reach, for a total of 6 samples.

2.2 Monitoring Reach Delineation

The sampling points specified in the CSBP consist of a stream feature known as a riffle. An ideal riffle is an area of rapid flow with some surface disturbance and a relatively complex and stable substrate. These areas provide increased colonization potential for benthic invertebrates. Riffles typically produce the greatest diversity of macroinvertebrates in a stream, and by selecting the "best" habitats available at each stream, comparability among monitoring reaches is possible.

Under optimal conditions, the CSBP recommends a sampling transect in a single riffle be established perpendicular to stream flow. In situations where the riffle is very narrow (as in Cottonwood Creek), a perpendicular transect is not possible and the samples must be taken to best represent available micro-habitat types. Each monitoring reach was sampled from downstream to upstream. Photographs were taken of the monitoring reaches and are presented in Appendix A.

2.3 Sample Collection

Once a sampling riffle was selected, benthic invertebrates were collected using a 1-ft wide, 0.5-mm mesh D-frame kick-net. A 2-ft^2 area upstream of the net was sampled by disrupting the substrate and scrubbing the cobble and boulders so that the organisms were dislodged and swept into the net by the current. The duration of the sampling generally ranged from 1 to 2 minutes, depending on substrate complexity. Three 2-ft^2 areas were sampled in the riffle and combined into 1 composite sample representing 6 ft^2. The three sample points in the riffle were selected to represent the diversity of habitat types present. This procedure was repeated for the next 2 riffles until 3 separate replicate samples were collected. Samples were transferred to 1-qt jars and preserved with 95 % ethanol and returned to MEC's laboratory for processing.

2.4 Physical Habitat Quality Assessment

For each monitoring reach sampled, the physical habitat of the stream and its adjacent banks were assessed using U.S. EPA Rapid Bioassessment Protocols. Habitat quality parameters were assessed to provide a record of the overall condition of the reach. Parameters such as channel alteration, frequency of riffles, width of riparian zones, and vegetative cover help to provide a more comprehensive understanding of the condition of the stream. Additionally, specific

characteristics of the sampled riffles were recorded, including riffle length, depth, gradient, velocity, substrate complexity, and substrate composition.

Water quality measurements were taken at each of the monitoring sites. Measurements included water temperature, specific conductance, pH, and dissolved oxygen.

2.5 Laboratory Processing and Analysis

At the laboratory, samples were poured over a No. 35 standard testing sieve (0.5-mm stainless steel mesh) and the ethanol retained for re-use. The sample was gently rinsed with fresh water, and large debris such as wood, leaves, or rocks were removed. The sample was transferred to a glass tray marked with grids 50 cm^2 in size. One grid was randomly selected and the sample material contained within the grid was removed and processed. In cases where the animals appeared extremely abundant, a fraction of the grid may have been removed. The material from the grid was examined under a stereomicroscope and all the invertebrates were removed, sorted into major taxonomic groups, and placed in vials containing 70% ethanol. This process was repeated until 300 organisms were removed from the sample. Organisms from a grid in excess of the 300 were placed in a separate vial labeled "remaining animals", so that a total abundance for the sample could be estimated. Processed material from the sample was placed in a separate jar and labeled "sorted", and the unprocessed material was returned to the original sample container, labeled "unsorted", and archived. Sorted material was retained for quality assurance purposes.

All organisms were identified to a standard taxonomic level, genus level for most insects, and order or class for non-insects, using standard taxonomic keys (Larson, Alarie, and Roughly 2000; Merritt and Cummins 1995; Pennak 1989; Thorp and Covich 1991; Usinger 1963; Wiggins 1996). These taxonomic levels are fixed under the California Stream Bioassessment Protocol, and are detailed in the CAMLnet List of Californian Macroinvertebrate Taxa and Standard Taxonomic Effort. The current level of taxonomic effort has been revised, and Chironomidae are now left at the family level, and Oligochaetes are left at the class level.

2.6 Data Analysis

A taxonomic list of benthic macroinvertebrates identified from the samples was created using Microsoft Excel. BMI community based metric values were calculated from the database. A list of these metric values and a brief description of what they signify is presented in Table 2.1.

An Index of Biotic Integrity (IBI) was calculated for each monitoring reach utilizing the most recent method developed by CDFG (Ode, Rehn, and May, In Press). The IBI replaces the Benthic Macroinvertebrate Index (BMI) Ranking Score used in past analyses and is a significant improvement because it gives an absolute value to the benthic community quality based on the range of reference conditions in the region. The IBI can also be used to evaluate community conditions over time to monitor the effects of habitat degradation or the success of restoration efforts. The BMI ranking score was limited to a comparison of sites within a single survey, and the rankings were relative to the average quality of the sites sampled.

3.0 RESULTS AND DISCUSSION

3.1 Benthic Invertebrate Community Structure

A complete listing of the benthic invertebrates identified at all stations and replicates are presented in Table 3.1, and in ranked order in Table 3.2. The listing also shows the assigned tolerance values and functional feeding group of each taxa. All of the insects identified in the samples were in the larval and pupal stages of development, which metamorphose into an aerial adult form. All of the non-insect taxa are aquatic for their entire life cycle.


Blue Dancer Damselfly (*Argia* sp.)

Both of the Cottonwood Creek sites were dominated by Ostracod crustaceans. The black fly *Simulium* and non-biting midges (family Chironomidae) were also relatively abundant. The benthic community at Encinitas Creek was dominated by the amphipod *Hyalella*, and crayfish were present at each sampling riffle.

3.2 Benthic Invertebrate Community Metrics

The values for benthic invertebrate community metrics for each monitoring reach are presented in Table 3.3. A brief description of each metric and how these values change in response to habitat impairment are given in Table 2.1.

Species Diversity and Dominance

Overall, the benthic communities at the two monitoring reaches at Cottonwood Creek were quite similar to one another. Cumulative taxa values (the total number of unique species for the three replicate samples) were 9 and 10 for the upstream and downstream sites, respectively (Table 3.3). The Shannon Diversity Index was 1.4 at the upstream site, and 1.0 at the downstream site. The Percent Dominant Taxa value was higher at the downstream site with 67% dominance by a single taxon, compared with 50% dominance at the upstream site (Table 3.4). Encinitas Creek had 11 different taxa, a Shannon Diversity Index of 0.7, and the dominant taxon accounted for 85% of the community.

EPT Taxa

Of the three orders of insects that make up the EPT taxa (Ephemeroptera, Plecoptera, and Trichoptera), only Trichopterans were present at Cottonwood Creek, represented by the micro-caddisfly *Hydroptila* sp (Table 3.1, 3.2). This organism was present in low numbers at both Cottonwood Creek sites. Encinitas Creek did not have any EPT taxa present.

Tolerance Measures

For the great majority of stream macroinvertebrates, a tolerance value has been determined for each genera or species through prior research on the animals' life history (e.g., Hilsenhoff 1987). Tolerance values range from 0 for animals highly sensitive to impairments, to 10 for animals that

are highly tolerant to impairments. The presence of impairment tolerant animals does not always imply impairment (SDRWQCB 2001), but the presence of intolerant animals is unlikely when impairment has occurred.

The Cottonwood Creek upstream site had an overall tolerance value of 6.9 and the downstream site had an overall value of 7.4 (Table 3.3). Encinitas Creek had a tolerance value of 7.7. There were no highly intolerant organisms at any of the sites, and the range of individual species tolerance values was from 4 to 8.

Functional Feeding Groups
As with tolerance values, functional feeding group designations have been determined through prior life-history research of each genera or species. Feeding group designations have been revised since the previous report. Collector-Gatherers, which feed on fine particulate organic matter, dominated all of the monitoring reaches (Table 3.1, 3.3).

Estimated Total Abundance
The estimated total abundance is the total number of animals predicted to be in the sample if the entire sample had been sorted, and it represents an estimate of the number of animals living in 6 ft^2 of benthic habitat. The total abundance data is presented only as a general indicator of benthic community conditions. Response to moderate habitat impairment is often indicated by an increase in total abundance (by highly tolerant organisms) with a corresponding decrease in taxa richness and diversity, however, severe impairment can result in a catastrophic decrease in total abundance.

Mean estimated total abundance values per sample at Cottonwood Creek were 5,039 at the upstream site, and 7,104 at the downstream site (Table 3.3). Encinitas Creek had a mean total abundance of 288 organisms per sample, which is relatively low.

3.3 Physical Habitat Quality Assessment

Ten parameters of the physical habitat were scored on a 1 to 20 scale, thus 200 is the highest possible score. Most of the physical habitat quality parameters are scored in a qualitative manner, and they provide a good comparative tool for sites within this sampling program.

The two sites on Cottonwood Creek had very similar physical habitat scores (Table 3.5). The upstream site had slightly higher quality riffle habitat, with greater current velocity, and the riparian vegetation zone provided greater canopy cover. The physical habitat quality at Encinitas Creek was better than at Cottonwood Creek. Although the instream riffle habitat was not optimal, the monitoring reach supported dense bank and riparian vegetation.

Water quality measures were quite similar between the Cottonwood Creek upstream and downstream sites, with slightly higher pH and dissolved oxygen values recorded at the upstream site (Table 3.6). Specific conductance levels were somewhat elevated at both sites. Encinitas Creek water quality measurements also had somewhat elevated specific conductance levels.

3.4 Index of Biotic Integrity

During the last two years, the CDFG Aquatic Bioassessment Laboratory has been developing an Index of Biotic Integrity (IBI) applicable to a region extending from Monterey County to the Mexican Border, and inland to the borders of the Central Valley and the Mojave and Colorado Deserts. A preliminary San Diego IBI was published in December of 2002, and a revised Southern California IBI was developed in 2003. For this report, the Southern California IBI formula was used to calculate IBI scores for the monitoring reaches. The IBI is a multimetric index based on the cumulative value of seven biological metrics: percent collector-filterers plus collector-gatherers, percent non-insect taxa, percent tolerant taxa, cumulative Coleoptera taxa, cumulative predator taxa, percent tolerant individuals, and cumulative EPT taxa. These seven metrics were selected from sixty-one possible metrics based on responsiveness to disturbance and lack of correlation to other metrics (to avoid redundancy). In developing the revised IBI, analysis included data sets from a variety of studies, using collection protocols that differed somewhat in the level of sampling effort and habitat types sampled. To correlate samples collected according to the CSBP with other sampling protocols (on which the IBI scoring ranges are based) the 900 organism subsamples were reduced to 500 organisms by random elimination of taxa, and then the IBI was calculated.

Each metric value was given a score from zero to ten based on the range of reference conditions in the region. The scores were summed and the total index score was categorized into qualitative ratings of Very Good, Good, Fair, Poor, and Very Poor. The revised IBI is more sensitive than the preliminary IBI, and reference sites in San Diego County rarely score in the Very Good range. The metrics and scoring ranges are shown in Table 3.7.

IBI scores for the monitoring reaches from two surveys are shown in Table 3.8. Although both the upstream and downstream sites scored in the Poor range, the downstream site had a substantially higher score than the upstream site. The downstream benthic community benefited by having a lower percentage of non-insect taxa and a lower percentage of tolerant taxa.

4.0 SUMMARY

The stream bioassessment survey at Cottonwood Creek indicated that reaches of the stream upstream and downstream of the water purification facility are very similar in benthic macroinvertebrate community composition. Chironomid midges, the black fly *Simulium*, and ostracod crustaceans dominated both sites. The Index of Biotic Integrity was substantially higher downstream of the water purification facility, due to a lower percentage of non-insect taxa and a lower percentage of tolerant taxa.

The benthic community of Encinitas Creek was of low quality, with an IBI score of 1. None of the monitoring reaches contained organisms that are highly intolerant to physical or chemical impairment.

Figure 2.1. Bioassessment Monitoring Stations, May 2002.

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Table 2.1: Bioassessment Metrics Used to Characterize BMI Communities.

BMI Metric	Description	Response to Impairment
Richness Measures		
Taxa Richness	Total number of individual taxa	Decrease
EPT Taxa	Number of taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders	Decrease
Dipteran Taxa	Number of taxa in the insect order (Diptera, "true flies")	Increase
Non-Insect Taxa	Number of non-insect taxa	Increase
Composition Measures		
EPT Index	Percent composition of mayfly, stonefly, and caddisfly larvae	Decrease
Sensitive EPT Index	Percent composition of mayfly, stonefly, and caddisfly larvae with tolerance values between 0 and 3	Decrease
Shannon Diversity Index	General measure of sample diversity that incorporates richness and evenness (Shannon and Weaver 1963)	Decrease
Tolerance/Intolerance Measures		
Tolerance Value	Value between 0 and 10 weighted for abundance of individuals designated as pollution tolerant (higher values) or intolerant (lower values)	Increase
Percent Dominant Taxa	Percent composition of the single most abundant taxon	Increase
Percent Chironomidae	Percent composition of the tolerant dipteran family Chironomidae	Increase
Percent Intolerant Organisms	Percent of organisms in sample that are highly intolerant to impairment as indicated by a tolerance value of 0, 1 or 2	Decrease
Percent Tolerant Organisms	Percent of organisms in sample that are highly tolerant to impairment as indicated by a tolerance value of 8, 9 or 10	Increase
Functional Feeding Groups (FFG)		
Percent Collector-gatherers	Percent of macrobenthos that collect or gather fine particulate matter	Increase
Percent Collector-filterers	Percent of macrobenthos that filter fine particulate matter	Increase
Percent Scrapers	Percent of macrobenthos that graze upon periphyton	Variable
Percent Predators	Percent of macrobenthos that prey on other organisms	Variable
Percent Shredders	Percent of macrobenthos that shreds coarse particulate matter	Decrease
Percent Others	Percent of macrobenthos that are parasites, macrophyte herbivores, piercer herbivores, omnivores, and xylophages	Variable
Abundance		
Estimated Abundance	Estimated number of BMIs in sample calculated by extrapolating from the proportion of organisms counted in the subsample	Variable

Source: SDRWQCB 1999

Table 3.1: Taxonomic Listing, October 2003.

TV=Tolerance Value: range is 0-10; 0 is intolerant to impairment, 10 is highly tolerant to impairment. FFG=Functional Feeding Group: cg=collector gatherer, cf=collector filterer, sc=scraper, sh=shredder, pa=parasite, mh=macrophyte herbivore, ph=piercer herbivore, om=omnivore, xy=xylophage (wood eater)

NAME	TV	FFG	CC-E-DS			CC-E-US			ENC-GVR		
			T1	T2	T3	T1	T2	T3	T1	T2	T3
PHYLUM ARTHROPODA											
Class Insecta											
Odonata											
Aeshindae											
Aeshna sp	5	p									1
Coenagrionidae	9	p									1
Argia sp	7	p	2	6	15		1	26			
Trichoptera											
Hydroptilidae											
Hydroptila sp	6	ph	2	5	4			1			
Diptera											
Chironomidae	6	cg	20	20	59	8	14	174	19	4	1
Stratiomyidae											
Odontomyia sp	5	cg									1
Pericoma sp	4	cg		1				1			
Simuliidae											
Simulium sp	6	cf	7	4	106	11	91	7	7	1	
Tipulidae											
Tipula sp	4	om	1								
Class Malacostraca											
Amphipoda		cg				1		1	5	2	
Hyalellidae											
Hyalella sp	8	cg		2	1		2	14	261	61	88
Decapoda	6	sh							2	5	2
Cambaridae	6	sh							5	4	8
Ostracoda	8	cg	223	224	95	251	156	6	2		
PHYLUM PLATYHELMINTHES											
Class Turbellaria											
Tricladida											
Planariidae	4	p			6	1	9	53			
PHYLUM ANNELIDA											
Class Oligochaeta	8	cg							2	1	1
PHYLUM MOLLUSCA											
Class Gastropoda											
Basommatophora											
Physidae											
Physa/Physella sp	8	sc						1			

Table 3.2: City of Encinitas Stream Bioassessment, October 2003. Ranked Abundance of Benthic Macroinvertebrates.

NAME	CC-E-DS	CC-E-US	ENC-GVR	Grand Total
Ostracoda	542	413	2	957
Hyalella sp	3	16	410	429
Chironomidae	99	196	24	319
Simulium sp	117	109	8	234
Planariidae	6	63		69
Argia sp	23	27		50
Cambaridae			17	17
Hydroptila sp	11	1		12
Amphipod, unid.		2	7	9
Decapoda			9	9
Oligochaeta			4	4
Pericoma sp	1	1		2
Aeschna			1	1
Coenagrionidae			1	1
Odontomyia sp			1	1
Physa/Physella sp		1		1
Tipula sp	1			1
Grand Total	803	829	484	2116
Estimated Mean Total Abundance	7,104	5,039	288	

Table 3.3: City of Encinitas Stream Bioassessment Metrics, October 2003.

Metric	CC-E-DS	CC-E-US	ENC-GVR
Taxa Richness	9	10	11
Ephemeropteran Taxa	0	0	0
Plecopteran Taxa	0	0	0
Trichopteran Taxa	1	1	0
EPT Taxa	1	1	0
Dipteran Taxa	4	3	3
Non Insect Taxa	3	5	6
% EPT	1%	0.1%	0%
Sensitive EPT %	0%	0%	0%
Shannon Diversity	1.0	1.4	0.7
Tolerance Value	7.4	6.9	7.7
% Dominant Taxa	67%	50%	85%
% Chironomidae	12%	24%	5%
% Intolerant Organisms	0%	0%	0%
% Tolerant Organisms	68%	52%	86%
% Grazer	1%	0.1%	0%
% Collector Gatherer	80%	76%	93%
% Collector Filterer	15%	13%	2%
% Predator	4%	11%	0.4%
% Shredder	0%	0%	5%
% Scraper	0%	0.1%	0%
% Other	1%	0.1%	0%

Table 3.4: City of Encinitas Stream Bioassessment.
Top Five Most Abundant Taxa Collected October 2003.

Station	1st	2nd	3rd	4th	5th	6th
CC-E-DS	Ostracoda 67%	Simulium sp 15%	Chironomidae 12%	Argia sp 3%	Hydroptila sp 1%	Planariidae 1%
CC-E-US	Ostracoda 50%	Chironomidae 24%	Simulium sp 13%	Planariidae 8%	Argia sp 3%	Hyalella sp 2%
ENC-GVR	Hyalella sp 85%	Chironomidae 5%	Cambaridae 4%	Decapoda 2%	Simulium sp 2%	Amphipod, unid. 1%

Table 3.5: City of Encinitas Physical Habitat Scores of Monitoring Reaches, May 2002 and October 2003.

	May-02		Oct-03		
Measure	CC-EDS	CC-EUS	CC-EDS	CC-EUS	ENC-GVR
1. Instream Cover	12	12	10	12	13
2. Embeddedness	8	9	10	8	10
3. Velocity / Depth Regimes	7	8	9	13	11
4. Sediment Deposition	12	11	16	15	12
5. Channel Flow	14	14	15	15	14
6. Channel Alteration	7	7	6	8	13
7. Riffle Frequency	13	13	13	17	11
8. Bank Stability	10	6	14	8	18
9. Vegetation Protection	10	10	14	10	16
10. Riparian Vegetative Zone	2	3	2	8	15
Total	**95**	**93**	**109**	**114**	**133**

Table 3.6: City of Encinitas, Water Quality Measures of Monitoring Reaches, May 2002 and October 2003.

Watershed/Stream	Station	pH	Specific Conductance (mS/cm)	Water Tempurature (C)	Dissolved Oxygen (mg/l)	Average Riffle Depth (inches)	Average Riffle Velocity (ft/sec)	Elevation (ft above sea level)
May-02	CC-EDS	7.4	4.4	14.8	7.9	3.3	1.3	30
	CC-EUS	7.4	4.7	15.1	8.2	3.3	1.4	40
Oct-02	CC-EDS	7.3	4.5	20.1	9.5	3.7	1.5	30
	CC-EUS	7.6	4.5	20.3	10.0	3.7	1.8	40
	ENC-GVR	8.0	4.7	19.9	10.8	4.3	1.2	40

Table 3.7: Index of Biotic Integrity Parameters and Scoring Ranges.

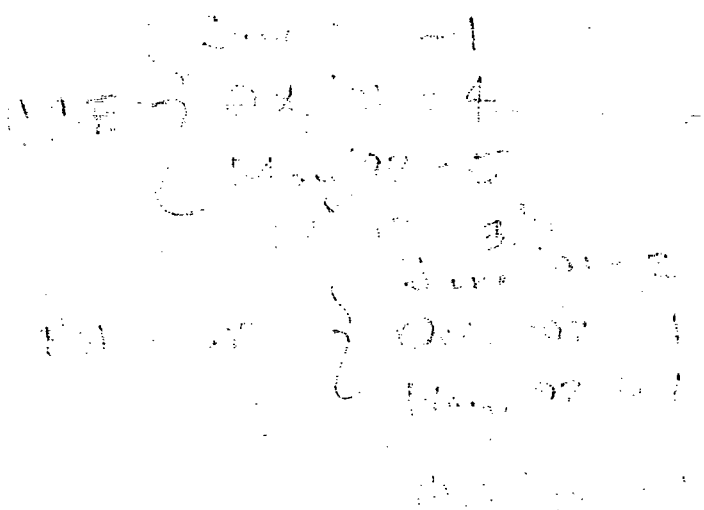
Parameter	% CF+CG	% Non-Insect Taxa	% Tolerant Taxa	Coleoptera Taxa	Predator Taxa	% Intolerant Individuals	EPT Taxa
Metric Score							
10	0-51	0-7	0-6	>5	>13	30-100	>19
9	52-55	8-12	7-9		12,13	27-29	17-19
8	56-60	13-16	10-12	5	11	24-26	15-16
7	61-66	17-20	13-16	4	10	21-23	13-14
6	67-71	21-25	17-19		9	18-20	11-12
5	72-76	26-29	20-22	3	8	15-17	9-10
4	77-81	30-33	23-26	2	7	12-14	7-8
3	82-86	34-38	27-29		6	9-11	5-6
2	87-91	39-42	30-32	1	5	6-8	3-4
1	92-95	43-46	33-35		4	3-5	1-2
0	96-100	47-100	36-100	0	0-3	0-2	0

Total IBI Scoring Ranges	0-13 Very Poor	14-26 Poor	27-40 Good	41-55 Good	56-70 Very Good

Source: Ode, Rehn, and May, Unpubl. Data

Table 3.8: City of Encinitas, Index of Biotic Integrity Scores, October 2003.

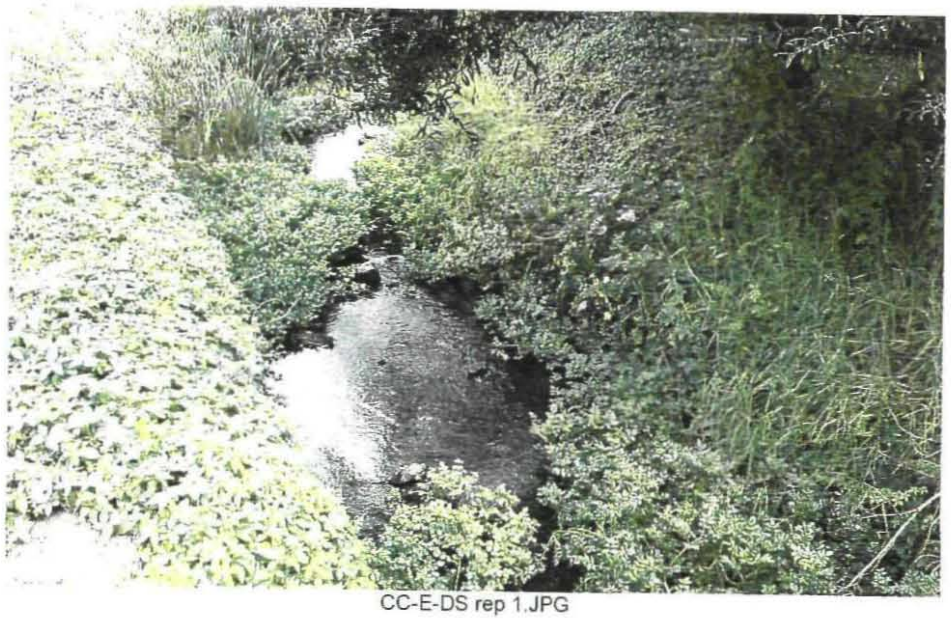
	Metric Values							IBI Scores							
STATION	% CF+CG	% Non-Insect Taxa	% Tolerant Taxa	Coleoptera Taxa	Predator Taxa	% Intolerant Individuals	EPT Taxa	% CF+CG	% Non-Insect Taxa	% Tolerant Taxa	Coleoptera Taxa	Predator Taxa	% Intolerant Individuals	EPT Taxa	Total IBI
CC-E-DS	95%	33%	22%	0	2	0%	1	1	4	5	0	0	0	1	11
CC-E-US	88%	56%	33%	0	2	0%	0	2	0	1	0	0	0	0	3
ENC-GVR	94%	55%	36%	0	2	0%	0	1	0	0	0	0	0	0	1



APPENDIX A

Site Photographs

Appendix A



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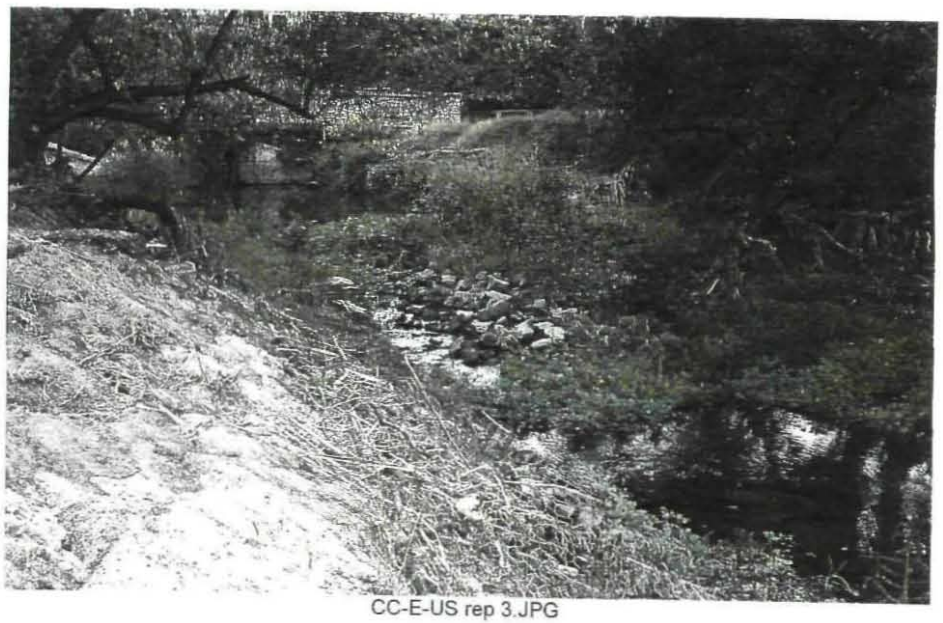
CC-E-DS rep 3.JPG

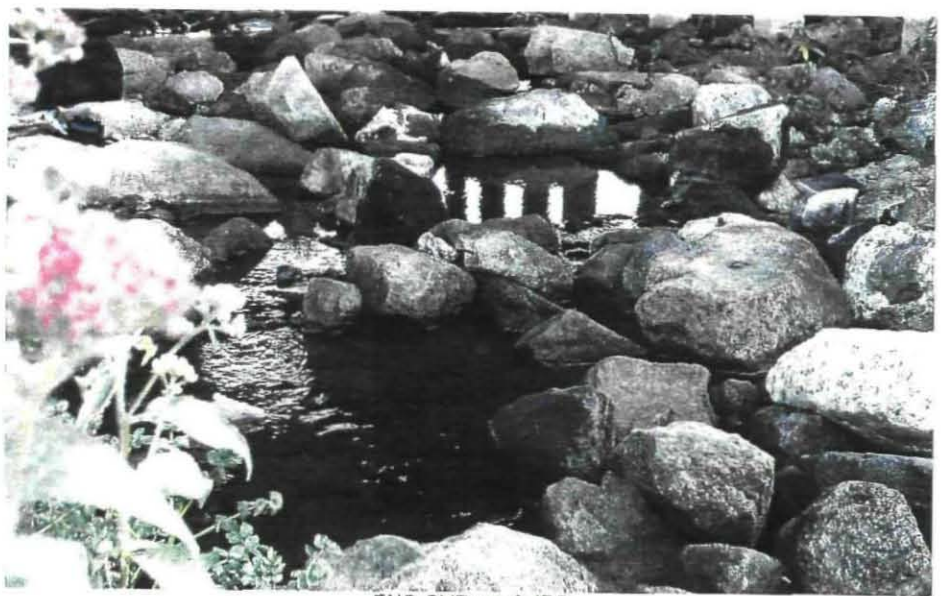


CC-E-US rep 3.JPG

Appendix A

CC-E-US reps 1 and 2.JPG

ENC-GVR rep 1.JPG



ENC-GVR rep 2.JPG

ENC-GVR rep 3.JPG

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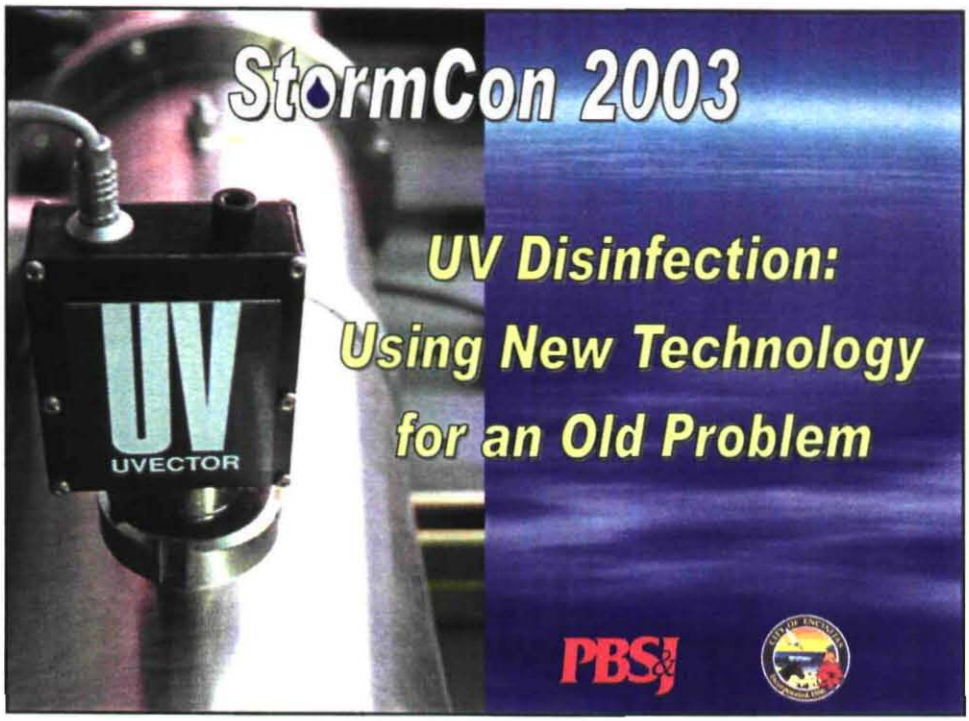


Agenda

- Planning & Funding — *Kathy Weldon*
- Design & Implementation — *Jim Rasmus*
- Results & The Future — *Kathy Weldon*

PBS&J

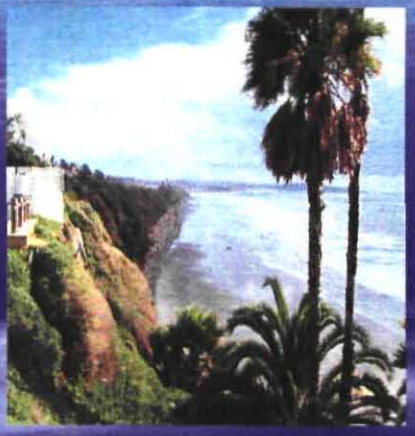
Planning & Funding

Presented by

Kathy Weldon

PBSJ

Project Goals



- Eliminate Beach Postings
- Improve recreational public health
- Improve beach economy
- Eliminate negative publicity

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Overview of Watershed

- 3 sq. mi (2,000 acres)
- 95% heavily urbanized (shopping center, gas stations, restaurants, nurseries)
- Majority of creek is under Encinitas Blvd.

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Moonlight State Beach

- Surfing, swimming, beach town identity
- $47 million economic value
- Over 2,500,000 visitors reported in 2001

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Cottonwood Creek

- Runs through the heart of Encinitas
- Discharges onto Moonlight Beach
- Flows year round at ~150 gpm during dry weather

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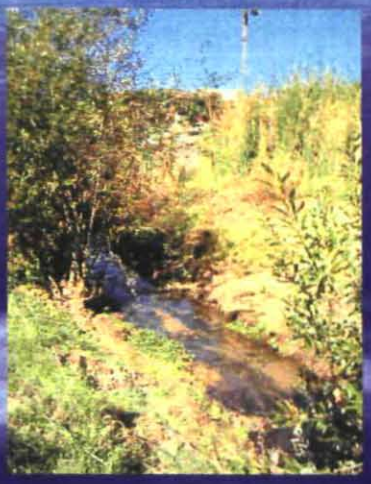
Cottonwood Creek



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Causes of Degradation

- Highly urbanized watershed
- Encinitas is the Flower Capital
  - High nitrogen levels
  - High bacteria levels

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Urban Runoff

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Source Control Program

- Source Identification (water quality testing)
- Educate businesses and residents along creek
- Enforce Storm Water Ordinance
- Implemented structural BMPs
- Initiated Storm Drain Cleaning Program

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Strict AB411 Standard

- AB411 introduced enterococcus standard in 2000
- One hit standard - Exceedance of total, fecal, or entero means beach posting

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Chronic Postings

- "F" from environmental groups
- Consistently ranked one of the worst beaches for water quality
- Posted 93 days in 2000
- Potential TMDL site

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Unique site at Third & B Streets

- Space available at an existing pump station
- Existing double box culvert for intake and discharge
- Approximately 1,000 feet from beach outlet

PBS&J

California's Clean Beach Initiative

- $40 million set aside for Clean Beach Initiative (CBI) projects
- Beach Water Quality Work Group – applied leverage to the State
- Special Circumstances – Our project matched the goals of the CBI exactly – Reduce Beach Closures
- Project was the 1st funded

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Design & Implementation

Presented by

Jim Rasmus

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Options Considered

- Divert to sanitary sewer
- Chemical treatment
- Ozone treatment
- UV treatment
- Other, mixed oxidant systems (UV/Ozone)

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Quickly Dismissed Options

- Divert to sanitary sewer
  - Creek flow has historical, aesthetic, and biological value
  - Cost impacts associated with sanitary system and treatment system unacceptable
- Chemical Treatment
  - Chemical storage and handling issues not acceptable
  - Dechlorination would require additional chemicals
  - Public perception

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Treatment Options

- *Ozone treatment (As compared with UV)*
  - Higher capital expensive O & M
  - Ozone generation and residual result in significant mechanical equipment
  - Larger space requirements
  - Not well-suited to handle flow variations without flow-equalization

PBSJ

Treatment Options

- UV treatment (as compared with Ozone)
  - Lower capital and O & M costs
  - No residual to deal with
  - Water quality specifics – Iron, Manganese, TOC, Turbidity are key parameters
  - Generally lower operator skill level required
  - Less mechanical equipment and space required

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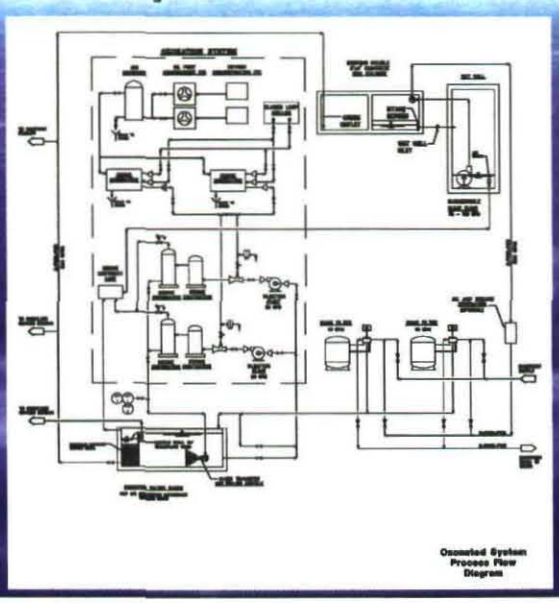
Treatment Options – Ozone Process



Ozonated System Process Flow Diagram

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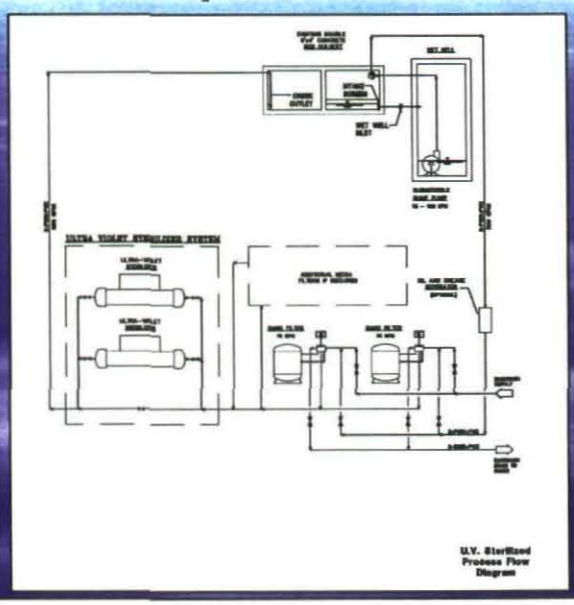
Treatment Options – UV Process



U.V. Sterilized Process Flow Diagram

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Bacterial Objectives		
Standards	**State Criteria**	**Design Criteria**
30-Day Avg. Total Coliform	1,000	<20
Total Coliform Single Sample	10,000	n/a
30-Day Avg. Fecal Coliform	200	<20
Fecal Coliform Single Sample	400	n/a
30-Day Avg. Enterococcus	35	<20
Enterococcus Single Sample	104	n/a

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UV Facility
Process Overview

- Intake line from creek inside of existing box culvert
- Wet well with pumps
- Basket filters
- Multimedia filters
- UV Process
- Discharge from facility back inside existing box culvert

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Advertise, bid, award, and construction was smooth

- Contract was awarded in April 2002
- Construction began June 2002
- Facility completed August 2002 (one day ahead of schedule)
- First CBI project completed!
- Ribbon cutting ceremony September 2002

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Results & the Future

Presented by

Kathy Weldon

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On-going Monitoring

- **Water quality**
  - Routine bacteria and turbidity (daily, weekly, monthly)
- **Biological monitoring**
  - Habitat assessment
  - Aquatic assessment

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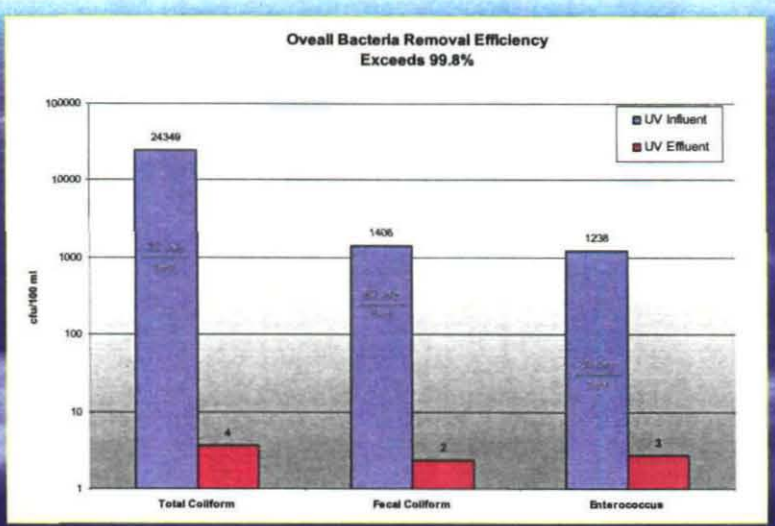
Bacteria Removal Efficiency



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Reductions in Exceedances in the Mixing Zone

- Total Coliform – 100 percent reduction
- Fecal Coliform – 81 percent reduction
- Enterococcus – 55 percent reduction
- Overall – 69 percent reduction
- Overall - this is a success!

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Typical Operations and Maintenance

- 10 hours/week total staff time for monitoring and maintenance of the intake within the culvert
- Estimated maximum of $2k/year in bulb replacement
- Daily basket strainer check and review of key performance indicators done as part of pump station routine maintenance

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Teamwork/Cooperation/Partnerships were the key to project success

- Local stakeholders support
  - City officials
  - Cottonwood Creek Conservancy
  - Baykeeper
  - Dedicated Project Team
- State Water Resources Control Board – Laura Peters
- Project Designer – PBS&J
- Contractor – Falcon Construction
- UV Supplier – Clear Creek Systems
- Construction Manager – Brady & Associates

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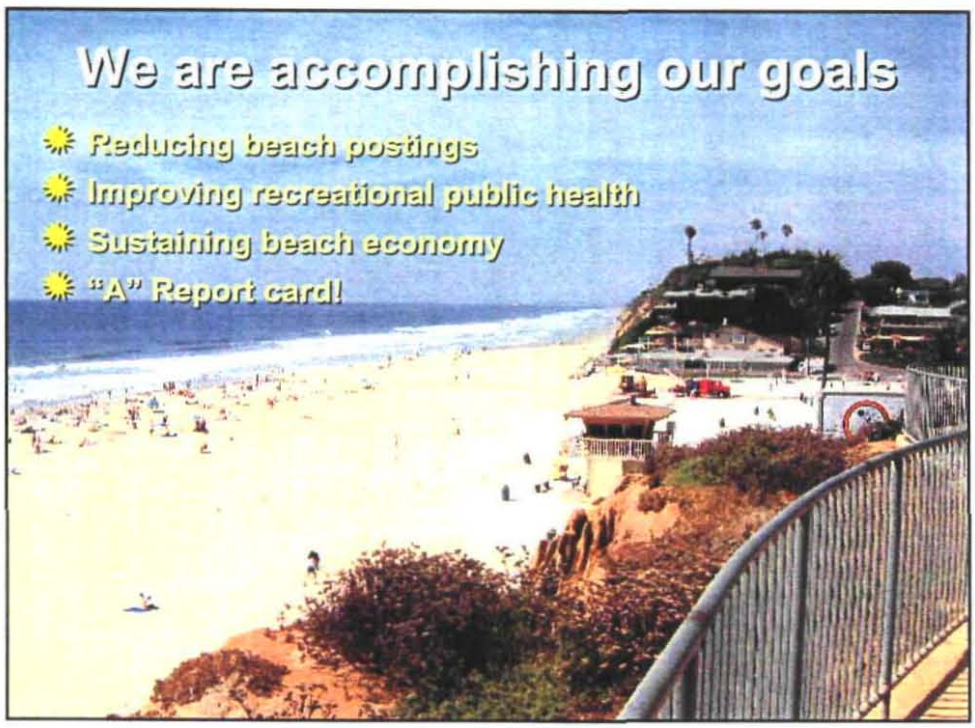
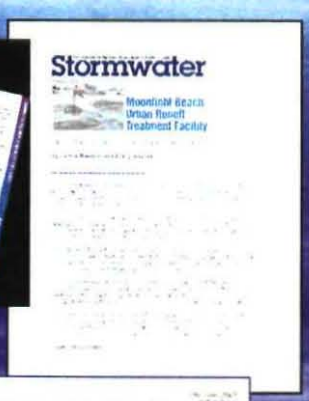
We are accomplishing our goals

- Reducing beach postings
- Improving recreational public health
- Sustaining beach economy
- "A" Report card!



...And earning national attention



APWA

ASCE American Society of Civil Engineers

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A Look to the Future

- In-stream alert system for illegal discharges
- Offers 100% containment of spills
- Future instrumentation upgrades will allow remote monitoring of key parameters
- Additional UV chambers could be added if needed

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Intake/Discharge System

- Intake on downstream end of north box culvert
- Discharge on upstream end of south box culvert
- 15% bypass for biological connectivity
- Removable weir for storm events

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Dual Filter System

- Low turbidity crucial for performance of UV lamps
- Basket filter for larger particles
- Multimedia filter for removal of turbidity

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UV Process System

- Two 4-foot lamp chambers

- 254 NM wavelength

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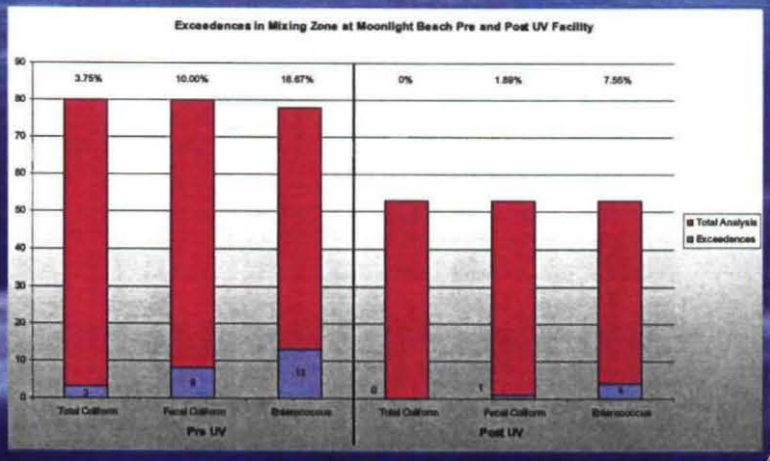
Comparison of Mixing Zone Bacteria Levels



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Early Lessons Learned

- Consider funding for engineering support services during project start-up and testing
- 15% by-pass system an inexact science
- Better screening needed to keep out aquatic critters

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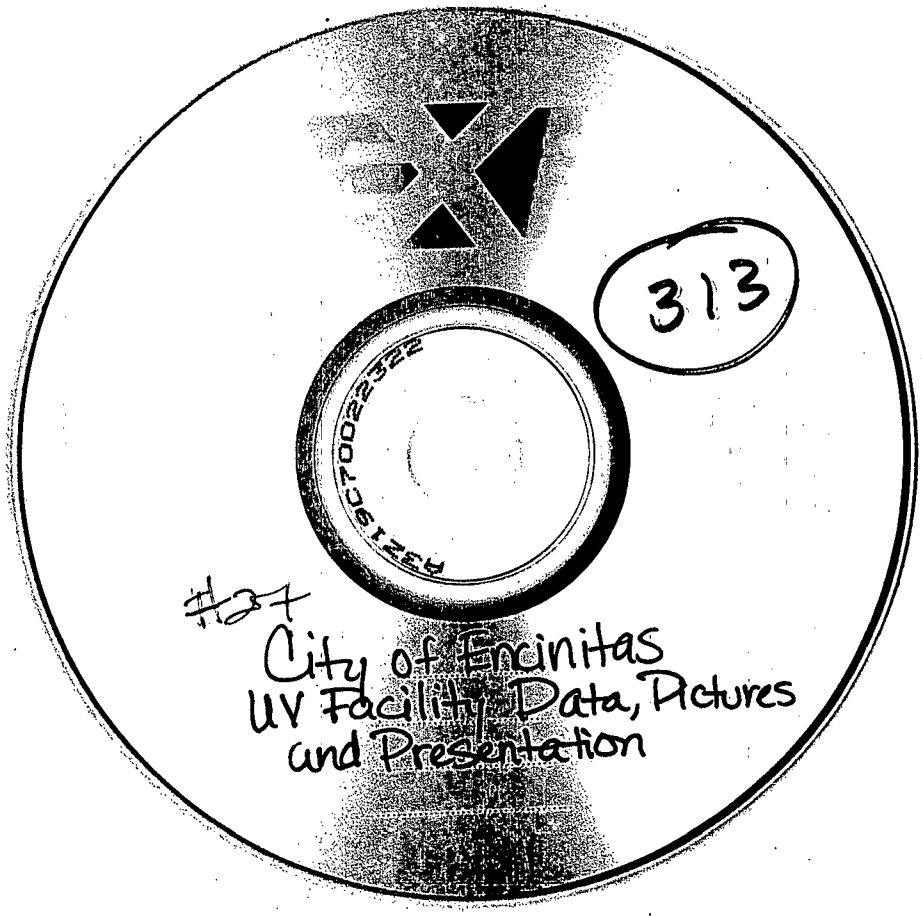
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City of Encinitas
UV Facility Data, Pictures
and Presentation