The National Park Service's **Mediterranean Coast Network** of Parks

Water Quality Monitoring Programs:
Information Compilation and Evaluation

(Santa Monica Mountains National Recreation Area,
Channel Islands National Park,
Cabrillo National Monument)

Prepared by:
Steve Williams
Conservation Biologist
Resource Conservation District of the Santa Monica Mountains

February 2004

Table of Contents

I. Project Overview 5
II. The Mediterranean Biome 5
A. The Southern California Mediterranean Coast 6
1. Aquatic Resources 6
2. Santa Monica Bay Watershed Management Area 8
B. SAMO Area Freshwater Water Quality Monitoring 10
1. TMDL Development: 10
2. Surface Water Ambient Monitoring Program (SWAMP) 12
3. RWQCB Toxic Substance Monitoring Program (TSMP) 15
4. RWQCB State Mussel Watch Program (SMWP) 17
5. RWQCB Toxicity Testing Programs 18
6. RWQCB Bay Protection and Toxic Cleanup Program (BPTCP) 18
7. Toxic Hot Spot Identification 20
8. LARWQCB Bioassessment project 21
9. RWQCB Nonpoint Source (NPS) Pollution Control Program 22
10. LA County Stormwater Water Quality Monitoring 22
11. NPDES Permittees in Santa Monica Bay WMA 23
III. SAMO (National Park Service)Water Quality Monitoring: 26
A. 1999-2001 RCDSMM Topanga Watershed Water Quality Study 28
1. Parameters sampled 28
2. Findings 28
3. Conclusions 28
B. RCDSMM Water Quality Study in Topanga Watershed (2004) 29
C. Malibu Watershed Monitoring Programs 29
1. Malibu Creek Watershed (Water Quality Issues) 30
2. Malibu Lagoon (Water Quality Issues) 30
3. Malibu TMDL 31
D. LA RWQCB Regional Programs 32
1. Malibu Watershed-wide Monitoring Program Scope of Work 33
2. MWWMP Hot Spot Testing: 34
3. Las Virgenes Municipal Water District 35
4. Stream Team Volunteer Water Quality Monitoring 37
IV. Resource Conservation District Water Quality Monitoring Programs 39
A. Malibu Lagoon Baseline Study – 1989 39
1. Calleguas Creek Watershed Monitoring 40
2. LARWQCB Regional Toxic Hot Spot Cleanup Plan 41
3. Ventura County Storm Water Monitoring Program 51
4. Ventura River Bioassessment Program 54
5. SAMO Area Ocean/ Beach/ Nearshore monitoring 56
6. Los Angeles County Department of Health Services - Beach Sampling 59
7. Santa Monica Baykeeper 62
8. Southern CA Bight ’03 Study: 65
V. Channel Islands NP Freshwater Water Quality Monitoring 67
A. Scheduled FY 2003 Activities and Products: 70
B. CHIS Ocean / Beach/ Nearshore Water Quality Monitoring 70
1. FY 2002 Accomplishments: 71
2. Channel Islands NP Areas of Special Biological Significance 71
3. Channel Islands National Marine Sanctuary 71
4. SWRCB Cruise Ship Wastewater Regulation Report 72
5. Santa Barbara Channelkeeper 72
6. Potential Threats to Park Waters 73
7. Ventura County Stormwater Monitoring Program 73
8. UCSB Plumes and Blooms Study 74
9. Surfrider Foundation - Ventura Chapter Monitoring Programs 76

10. Southern California Coastal Water Research Project Volunteer Opportunities: 76
11. Ventura County Dept. of Environmental Health 77
VI. Cabrillo National Monument Water Quality Monitoring: 78
A. FY 2002 Accomplishments 79
B. Scheduled FY 2003 Activities and Products: 80
C. Reports, Publications and Presentations 80
D. CABR Freshwater water quality monitoring 81
E. CABR Ocean / Beach/ Nearshore water quality monitoring 81
1. San Diego County Department of Environmental Health 81
2. City of San Diego Storm Drain Sampling 82
3. Pt. Loma Wastewater Treatment Plant Outfall Monitoring 83
4. Point Loma Ocean Outfall 84
5. State Impairments for San Diego Bay 84
F. SD Regional Water Quality Control Board Programs 85
1. State Mussel Watch program (SMWP) 85
2. Bay Protection and Toxic Cleanup Program 86
G. SD Surfrider Foundation /SD Baykeeper 91
VII. Bibliography 92
Appendix I: RWQCB SWAMP Methods/ Sampling Protocols: 93
Appendix II: RWQCB Toxic Substance Monitoring Program Methods 95
Appendix III RWQCB SMWP Methods 97
Appendix IV RWQCB BPTCP Methods 99
Appendix V RWQCB Bioassessment Program Methods 100
Appendix VI SAMO (NPS) Water Quality Monitoring Methods 101

List of Figures

Figure 1 Mediterranean climate regions world-wide 5
Figure 2 Map of the National Park Service's Mediterranean Coast Network 6
Figure 3 Santa Monica Mountains National Recreation Area 7
Figure 4 Streams and Watersheds of the Santa Monica Mountains 7
Figure 5 A portion of the Santa Monica Bay WMA (LARWQCB -12/02) 8
Figure 6 In the Santa Monica Mountains, from Pt. Mugu to Santa Monica Canyon, there are 9 streams, 4 lakes and 1 lagoon listed by the RWQCB as impaired. The following are listed: 10
Figure 7 SWAMP sites within the Santa Monica Mountains 13
Figure 8 TSMP (16) sites fall within the Santa Monica Mountains study area: 16
Figure 9 Mussel Watch sites within the vicinity of the Santa Monica Mountains. 17
Figure 10 State Mussel Watch Station Sampling History 18
Figure 11 Impaired water bodies from the Malibu Creek Watershed 29
Figure 12 Impaired water bodies from the Topanga Creek Watershed including Malibu Lagoon 32
Figure 13 Receiving Water Monitoring and Tapia Effluent Discharge Sites 36
Figure 14 Locations of seven of the HTB monitoring sites 38
Figure 15 Area of Special Biological Significance No. 24 - Western Section Mugu Lagoon to Latigo Point 41
Figure 16 Distribution of Stations in Mugu Lagoon Demonstrating Benthic Community Structure 42
Figure 17 Toxicity of Sediment Samples in Mugu Lagoon 44
Figure 18 Ventura Countywide Storm-water Monitoring Sites- Mass Emissions and Land Use Sites 51
Figure 19 Ventura River Bioassessment Monitoring Program Sites 55
Figure 20 303d listed beaches along the Santa Monica Mountains and Santa Monica Bay. 57
Figure 21 State Water Quality Protection Area No. 24 (SWQPA) aka Areas of Special Biological Significance (ASBS) 58
Figure 22 Locations of Storm Drains along the Santa Monica Mountains and Santa Monica Bay 59
Figure 23 Spatial distribution of zinc enrichment measured in the sea surface microlayer (ratio of the zinc concentration in the microlayer to the zinc concentration in the bulk water). 67
Figure 24 Channel Islands National Marine Sanctuary map, showing the five Islands of Channel Islands National Park 68

Figure 25 Water Quality sampling locations on Santa Rosa and Santa Cruz Islands 69
Figure 26 Marine Protected Areas within the four northern islands of Channel Islands National Park 71
Figure 27 AVHRR SST image showing the location of Plumes and Blooms Stations. 75
Figure 28 These Ventura County DEH monitoring sites fall within ASBS No.24 Mugu – Latigo 78
Figure 29 Heal the Bay posts the weekly results of the sampling at these stations on its Beach Report Card webpage. 82
Figure 30 Pt. Loma Treatment Plant 83
Figure 31 Pt. Loma Outfall 84
Figure 32 Percent Total Copper Loading to San Diego Bay 87
Figure 33 Percent Total PAH Loading to San Diego Bay 87

List of Tables

Table 1 Santa Monica Bay WMA 303(d)-listed Waters. SWRCB. 16 Feb 2004 11
Table 2 Summary Schedule for TMDL Development (by watershed) 12
Table 3 List of 33 streams to be tested as part of the SWAMP '03-'04 workplan: 14
Table 4 SWAMP Parameters: 14
Table 5 TSMP Methods: (see Appendix II) 16
Table 6 Toxicity Testing Program parameters as identified in the SWAMP 03-04 Workplan 18
Table 7 Excerpt from Candidate Toxic Hot Spot List 19
Table 8 Water Code-mandated deadlines for the BPTCP 21
Table 9 Regional Non Point Source Problems by Management Measure Category 23
Table 10 Stream Codes 27
Table 11 MWWMP Primary Parameters: 33
Table 12 MWWMP Secondary Parameters: 34
Table 13 LVMWD Parameters: 35
Table 14 Stream Team Monitoring Parameters 37
Table 15 Candidate Toxic Hot Spot List: 41
Table 16 Los Aangels region – water-bodies covered under bay protection and toxic cleanup program. . 42
Table 17 Mugu Lagoon BPTCP Stations With Sediment Chemistry Concentrations Exceeding ERM Threshold 44
Table 18 Summary Schedule for TMDL Development (by watershed) RWQCB 49
Table 19 Environmental Samples and QA/QC Samples Collected at the Mass Emission Site ME-CC (Calleguas) 52
Table 20. Conventional and Nutrient Results from the Mass Emission Stations 53
Table 21 Metals Results from the Mass Emission Station (ME-CC) 53
Table 22 The seven beaches in ASBS No.24 listed as impaired for beneficial uses 59
Table 23 LA County DHS Beach Water Quality Sampling Stations: 60
Table 24 Key to Sampling Agencies 61
Table 25 BeachKeeper Monitoring Locations (in SAMO Study Area): 62
Table 26 Beachkeeper Pollutants of Concern 63
Table 27 Comparison of atmospheric and non-atmospheric trace metal inputs to Santa Monica Bay (mt/year) 66
Table 28 USEPA 1998 TMDL's for Dan Diego Bay 84

I. Project Overview

The goal of this report is to provide an overview of water quality monitoring efforts occurring within 1 mile of boundaries of the National Park Service's Mediterranean Coastal Network Parks. These include the Channel Islands National Park, Santa Monica Mountains National Recreation Area and Cabrillo National Monument. The focus is on listing the agencies and general information about their monitoring programs such as parameters, testing frequencies, methods and data repository information. Also, current thoughts on gaps in knowledge and monitoring improvements will be discussed. In this way, the Network will have baseline information to help define and prioritize their water quality monitoring resources.
Introduction to Study Area:

II. The Mediterranean Biome[1]

"The Mediterranean biome occurs only in five relatively small areas around the planet. The five Mediterranean regions have been highly favored—and impacted—by humans for habitation, agriculture and recreation. As a result, this ecosystem type (which only occurs on about two percent of the earth's total land area) is one of the most highly altered on the planet and contains the least undisturbed area of any biome (Hannah, et al. 1995)…"

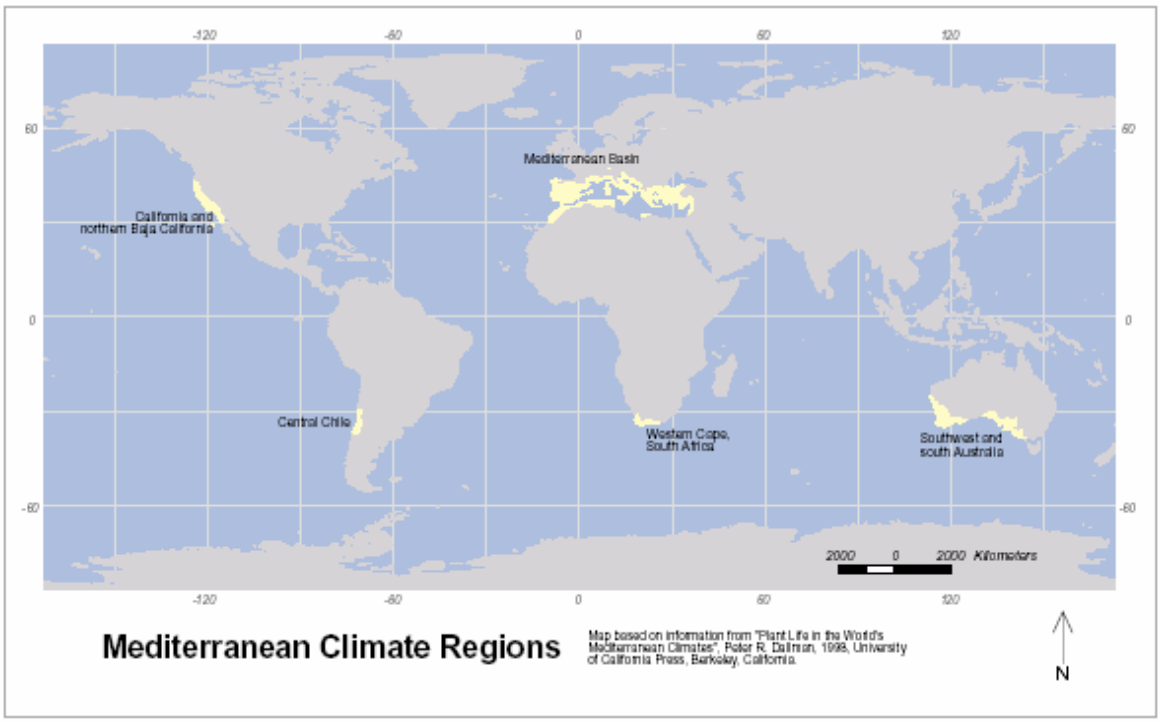

Figure 1 Mediterranean climate regions world-wide

[1] Mediterranean Coast Network of Parks Inventory and Monitoring website. NPS. 16 Feb.2004. <http://www1.nature.nps.gov/im/units/nw29/MediterraneanBiome.asp>

A. The Southern California Mediterranean Coast

"…The high degree of urbanization along the southern California coastline has resulted in the loss of significant natural areas and increasing human impacts to natural systems. Nevertheless the Mediterranean-type ecosystem of southern California has been identified as one of the world's "hot spots" for biodiversity[2]. Additionally, the southern California bight, an ecologically unique area of near-shore Pacific Ocean coastal habitat extending from Point Conception south and encompassing the San Diego area, provides conditions that promote high species richness and diversity (Hannah et al., 1995).

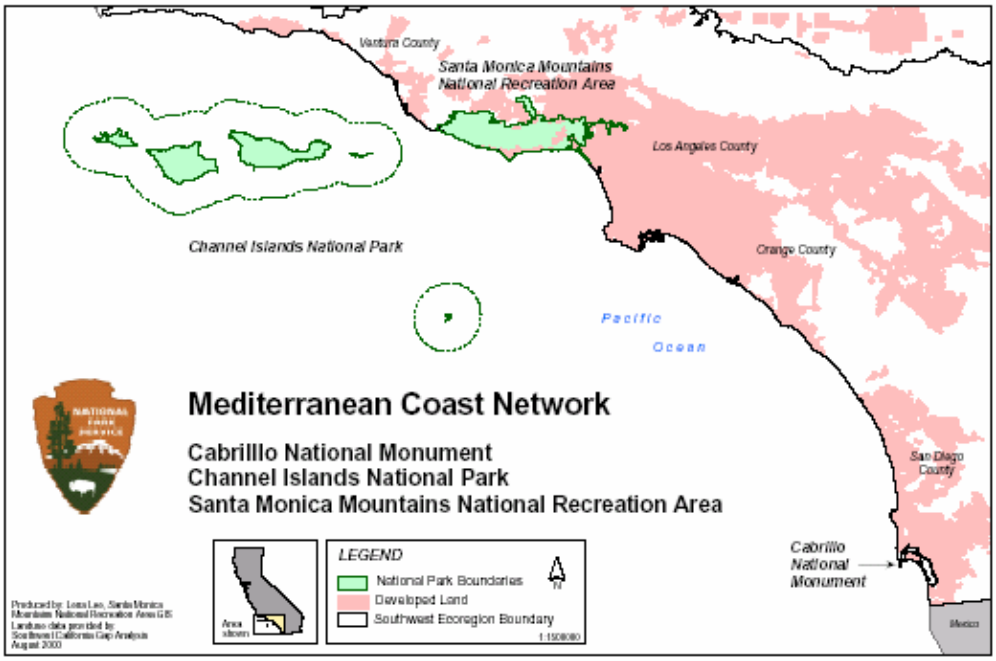

Figure 2 Map of the National Park Service's Mediterranean Coast Network

1. Aquatic Resources

The Santa Monica Mountains National Recreation Area (SAMO) exists as a mosaic of different land ownerships and land uses extending over 60,750 ha (150,050 acres). Of that amount, 29,495 ha (72,850 acres) are currently in protected status through public ownership (8,753 ha, approximately 21,620 acres, are owned and managed by the NPS), with the remaining 31,255 ha (77,200 acres) in private ownership. Unlike most national parks, SAMO is still expanding as remaining open space parcels become available and are purchased as public parkland.

The aquatic resources of the Santa Monica Mountains are very diverse. Dozens of north-south canyons parallel each other throughout the mountains. Each of these has an intermittent or perennial stream, with associated riparian vegetation lining it. In addition, there are a large number of east-west trending drainages coming down the slopes of these canyons. Across the Santa Monica Mountains Zone (a region that extends beyond the recreation boundary to include watersheds within SAMO), there are a total of 828 stream segments, including 179 major streams with 49 coastal outlets.

[2] <Conservation International. 2002. Biodiversity Hotspots.>

Figure 3 Santa Monica Mountains National Recreation Area

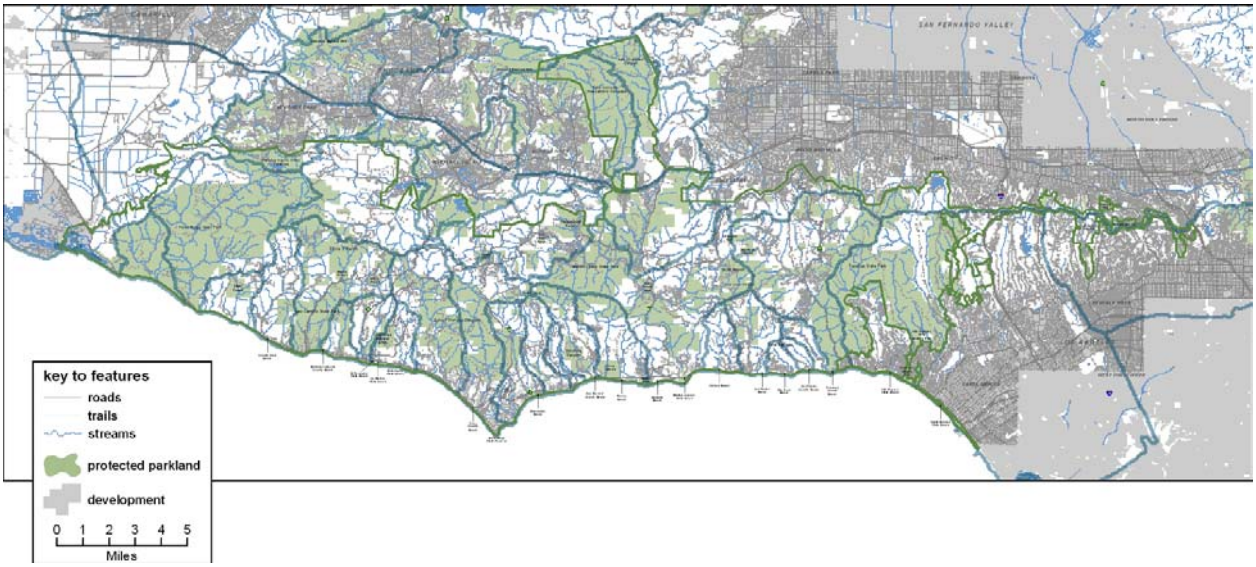

Figure 4 Streams and Watersheds of the Santa Monica Mountains

The largest watershed within SAMO is the Malibu Creek watershed. It contains a total of 105 square miles and incorporates several major drainage basins (Medea Creek, Triunfo Creek, Cold Creek, Malibu Creek, Sleeper, Las Virgenes, and Potrero Valleys). Conversely, the smallest stream courses in the Santa Monica Mountains are the numerous isolated drainages. The group of small, isolated drainages comprises 17 percent of all streams in the Santa Monica Mountains Zone.

A wide variety of wildlife and localized plant communities can be found associated with the streams and aquatic resources of the Santa Monica Mountains. These include one of the southernmost runs of the endangered steelhead trout (Oncorhynchus mykiss) in the U.S., a diverse array of aquatic insects, and unique populations of big leaf maples (Acer macrophyllum), cottonwoods (Populus sp.) and alder (alnus sp.). The arroyo chub (Gila orcutti) is found in Malibu Creek and the endangered tidewater goby (Eucyclogobius newberryi) was recently reintroduced (1991) to Malibu Lagoon. In creeks that feed from the developed recreational/water supply lakes in the mountains, a variety of non-native fauna have been introduced, many significantly impacting sensitive native communities.

Runoff generated from developed areas has placed increasing pressure on the existing fresh water resources. Runoff from urban developments (e.g., roads, parking lots, residential and commercial areas) generally contributes more runoff, more quickly and with higher concentrations of pollutants than pre-development areas. The runoff from the developed areas could contain elevated levels of nutrients (such as phosphorous and nitrogen), pathogens, toxicants (e.g., heavy metals), and litter and trash loads. It is critical for the park to identify and monitor the consequences of these impacts on the condition and quality of water resources in the Santa Monica Mountains."

2. Santa Monica Bay Watershed Management Area

The Regional Water Quality Control Board (RWQCB) divides the state into Watershed Management Areas. The Santa Monica Bay WMA includes the area of the Santa Monica Mountains defined as the Study Area of this report, and extends inland into the Los Angeles Basin and south to Palos Verdes.[3]

Water Quality Problems and Issues:

Though relatively small in its size compared with watersheds in other parts of the country, the Santa Monica Bay WMA embraces a high diversity in geological and hydrological characteristics, habitat features, and human activities. Almost every beneficial use defined in the Basin Plan is identified in water bodies somewhere in the WMA. Yet many of these beneficial uses have been impaired for years. While some of the impaired areas are showing signs of recovery, beneficial uses that are in relatively good condition still face the threat of degradation.

Figure 5 A portion of the Santa Monica Bay WMA (LARWQCB -12/02)

[3] LARWQCB Santa Monica Bay WMA. SWRCB. 16 Feb.2004. <http://www.swrcb.ca.gov/~rwqcb4/html/programs/regional_program/wmi/SANTA%20MONICA%20BAY%20WMA.pdf>

Existing and potential beneficial use impairment problems in the watershed fall into two major categories: human health risk, and natural habitat (wildlife) degradation. The former are issues primarily associated with recreational uses of the Santa Monica Bay. The latter are issues associated with terrestrial, aquatic, and marine environments. Pollutant loadings that originate from human activities are common causes of both human health risks and habitat degradation.

…A considerable number of monitoring programs have been implemented in the Santa Monica Bay WMA, particularly over the last twenty years. Sampling efforts tend to center around assessing urban runoff effects in general along the coastline and reservoirs of PCBs and DDT contaminated sediment in the area of the Palos Verdes Shelf. Four statewide monitoring programs, State Mussel Watch, Bay Protection and Toxic Cleanup, Coastal Fish Contamination Program and Toxic Substances Monitoring, focus on biological measurements.

The data from these programs indicate that in general the open coastline is much cleaner than the Bay's enclosed waters, except with regards to DDT and PCBs on the Palos Verdes Shelf. Pollutants of particular concern are chlordane, DDT, copper, and zinc. The BPTCP has listed the Santa Monica Bay - Palos Verdes Shelf area as a toxic hot spot for DDT and PCBs human health advisories (fishing) and NAS exceedances of DDT levels in fish. Marina Del Rey is listed as a toxic hot spot due to sediment concentrations of DDT, PCB, copper, mercury, nickel, lead, zinc and chlordane, and sediment toxicity; Ballona Creek Entrance Channel is listed due to sediment concentrations of DDT, zinc, lead, chlordane, dieldrin, and chlorpyrifos, and sediment toxicity. The BPTCP listed King Harbor as a site of concern, due to sediment concentrations of DDT and PCB and sediment toxicity (not recurrent).

Urbanization has had a significant impact on the riparian and wetland resources of the watershed, primarily through filling, alteration of flows, and decrease in water quality. It is estimated that 95% of the historic wetlands of the Santa Monica Bay WMA have been destroyed, with the remaining wetlands significantly degraded.

Although groundwater accounts for only a limited portion of the Santa Monica Bay WMA's supply of fresh water, the general quality of groundwater in the watershed has degraded from background levels.

Greater Santa Monica Bay

Santa Monica Bay is heavily used for fishing, swimming, surfing, diving etc., activities classified as water contact recreation (REC-1). However, the ability for people to enjoy these activities has been lost to a certain degree because of the real or perceived risk to human health. The primary, and also the best documented, problems are acute health risk associated with swimming in runoff-contaminated surfzone waters, and chronic (cancer) risk associated with consumption of certain sport fish species in areas impacted by DDT and PCB contamination.

The general public has also been concerned about potential health risks associated with the consumption of contaminated seafood from Santa Monica Bay. This is the primary pathway through which humans are exposed to toxic chemicals found in the marine environment. Recent studies, however, have shown that health risks are limited to consumption of certain seafood species found at certain locations."

One of the most evident impacts in marine habitats is sediment contamination and damage to marine life that the contaminants cause when they are released from the sediment (through natural fluctuations or through disturbance of the sediment) into the food chain. Organic compounds such as DDT, PCBs, polycyclic aromatic hydrocarbons (PAHs), chlordane, and tributyltin (TBT) are found in sediments in concentrations that are harmful to marine organisms at various locations in the Bay.

Also found in Bay sediments are heavy metals such as cadmium, copper, chromium, nickel, silver, zinc, and lead. The major historic sources of sediment contamination have been wastewater treatment facilities; thus the accumulations are highest near treatment plant outfalls off of Palos Verdes and Playa del Rey. Bioaccumulation of DDT in white croaker, dover sole, and California brown pelicans are well-known examples of the impacts caused by sediment contamination. Prior to the 1980s, high

concentrations of DDT were found in muscle tissues of these organisms. DDT in these organisms was implicated in fin erosion and other diseases in fish as well as eggshell thinning and subsequent species decline in the California Brown Pelican.

B. SAMO Area Freshwater Water Quality Monitoring

SAMO Study Area:

This area includes the approximately 50 coastal streams with ocean outlets, the upper watershed streams, and the lakes and reservoirs of the Santa Monica Mountains. Although the SM Mountains extend east toward Highway 101 in Hollywood, the bulk of the SMMNRA lies west of the coastal portion of the mountains. At Santa Monica Canyon (Will Rogers Beach), the mountains leave the coast and continue eastward, so this was chosen as the southern limit of the study area.

Coastal lagoons will be considered in this section, even though they are often a mix of fresh and saltwater. Mugu Lagoon is mentioned in the section regarding monitoring for toxic substances, yet the Calleguas Watershed is primarily considered in its own section.

SAMO Freshwater 303d list

The Clean Water Act requires states to identify water bodies that do not meet applicable water quality standards. This list of water bodies (303d list) is compiled by the Regional Water Quality Control Board and is updated and revised every two years.

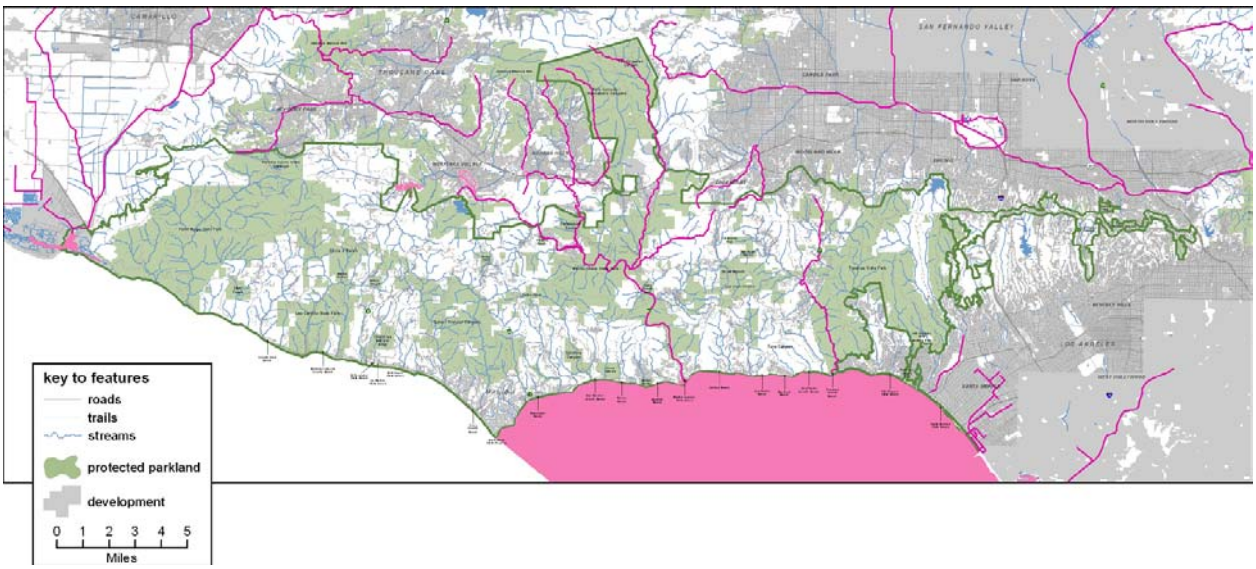

Figure 6 In the Santa Monica Mountains, from Pt. Mugu to Santa Monica Canyon, there are 9 streams, 4 lakes and 1 lagoon listed by the RWQCB as impaired. The following are listed:

1. TMDL Development:

Section 303d of the Federal Clean Water Act requires States to establish maximum limits of pollutants that streams, rivers, lakes and ocean can accept before their beneficial uses such as swimming and fishing are impaired. These limits are referred to as Total Maximum Daily Loads (TMDLs).[4]

[4] LARWQCB Regional Programs website. Watershed management. LARWQCB. 16 Feb. 2004 <http://www.swrcb.ca.gov/~rwqcb4/html/programs/regional_programs.html>

Table 1 Santa Monica Bay WMA 303(d)-listed Waters. SWRCB. 16 Feb 2004[5]

Santa Monica Bay Watershed 303d List Impairments - Freshwater Creeks, Lakes, Lagoon							
Waterbody Name	**State Impairment(s)**						
Lake Lindero	Selenium	Algae	Chloride	Eutrophic	Odors	Specific Conductivity	Trash
Lake Sherwood	Mercury	Algae	Ammonia	Eutrophic	Organic Enrichment/ Low DO		
Westlake Lake	Chlordane	Algae	Ammonia	Eutrophic	Organic Enrichment/ Low DO	Copper	Lead
Malibou Lake	Chlordane	Algae	PCBs	Eutrophic	Organic Enrichment/ Low DO	Copper	
Malibu Lagoon	Benthic Impacts	Enteric Viruses	High Coliform	Eutrophic	Shellfish Harvesting Advisory	Swimming Restriction	
Malibu Creek	Fish Barriers	Algae	High Coliform	Scum/Foam-Unnatural	Trash		
Las Virgenes Creek	Selenium	Algae	High Coliform		Organic Enrichment/ Low DO		
Lindero Creek Reach 1	Selenium	Algae	High Coliform	Scum/Foam-Unnatural	Trash		
Lindero Creek Reach 2	Selenium	Algae	High Coliform	Scum/Foam-Unnatural	Trash		
Medea Creek Reach 1 (Lake to Confl. With Lindero)	Selenium	Algae	High Coliform	Trash			
Medea Creek Reach 2 (Abv. Cofl. With Lindero)	Selenium	Algae	High Coliform	Trash			
Palo Comado Creek			High Coliform				
Santa Monica Canyon	Lead		High Coliform				
Stokes Creek			High Coliform				
Topanga Canyon Creek	Lead						
Triunfo Canyon Creek Reach 1	Lead	Mercury					
Triunfo Canyon Creek Reach 2	Lead	Mercury					

"Grouping TMDLs is a reasonable and logical way to collapse the total number of individual TMDLs to make the most effective use of resources we currently have and any that we may obtain in the future. This is largely due to the fact that some of the "pollutants" for which a water may be listed are actually "effects" of pollutants. For example, many reaches of the Los Angeles River are listed for ammonia. Some of the same reaches are listed for pH problems while other reaches are listed for algae, scum, and odors. It is very likely the presence of these "pollutants" is interrelated. Excessive nitrogen (reflected here as high levels of ammonia) may lead to a condition of eutrophication (excessive nutrient loading), which can influence pH levels as well as promote increased algal growth. Scum may be evident due to floating algal

5

<http://www.swrcb.ca.gov/~rwqcb4/html/programs/regional_program/wmi/Santa%20Monica%20Bay%20WMA%20303.pdf >

material and odors may result when excessive algae starts to die off. Thus, it makes sense to group these TMDLs (calling it a "nitrogen and related effects" TMDL "group") and approach the problem by determining the sources of nitrogen loading into the watershed and the appropriate allocations in order to reduce loadings. Table 7A (pdf version) of the WMI Chapter lists all of the TMDLs in the Region as well as a schedule for completion. All TMDLs must be completed by 2011 (as requested by U.S. EPA and State Board and per a consent decree).

Litigation in 1998 by Santa Monica BayKeeper, Heal the Bay and NRDC established a time schedule for TMDL development in the Los Angeles area, including Santa Monica Bay beaches."

Table 2 Summary Schedule for TMDL Development (by watershed)[6]

303(d)Listed Water body (Reach)	Pollutant	Type of TMDL	TMDL Start (start Date of monitoring - Fiscal Year)	TMDL Completion Fiscal Year (Basin Plan Amendment)
Medea Creek Reach 2 (above confl. with Lindero)	coliform	coliform and its effect	1998/99	2001/02
Malibu Lagoon	eutrophication	Nutrients and their effects	1998/99	2001/02
Topanga Cyn Creek	Pb	metals and their effects	2004/05	2006/07
Westlake Lake	chlordane	hist. pest	2006/07	2009/10
Westlake Lake	Pb	metals	2005/06	2007/08
Medea Creek Reach 2	trash	trash	2005/06	2006/07
Lake Lindero	chloride specific conductivity	chloride	2006/07	2009/10
Malibu Lagoon	benthic community effects	N/A Cause needs to be determined	2006/07	2009/10

2. Surface Water Ambient Monitoring Program (SWAMP)[7]

SWAMP is a statewide monitoring effort designed to assess the conditions of surface waters throughout the state of California. The program is administered by SWRCB. Responsibility for implementation of monitoring activities resides with the nine RWQCB's that have jurisdiction over their specific geographical areas of the state. Monitoring is conducted in SWAMP through the Department of Fish and Game and US Geological Survey master contracts and local RWQCBs monitoring contracts. SWAMP also hopes to capture monitoring information collected under other State and Regional Board Programs such as the State's TMDL (Total Maximum Daily Load), Nonpoint Source, and Watershed Project Support programs. SWAMP does not conduct effluent or discharge monitoring which is covered under National Pollutant Discharge Elimination System permits and Waste Discharge Requirements.[8]

"California Water Code Section 13192 required the SWRCB to assess and report on the State monitoring programs and to prepare a proposal for a comprehensive surface water quality monitoring program. As currently envisioned, the Surface Water Ambient Monitoring Program (SWAMP) will be implemented using a scientifically sound monitoring design with meaningful indicators of the environment and the results will be readily available to the public. Ambient monitoring serves as a measure of the overall quality of water resources and the overall effectiveness of Regional Boards prevention, regulatory, and remedial actions.

---

[6] Excerpted from: <http://www.swrcb.ca.gov/~rwqcb4/docs/table7_wmi_appdx.pdf>

[7] Surface Water Ambient Monitoring Program. SWRCB website.16 Feb.2004. <http://www.swrcb.ca.gov/swamp/index.html>

[8] (From "RWQCB Regionwide Activities Report '01", http://www.swrcb.ca.gov/~rwqcb4/html/programs/regional_program/wmi/Regionwide Activities.pdf):

1. The SWAMP is intended to meet four goals:
2. Identify specific problems preventing the SWRCB, RWQCBs, and the public from realizing beneficial uses in targeted watersheds.
3. Create an ambient monitoring program that addresses all hydrologic units of the State using consistent and objective monitoring, sampling and analysis methods; consistent data quality assurance protocols; and centralized data management.
4. Document ambient water quality conditions in potentially clean and polluted areas.
5. Provide the data to evaluate the effectiveness of water quality regulatory programs in protecting beneficial uses of waters of the State.

Eventually, each of the SWRCB and RWQCBs existing monitoring programs (e.g., the State Mussel Watch Program, Toxic Substances Monitoring Program, Coastal Fish Contamination Program, and toxicity studies) will be incorporated into SWAMP to ensure a coordinated approach without duplication."

"…Our general approach to implementing the SWAMP will be to sample following the rotating watershed cycle. For example, in FY02-03 we would focus sampling in the Santa Monica Bay WMA, which is targeted under the WMI that year. That way, each hydrologic unit in the Region would be sampled every five years. Possible exceptions to this approach include investigating reference sites in non-targeted as well as targeted watersheds and conducting follow-up work at problem sites. We will generally utilize a stratified random approach to select sample sites (stratified to include areas around major confluences) except for our investigation into eutrophication which would utilize a uniform sampling approach and our follow-up work at previously identified problem sites. Depending on the number of samples deemed necessary (by the scientific review panel) in each stratum to give reliable results (and the associated costs), a more uniform sampling approach may be utilized instead, such as uniform sampling or sampling at confluences. There will likely be considerably less than the current approximately $330,000 available in FY02/03 for sampling and analysis due to recent budget cuts. The majority (~60%) of those resources are anticipated to be dedicated toward biological monitoring as opposed to chemical analyses. Biological monitoring may include freshwater toxicity tests, habitat assessments, analysis of benthic invertebrates, fish bioassessments, or sediment toxicity tests. Much of this work will be conducted through a master contract with the Department of Fish & Game."

SWAMP Methods/ Sampling Protocols: (See Appendix 1)

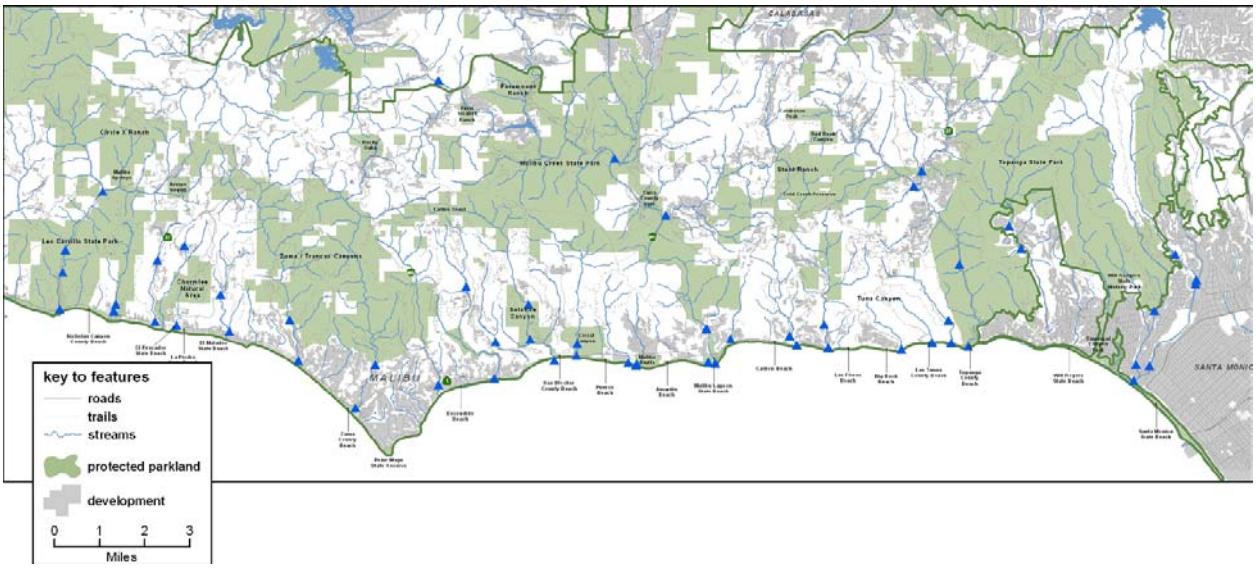

Figure 7 SWAMP sites within the Santa Monica Mountains

Table 3 List of 33 streams to be tested as part of the SWAMP '03-'04 workplan:

SWAMP MONITORING SITES (in Santa Monica Mountains)	
Arroyo Sequit @ Fork	Malibu Lagoon
Arroyo Sequit Upper	Sweetwater Cyn Crk Upper
Arroyo Sequit Lower	Sweetwater Cyn Crk Lower - just above PCH
San Nicholas Cyn Crk Upper	Carbon Cyn Crk Upper
San Nicholas Cyn Crk Lower	Carbon Cyn Crk Lower
Los Alisos Cyn Crk Upper	Las Flores Cyn Crk Upper
Los Alisos Cyn Crk Lower	Las Flores Cyn Crk Lower
Lachusa Cyn Crk Upper	Piedra Gorda Cyn Crk Upper
Lachusa Cyn Crk Lower	Piedra Gorda Cyn Crk Lower
Encinal Cyn Crk Upper	Pena Cyn Crk Upper
Arroyo Sequit above State Park Campground	Pena Cyn Crk Lower
Encinal Cyn Crk Lower	Tuna Cyn Upper
Trancas Cyn Crk Upper	Tuna Cyn Crk Lower
Trancas Cyn Crk Lower	Topanga Cyn Crk Upper
Dume/Zuma Cyn CrkUpper	Topanga Cyn Crk Middle
Dume/Zuma Cyn Crk Lower	Topanga Lagoon
Ramirez Cyn Crk Upper	Malibu Creek
Ramirez Cyn Crk Lower	Cold Creek
Escondido Cyn Crk Upper	Las Virgenes Cyn Crk
Escondido Cyn Crk Lower	Medea Creek
Latigo Cyn Crk Lower	Triunfo Cyn Crk
Latigo Cyn Crk Upper	Topanga @ Greenleaf
Solstice Cyn Crk Middle	Santa Ynez Cyn Crk Middle
Solstice Cyn Crk Upper @ Waterfall/Tropical Terrace	Santa Ynez Cyn Crk Upper
Solstice Cyn Crk Lower	Santa Monica Cyn Crk Upper
Corral Cyn Crk Upper	Santa Monica Cyn Crk Lower
Corral Cyn Crk Lower	Rustic Cyn Creek Upper
Puerco Cyn Crk Upper	Rustic Cyn Creek Lower
Puerco Cyn Crk Lower - outlet to ocean	Upper Sullivan Creek
Marie Cyn Crk Upper	Santa Monica Cyn Crk at confluence with Mandeville & Sullivan
Marie Cyn Lower towards beach	Lower Sullivan Cyn just above confluence with Santa Monica Cyn
Marie Cyn Lower - north side of Malibu Rd	

Table 4 SWAMP Parameters:

SWAMP FY01-02 RWQCB 4 Funds-- Task Order No. 01-4-001	Task Order Title: "Field and Lab Services for RWQCB 4 for FY01-02 funds"
Analysis or Service to be Performed	Description
Sediment and/or Water Sample Collection	Collect sed and/or water samples; conduct centroid velocity measurement; conduct multiparameter probe reading; includes all sample shipping. For close access, drive-up sites only.

Trace Organic Chemistry	Organophosphate Scan (incl chlorpyrifos and diazinon) - water
	MTBE & BTEX - water
Trace Metal Chemistry	Water ICPMS metals suite--filtered "dissolved" (Includes Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As, Se)
Conventional Water Chemistry	Major anions nutrient scan: ortho-phosphate, nitrate, nitrite, chloride, sulfate
	Total Phosphate
	Boron
	TKN
	TDS
	Ammonia
	Chlorophyll-a
	Alkalinity
	Flouride
	Total N
	Hardness
Bacteriology and Pathology	To be negotiated, based on actual analyses requested estimated to be using Colilert & Enterolert
Biological Assessment	Site collection, sorting, taxonomy, QA, report (3 replicates at $407 each)
	Sample sorting, taxonomy, QA, report (no sample collection; sample must be provided by RWQCB per ABL protocols)
Toxicity Testing - Salt Water Origin	Water
	Larval Development (sea urchin, abalone, bivalve)
	Larval Development at Sediment Water Interface
	Sea Urchin Fertilization
	Mysid Juvenile 96-h Survival
	Additional Sample Dilutions
	Sediment
	Amphipod 10-d Survival (Rhepoxynius or Euhaustorius)
	Amphipod 10-d Survival (Ampelisca)
	Polychaete 20-d Growth & Survival (Neanthes)
Toxicity Testing - Fresh Water Origin	Water
	Ceriodaphnia 7-day Survival & Reproduction
	Pimephales (fathead minnow) 7 - day
Other Toxicity Testing Services	ELISA for Diazinon
	ELISA for Chlorpyrifos

3. RWQCB Toxic Substance Monitoring Program (TSMP)[9]

[9] Toxic Substance Monitoring Program (TSMP) website. RWQCB. 16 Feb.2004. < http://www.swrcb.ca.gov/swamp/programs.html>

The Toxic Substance Monitoring Program (TSMP) was initiated in 1976 by the SWRCB. The TSMP provides a uniform Statewide approach to the detection and evaluation of the occurrence of toxic substance in fresh, estuarine, and marine waters of the State through the analysis of fish and other aquatic life. The TSMP primarily targets water bodies with known or suspected impaired water quality and is not intended to give an overall water quality assessment. Sampling stations are selected primarily by the nine RWQCBs. Data are used by the SWRCB, RWQCBs, and other agencies to identify waters impacted by toxic pollutants.

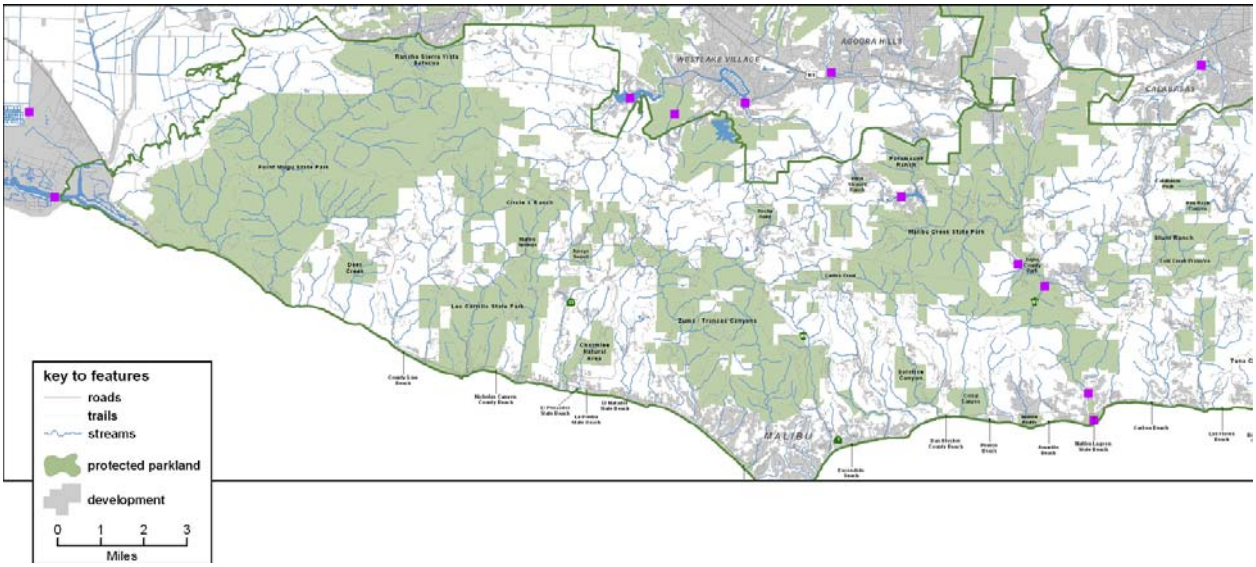

Figure 8 TSMP (16) sites fall within the Santa Monica Mountains study area:

Table 5 TSMP Methods: (see Appendix II)

Station Name	Station Description
Revolon Slough	Station located below concrete apron just downstream of Woods Road.
Mugu Lagoon	Station located at Laguna Road Bridge.
Calleguas Creek	Station located downstream of Lewis Road crossing.
Conejo Creek	Station located at Rancho Road crossing south west of Camarillo.
Arroyo Conejo	Station located upstream of second wet crossing of the creek. Access is through the Thousand Oaks Sewage Treatment Plant.
Arroyo Conejo/d/s Forks	Station located downstream of weir below waste treatment plant.
Arroyo Conejo/u/s HCTP	Station located on North Fork Arroyo Cr. about 600 yards upstream of the treatment plant.
Malibu Lagoon	Station located 100 yards upstream from the Pacific Coast Highway bridge downstream to the mouth.
Malibu Creek	Station located at Cross Creek Road crossing.
Malibu Creek/Tapia Park	Station located downstream from treatment plant to flow gaging station.
MalibuCreek/u/sTapia Discharge	Station located upstream of treatment plant discharge at Tapia Park.
Malibou Lake	Station located near Lake Vista Drive and Cornell Road.
Lindero Lake	Station located at Mainsail Cul-de-Sac off Lake Lindero Drive.
Westlake Lake	Station located at Triunfo Canyon Road and Lindero Canyon Road.
Eleanor Lake	Station located beside Westlake Blvd. (Highway 23 So.) about 3/4 mile south of Potrero Road.
Sherwood Lake	Station located off Potrero Road about 1 1/2 miles east of Westlake Blvd.

4. RWQCB State Mussel Watch Program (SMWP)[10]

The California State Mussel Watch (SMWP) initiated in 1977 by the SWRCB, provides a uniform Statewide approach to the detection and evaluation of the occurrence of toxic substances in the waters of California's bays, harbors and estuaries. This is accomplished through the analysis of transplanted and resident mussels and clams. The SMWP primarily targets area with known or suspected impaired water quality and is not intended to give an overall water quality assessment. Information collected in the SMWP is used by the SWRCB, RWQCBs, and other agencies to identify waters impacted by toxic pollutants.

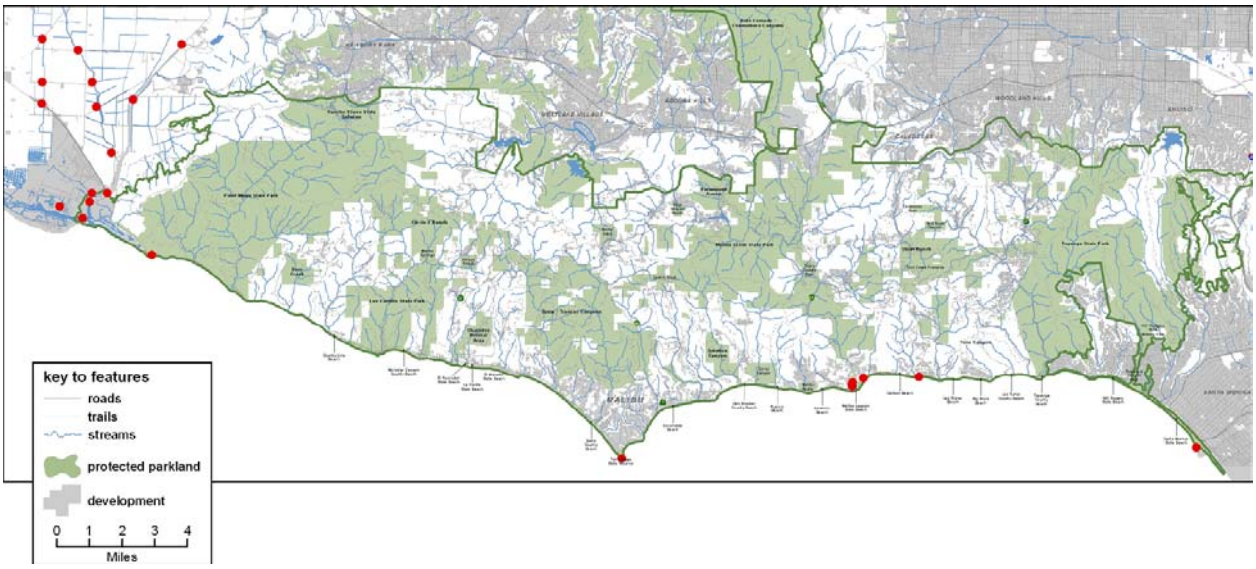

Figure 9 Mussel Watch sites within the vicinity of the Santa Monica Mountains.

There are 16 Sites in the Calleguas watershed (11 Mugu Lagoon and drainages), and 6 sites in Malibu, (including Pt. Dume and Big Rock).[11]

APPENDIX D
State Mussel Watch Program
Station Sampling History

Station Number	Station Name	Sample Year* 78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
507.1	Mugu Lagoon/L Street	--	--	--	--	--	--	--	--	--	DO	--	--	--	O	--	--	--	--	--	--
507.2	Mugu Lagoon/Laguna Road	--	--	--	--	--	--	--	--	O	DO	--	--	--	O	--	--	--	--	--	--
507.3	Mugu Lagoon/Calleguas Creek	--	--	--	--	--	--	--	--	O	DO	--	DO	O	O	O	O	DO	--	--	--
507.4	Ag Drain/Etting Road	--	--	--	--	--	--	--	--	--	--	--	--	--	O	--	--	--	--	--	--
507.6	Ag Drain/Pleasant Valley Road	--	--	--	--	--	--	--	--	--	--	--	--	--	O	--	--	--	--	--	--
507.7	Revolon Slough/Las Posas Rd	--	--	--	--	--	--	--	--	--	--	--	--	--	O	--	--	--	--	--	--
507.8	Revolon Slough	--	--	--	--	--	--	--	--	--	DO	O	O	O	O	--	--	--	--	--	--
508.1	Mugu Drainage 1	--	--	--	--	--	--	--	--	--	--	--	--	O	--	--	--	--	E	--	--
508.2	Mugu Drainage 2	--	--	--	--	--	--	--	--	--	--	--	--	O	--	--	--	--	--	--	--
508.3	Mugu Drainage 3	--	--	--	--	--	--	--	--	--	--	--	--	O	--	--	--	--	--	--	--
508.4	Mugu Drainage 4	--	--	--	--	--	--	--	--	--	--	--	--	O	--	--	--	--	--	--	--
508.5	Mugu Drainage 5	--	--	--	--	--	--	--	--	--	--	--	--	O	--	--	--	--	--	--	--
508.6	Mugu Drainage 6	--	--	--	--	--	--	--	--	--	--	--	--	O	--	--	--	--	--	--	--
508.7	Mugu Drainage 7	--	--	--	--	--	--	--	--	--	--	--	--	O	--	--	--	--	--	--	--
509.0	Calleguas	--	--	--	--	--	--	--	--	--	--	--	--	O	--	--	--	--	--	--	--

[10] < http://www.swrcb.ca.gov/programs/smw/index.html>

[11] SMWP in Santa Monica Mountains study area from 1978-1997: <http://www.swrcb.ca.gov/programs/smw/docs/9597/appendix_d.pdf>

647.0	Point Dume	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
648.0	Malibu	--	--	--	E	--	--	--	--	--	--	--	--	--	EO	--	EO	EO	EO	EO	EO
648.1	Malibu Lagoon/Channel A	--	--	--	--	--	--	--	--	--	--	--	--	--	--	EO	EO	--	--	--	--
648.3	Malibu Lagoon/Channel C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	EO	EO	--	--	--	--
648.5	Malibu Lagoon/PCH	--	--	--	--	--	--	--	--	--	--	--	--	--	--	EO	EO	--	--	--	--
649.0	Big Rock Beach	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

* Sample Year = State Fiscal Year (July 1 - June 30). For example, Sample Year 78 = 1977-78 Fiscal Year.
-- = Not Sampled. O = Synthetic Organics Only. E = Trace Elements Only. EO = Trace Elements and Synthetic Organics.

Figure 10 State Mussel Watch Station Sampling History[12]

SMWP Methods: (See Appendix III)

5. RWQCB Toxicity Testing Programs

The Toxicity Testing Program (TTP) is intended to assess water quality in surface waters of the State using reliable USEPA standardized toxicity testing procedures, modified USEPA Toxicity Identification Evaluation and supporting chemical analysis. For the past several years, the TTP has been effective in providing information that can identify waterways where toxicity water quality standards (objectives) are not being met and whether these surface waters can support biological communities in aquatic ecosystems. The intent of the TTP is to identify high-risk areas and to identify the spatial and temporal extent of water quality problems, as well as, the geographic and land use/water use sources of the causative chemical(s).

Table 6 Toxicity Testing Program parameters as identified in the SWAMP 03-04 Workplan

Toxicity Testing – Salt Water Origin	Water
	Larval Development (sea urchin, abalone, bivalve)
	Larval Development at Sediment Water Interface
	Sea Urchin Fertilization
	Mysid Juvenile 96-h Survival
	Additional Sample Dilutions
	Sediment
	Amphipod 10-d Survival (Rhepoxynius or Euhaustorius)
	Amphipod 10-d Survival (Ampelisca)
	Polychaete 20-d Growth & Survival (Neanthes)
Toxicity Testing – Fresh Water Origin	Water
	Ceriodaphnia 7-day Survival & Reproduction
	Pimephales (fathead minnow) 7 - day
Other Toxicity Testing Services	ELISA for Diazinon
	ELISA for Chlorpyrifos

6. RWQCB Bay Protection and Toxic Cleanup Program (BPTCP)[13]

"In 1989, state legislation added Sections 13390 through 13396 to the California Water Code which established the BPTCP. The program has four main goals:
provide protection of existing and future beneficial uses of bays and estuarine waters,
identify and characterize toxic hot spots,
plan for cleanup or other mitigating actions of toxic hot spots, and

[12] http://www.swrcb.ca.gov/programs/smw/docs/9597/appendix_d.pdf:
[13] http://www.swrcb.ca.gov/~rwqcb4/html/programs/regional_program/wmi/Regionwide%20Activities.pdf

develop effective strategies to control toxic pollutants, abate existing sources of toxicity, and prevent new sources of toxicity.

While in its identification and characterization phase, the program implemented regional monitoring at each of the coastal Regions. Sediment toxicity tests, chemical analyses, and benthic community surveys were used to classify each bay or estuarine waterbody. Waters were generally "pre-screened" for contamination using toxicity tests; if enough was found, more intensive monitoring followed to confirm the existence and spatial extent of monitoring. Using this approach, the Santa Monica Bay/Palos Verdes Shelf, parts of, Consolidated Slip/Dominguez Channel, Cabrillo Pier, Mugu Lagoon/Calleguas Creek, McGrath Lake, Los Angeles River Estuary, Marina Del Rey, and Marina Del Rey Entrance Channel were identified as candidate toxic hot spots. A number of other waters were identified as sites of concern.

Table 7 Excerpt from Candidate Toxic Hot Spot List[14]

Water body name	Segment Name	Site Identification	Reason for Listing	Pollutants present at the site	Report reference
Santa Monica Bay	Palos Verdes Shelf	BPTCP 40031.1, 40031.2, 40031.3	Human health advisory; NAS level exceeded for DDT; sediment concentrations + sediment toxicity; degraded benthic community	DDT, PCB	[1], [2], [3], [4]

State Board adopted a statewide, consolidated cleanup plan in June 1999 with Office of Administrative approval following in November 1999. Regional cleanup plans deal specifically with high priority candidate toxic hot spots; detailed cleanup plans were not required for moderate priority candidate toxic hot spots or sites of concern although listed in the document.

Identified remediation/cleanup alternatives for toxic hot spots range from specific actions such as in-situ capping, issuing waste discharge requirements, or dredging to more regional/watershed activities such as long-term management of contaminated sediments or proactive application of the watershed management approach as a preventive measure. At this point, no specific funding source has been identified to pay for remediation activities although potential funding mechanisms are addressed in the statewide consolidated cleanup plan. The best chance for obtaining funds for cleanup appears to be through the use of Supplemental Environmental Projects (SEPs) from enforcement actions or by partnering with other groups within the context of the watershed management approach to take advantage of local efforts. Funding for staff resources ended in June 1999.

After the Consolidated Plan was approved, the Regional Board was required to reevaluate WDRs in compliance with Water Code Section 13395. The reevaluation was to consist of (1) an assessment of the WDRs that may influence the creation or further pollution of the known toxic hot spot; (2) an assessment of which WDRs need to be modified to improve environmental conditions at the known toxic hot spot; and (3) a schedule for completion of any WDR modifications deemed appropriate. We evaluated WDRs associated with high priority known toxic hot spots (i.e., Palos Verdes Shelf, Consolidated Slip, Cabrillo Beach, Mugu Lagoon, McGrath Lake) and did not identify any existing WDRs which required modifications. Similarly, we did not need to modify any WDRs associated with moderate and low priority known toxic hot spots. As we renew, modify or issue new WDRs, we need to include a finding that the discharge may contribute to the pollution present at the toxic hot spot."

The program has a thorough website which may be consulted for additional information: http://www.swrcb.ca.gov/bptcp.

The link to the database description, http://www.swrcb.ca.gov/bptcp/docs/dbasedes.doc, provides a twenty-three-page document that lists the parameters tested and descriptions of the data fields for each.

[14] (From: "REGIONAL TOXIC HOT SPOT CLEANUP PLAN" (LARWQCB 1999) http://www.swrcb.ca.gov/bptcp/docs/conplnv1.doc

7. Toxic Hot Spot Identification

The Water Code defines toxic hot spots as locations in enclosed bays, estuaries, or the ocean where pollutants have accumulated in the water or sediment to levels which (1) may pose a hazard to aquatic life, wildlife, fisheries, or human health, or (2) may impact beneficial uses, or (3) exceed SWRCB or RWQCB-adopted water quality or sediment quality objectives.

To identify toxic hot spots, water bodies of interest have been assessed on both a regional and site-specific basis. Regional assessments require evaluating whether water quality objectives are attained and beneficial uses are supported throughout the water body. In the past, the State Mussel Watch program, independent RWQCB studies, and other studies were used extensively to evaluate beneficial use impacts in many California enclosed bays and estuaries. The BPTCP efforts continue this work by focusing on measures of effects (such as toxicity) with the associated pollutants. Generally, where sites were not well characterized, regional monitoring programs have been implemented. The Department of Fish and Game (DFG) have performed this monitoring activity under contract with the SWRCB. The consolidated statewide database required by the Water Code was planned to eventually include all data generated by the regional monitoring programs.

Ranking Criteria

The Water Code (Section 13393.5) requires the SWRCB to develop criteria for ranking toxic hot spots. The ranking criteria must consider the pertinent factors relating to public health and environmental quality. The factors include three considerations: (1) potential hazards to public health, (2) toxic hazards to fish, shellfish, and wildlife, and (3) the extent to which the deferral of a remedial action will result, or is likely to result, in a significant increase in environmental damage, health risks, or cleanup costs.

Sediment Quality Objectives

State law defines sediment quality objectives as "that level of a constituent in sediment which is established with an adequate margin of safety, for the reasonable protection of beneficial uses of water or prevention of nuisances" (Water Code Section 13391.5). Water Code Section 13393 further defines sediment quality objectives as: "...objectives...based on scientific information, including but not limited to chemical monitoring, bioassays or established modeling procedures." The Water Code requires "adequate protection for the most sensitive aquatic organisms." Sediment quality objectives can be either numerical values based on scientifically defensible methods or narrative descriptions implemented through toxicity testing or other methods.

Toxic Hot Spot Cleanup Plans

The Water Code requires that each RWQCB must complete a toxic hot spot cleanup plan and the SWRCB must prepare a statewide consolidated toxic hot spot cleanup plan. To facilitate the development of these plans, the SWRCB began the development of a water quality control policy with guidance to the RWQCBs for consistent implementation of the BPTCP.

Each cleanup plan must include: (1) a priority listing of all known toxic hot spots covered by the plan; (2) a description of each toxic hot spot including a characterization of the pollutants present at the site; (3) an assessment of the most likely source or sources of pollutants; (4) an estimate of the total costs to implement the cleanup plan; (5) an estimate of the costs that can be recovered from parties responsible for the discharge of pollutants that have accumulated in sediments; (6) a preliminary assessment of the actions required to remedy or restore a toxic hot spot; and (7) a two-year expenditure schedule identifying State funds needed to implement the plan.

Within 120 days from the ranking of a toxic hot spot in a regional cleanup plan, each RWQCB is required to begin reevaluating waste discharge requirements for dischargers who have contributed any or all of the pollutants which have caused the toxic hot spot. These reevaluations shall be used to revise water quality

control plans wherever necessary. Reevaluations shall be initiated according to the priority ranking established in cleanup plans.

Screening Sites and Confirming Toxic Hot Spots[15]

In order to identify toxic hot spots a two-step process was used. Both steps are designed around an approach with three measures (sediment quality triad analysis) plus an optional bioaccumulation component. The triad analysis consists of toxicity testing, benthic community analysis, and chemical analysis for metals and organic chemicals.

The first step is a screening phase that consists of measurements using toxicity tests or benthic community analysis or chemical tests or bioaccumulation data to provide sufficient information to list a site as a potential toxic hot spot or a site of concern. Sediment grain size, total organic carbon (TOC), NH3 and H2S concentration are measured to differentiate pollutant effects found in screening tests from natural factors.

A positive result or an effect in any of the triad tests would trigger the confirmation step (depending on available funding). The confirmation phase consists of performing all components of the sediment quality triad: toxicity, benthic community analysis, and chemical analysis, on the previously sampled site of concern. Assessment of benthic community structure may have not be completed if there was difficulty in measuring or interpreting the information for a water body.

Legislative Deadlines

Recent legislation [SB 1084 (1993)] extended Program funding through 1998, the deadline for the Regional Toxic Hot Spot Cleanup Plans to 1998 and the Statewide Cleanup Plan until 1999 (Table 1); excluded agricultural dischargers from paying fees; created the BPTCP Advisory Committee; and mandated completion of an epidemiology study (a health effects study of swimming near storm drains at southern California beaches). AB 385 (1993) allowed an exemption for certain types of dischargers that create habitat for wildlife.

Table 8 Water Code-mandated deadlines for the BPTCP

Activities	Deadline
Sediment Quality Objectives Workplan	July 1, 1991
Consolidated Database	January 1, 1994
Ranking Criteria	January 30, 1994
Progress Report	January 1, 1996
Regional Cleanup Plans	January 1, 1998
Statewide Cleanup Plan	June 30, 1999

Summary of BPTCP Methods: (See Appendix IV)

8. LARWQCB Bioassessment project[16]

The Los Angeles RWQCB (Region 4) is currently funding a bioassessment project to determine the biological health of streams relative to land use in three watersheds (Malibu, Calleguas, and Santa Clara). The University of California Los Angeles (UCLA) is conducting the project, which began in the Fall 2001 sampling season. Furthermore, Region 4 recently initiated a bioassessment program as part of the Surface Water Ambient Monitoring Program (SWAMP), whereby both site-specific monitoring goals and the regional monitoring goals have been integrated into one ambient monitoring program. The information

[15] http://www.swrcb.ca.gov/bptcp/docs/r4cl99_f.doc , p.11
[16] http://www.swrcb.ca.gov/swamp/docs/bioassess_chapt2.pdf

gathered will be used to identify impaired beneficial uses, as well as potentially in the development of an index of biological integrity.[17]

Summary of Bioassessment Field Procedures

Bioassessment monitoring includes sampling of benthic invertebrates and periphyton for bioassessment evaluations. The procedure for collecting samples of benthic invertebrates from wadable streams is based on the method detailed in California Stream Bioassessment Procedures (Habitat Assessment and Biological Sampling) (CDFG 1996a). Specific procedures are documented in Appendix G. Please note that Biological Assessment procedures utilized for RWQCB 6, in the Lahontan Region, are conducted by U.C.'s Sierra-Nevada Aquatic Resources Laboratory (SNARL), and vary in several significant ways from the methods outlined below (number of replicates, level of taxa identified down to, sampling gear mesh sizes, etc. The SNARL procedures for bioassessment are provided in detail in Appendix G.

The method used throughout most of the state for SWAMP RWQCB biological assessment (California Stream Bioassessment Procedures--Habitat Assessment and Biological Sampling; CDFG 1996a), can be briefly summarized as follows:

Bioassessment Methods (See Appendix V)

9. RWQCB Nonpoint Source (NPS) Pollution Control Program

(From RWQCB website: http://www.swrcb.ca.gov/~rwqcb4/html/programs/regional_programs.html):
"California's Nonpoint Source (NPS) Pollution Control Program has been in effect since 1988; it has recently been updated (December 1999). A key element of the Program is the "Three-Tiered Approach," through which self-determined implementation is favored, but more stringent regulatory authorities are utilized when necessary to achieve implementation.

(The RWQCB) long-term goal for the NPS program is to improve water quality by implementing the management measures identified in the California Management Measures for Polluted Runoff Report (CAMMPR) by 2013.

Major current nonpoint source program priorities in the Los Angeles Region are: oversight of workplans for 319(h) projects, establishment of regional strategies addressing agriculture, marinas, and septic tanks (the latter will be focused on densely populated communities and areas where ground water is a source of drinking water), investigation of loading contributions from agriculture, nurseries, golf course, and horse stables (in aid of TMDL work), and expansion of our public education and outreach. It is anticipated that nonpoint source program implementation will heavily emphasize Tier 1, at least initially."

10. LA County Stormwater Water Quality Monitoring[18]

Urban Storm Water Runoff and Water Quality Impacts

Urban storm water contains pollutants that degrade water quality and adversely impact aquatic habitat. Pollutants found in storm water include suspended solids, heavy metals and a broad suite of organic compounds including pesticides, nutrients, petroleum compounds, pathogen indicators and other by-products of urban activities. Urban storm water has also been shown to alter water quality parameters such as pH, oxygen demand, specific conductance, temperature and turbidity. Finally, urbanization

[17] From: Surface Water Ambient Monitoring Program Section B2, Quality Assurance Management Plan Revision No. n/a, Date: 12/22/02, Page 80 of 144

[18] "Mitigation of Storm Water Impacts from New Development in Environmentally Sensitive Areas, Technical Report, October 2001", LARWQCB
http://www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/la_ms4_tentative/ESApaper.pdf

modifies the hydrologic properties of a site, generally leading to increased volumes of runoff from a given amount of precipitation, and a more rapidly developing runoff peak.

These pollutants and hydromodifications can directly result in negative impacts to biota and degrade ecosystems. Metals, organic compounds and other pollutants can have acute and/or chronic toxic effects to aquatic flora and fauna, and flow modifications can directly degrade the physical conditions of a habitat through erosion and deposition of sediments. A growing body of research links urban storm water runoff to water quality impairments and habitat degradation. Rivers and tributary streams, lakes, wetlands, estuaries and near shore ocean waters are susceptible to storm water impacts.

Adjacent habitats may be indirectly impacted by the degradation of aquatic areas. Fauna in riparian habitats may be negatively impacted by water quality degradation through reduced aquatic food sources, alteration of reproductive environments and habitat alteration that fosters proliferation of non-native species.

Table 9 Regional Non Point Source Problems by Management Measure Category

	Pollutants impairing or threatening Beneficial Uses arranged by Management Measure Category					
Watershed	Agriculture	Silviculture	Urban	Marinas & Recreational Boating	Hydromodifi-cation	Wetlands & Vegetated Treatment Systems
Santa Monica Bay WMA	coliform		coliform	coliform	exotic vegetation	reduced tidal flushing
	nitrogen		nitrogen PCBs sediment toxicity benthic comm. effects toxicity PAHs arsenic mercury other metals hist. pesticides trash fish consumption advisory debris salts	metals PCBs sediment toxicity benthic comm. effects toxicity PAHs TBT	habitat alteration hydromodification reduced tidal flushing	exotic vegetation

11. NPDES Permittees in Santa Monica Bay WMA

Of the major NPDES dischargers in the Santa Monica Bay WMA, the three POTWs (particularly the two direct ocean discharges) are the largest point sources of pollutants to Santa Monica Bay. Pollutants from the minor discharges have been estimated to contribute less than two percent of the total pollutants being discharged to the Bay.

Permitted discharges

- 191 NPDES discharges including: seven major NPDES permit discharges, three POTWs (two direct ocean discharges), one refinery, and three generating stations; 23 are minor discharges
- 161 dischargers covered under general permits
- 103 dischargers covered by an industrial storm waterpermit
- 113 dischargers covered by a construction stormwater permit”

Core Regulatory – Region 4 General Permits

There are many dischargers in this Region covered by general permits for discharges to surface water through a letter issued by the Executive Officer. This activity occurs as often outside as within the watershed cycle. 40 CFR §122.28 provides for issuance of general permits to regulate a category of point sources if the sources:

1. Involve the same or substantially similar types of operations;
2. Discharge the same type of waste;
3. Require the same type of effluent limitations or operating conditions;
4. Require similar monitoring; and
5. Are more appropriately regulated under a general permit rather than individual permits.

General permits currently in effect include:

1. NPDES Permit No. CAG914001 – for discharges of volatile organic compound contaminated groundwater to surface waters (threat/complexity rating 2B)
2. NPDES Permit No. CAG994002 – for discharges of treated groundwater from construction and project dewatering to surface waters (threat/complexity rating 3B)
3. NPDES Permit No. CAG994001 – for groundwater discharges from construction and project dewatering to surface waters (threat/complexity rating 3C)
4. NPDES Permit No. CAG674001 – for discharges of hydrostatic test water to surface waters (threat/complexity rating 3C)
5. NPDES Permit No. CAG834001 – for treated groundwater and other wastewaters from investigation and/or cleanup of petroleum fuel pollution to surface waters (threat/complexity rating 2B)
6. NPDES Permit No. CAG994003 – for discharges of nonprocess wastewaters not requiring treatment systems to surface waters (threat/complexity rating 3C)

Core Regulatory – Storm Water

Monitoring has indicated that mass emissions of pollutants to the ocean are significant from the urban watersheds such as the Los Angeles River, Ballona Creek, and Coyote Creek. Studies have found chemical concentrations of pollutants that exceed state and federal water quality criteria in storm drains flowing to the ocean and that beach water quality standards for bacteria indicators (Assembly Bill 411) are often exceeded. The presence of these high levels of bacteria indicates the existence of other pathogenic microorganisms that pose a health risk to humans. A 1996 epidemiological study, conducted by USC under the direction of the Santa Monica Bay Restoration Project, confirmed that swimming in water with significant concentrations of bacteria indicators increases the potential for contracting illnesses, such as stomach flu, ear infection, upper respiratory infection or major skin rash.

Storm water activities include those involving the three municipal permits in the Region, facilities regulated under the State's general industrial permit, and construction sites regulated under the State's general construction permit.

Municipal permits

Municipal storm water regulations at 40CFR 122.26 require that pollutants in storm water discharges be reduced to the maximum extent practicable (MEP). The definition of MEP has generally been applied to mean implementation of controls to reduce the discharge of pollutants to the maximum extent practicable using appropriate management practices, control techniques and system, design and engineering methods. Municipalities are required to implement or require the implementation of the most effective combination of BMPs for storm water/urban runoff pollution control. Municipal permits currently in effect include:

1. NPDES Permit No. CAS004003 – adopted in 1999 this is the permit for municipal storm water and urban runoff discharges within the city of Long Beach

2. NPDES Permit No. CAS004002 – adopted in 2000 this is the permit for municipal storm water and urban runoff discharges within the Ventura County Flood Control District, County of Ventura, and cities of Ventura County
3. NPDES Permit No. CAS004001 – revised in 2001 this is the permit for municipal storm water and urban runoff discharges within the county of Los Angeles

Standard Urban Storm Water Mitigation Plans (SUSMPs)

An important part of the municipal permits (Los Angeles County and City of Long Beach) are the Standard Urban Storm Water Mitigation Plans (SUSMPs) and numerical design standards for Best Management Practices (BMPs) which were adopted on March 8, 2000 and implemented by municipalities beginning in February 2001. The SUSMPs are designed to ensure that storm water pollution is addressed in one of the most effective ways possible, i.e., by incorporating BMPs in the design phase of new development and redevelopment. It provides for numerical design standards to ensure that storm water runoff is managed for water quality and quantity concerns. The purpose of the SUSMP requirements is to minimize, to the maximum extent practicable, the discharge of pollutants of concern from new development and redevelopment. The numerical design standard is that post-construction treatment BMPs be designed to mitigate (infiltrate or treat) storm water runoff from the first ¾ inch of rainfall, prior to its discharge to a storm water conveyance system. Other standards also apply; additional information on the SUSMP may be found on the Regional Board Storm Water website at:
http://www.swrcb.ca.gov/rwqcb4/html/news/susmp/susmp_details.html

Industrial permit

The 1987 amendments to the Clean Water Act established a framework for regulating municipal and industrial storm water discharges under the NPDES Program. In 1990, the USEPA published final regulations that established application requirements for storm water permits. The regulations require that storm water associated with industrial activity that discharge either directly to surface waters or indirectly through municipal storm drains must be regulated by an NPDES permit. State Board adopted the Industrial Activities Storm Water General Permit in 1997. The permit requires facility operators to

1. Eliminate unauthorized non-storm water discharges,
2. Develop and implement a Storm Water Pollution Prevention Plan (SWPPP), and
3. Perform monitoring of storm water discharges and authorized non-storm water discharges.

Facilities that discharge storm water associated with industrial activity requiring a General Permit are listed by category in the Code of Federal Regulations. These categories include manufacturing, mining/oil, recycling, steam electric generating, and light industry, among others. There are approximately 2,600 facilities in this Region covered by the general industrial permit. Most of these sites are in the Los Angeles River Watershed with the San Gabriel River Watershed and the Domiguez Channel and LA/LB Harbor WMA also containing a considerable number.

Five to ten additional PYs would be needed to fully address all aspects of industrial storm water permitting including compliance inspections of all facilities once every five years, review of SWPPPs, and followup work.

Construction permit

In 1990, USEPA published final regulations that establish storm water permit application requirements for specified categories of industries. The regulations provide that discharges of storm water to waters of the United States from construction projects that encompass five or more acres of soil disturbance are effectively prohibited unless the discharge is in compliance with an NPDES permit. State Board adopted a general permit for storm water discharges associated with construction activity in 1999 (State Board order No. 99-08-DWQ). It contains narrative effluent limitations and requirements to implement appropriate Best Management Practices (BMPs) which emphasize source controls. Elimination or reduction of non-storm water discharges is a major goal of the general permit. It prohibits the discharge of materials other than

storm water and authorized non-storm water discharges. It also requires development of a Storm Water Pollution Prevention Plan (SWPPP) and monitoring program. There is a total of 948 sites covered under the construction storm water permit as of November 2000. The majority of sites are in Ventura and western Los Angeles Counties with 310 in the Santa Clara River Watershed and 100 in the Calleguas Creek Watershed. There are a total of 307 residential sites of 10 acres or more in the Region compared to 112 sites of less than 10 acres. There are a total of 142 commercial sites of 10 acres or more while there are 104 sites of less than 10 acres. The Construction General Permit was modified in 2001 by State Board Resolution No. 2001-046. The modifications require that a sampling and analysis strategy and sampling schedule for discharges from construction activity be developed and included in projects' Storm Water Pollution Prevention Plans. More information about the sampling requirement can be found in the Construction Storm Water Sampling and Analysis Guidance Document, developed by the California Stormwater Quality Task Force. This document can be downloaded from the Regional Board Storm Water website at: http://www.swrcb.ca.gov/rwqcb4/html/programs/Stormwater/stormwater.html.

RWQCB "SWIM" NPDES Information Management:[19]

The State Water Information Management system (SWIM) is an organizational-wide database that was designed to facilitate electronic reporting, tracking, and analysis of regional data and information. The two modules that have been developed so far have incorporated the core structure of the Waste Discharger System (WDS) and information for the Underground Investigations (UGI). The modular structure of the database allows inclusion of new programs without redesigning the data model. WDS has now been shut down and converted statewide to SWIM. We continue to develop and pilot new models and tools. Currently under development is a query by address tool, expanded ad-hoc query tool, and environmental data entry and retrieval tools. The new database is Windows-based and uses pull-down menus to ensure consistency of data.

SWIM now tracks information on permits, both NPDES and non-NPDES. This module expands the old database in several ways. We can now record the permit limits and can perform compliance checking of electronic data against these limits. Data submitted electronically are also available for evaluation by region or watershed or through a number of other filters. Data is also available for historic permits. Previously only data from the current fiscal year was online.

The Underground Investigations (UGI) module is a replacement for Region 4's Well Investigation Program (WIP) database. This module tracks the progress of WIP facilities, and provides reports to USEPA. This module could be expanded to track the progress of facilities in other programs such as Above Ground Tanks, Department of Defense, or Spills, Leaks, Investigation, and Cleanup should the need arise. This module could also be expanded to evaluate groundwater treatment methods, to track contaminants spatially, and to tie into Region 4's geographic information system (GIS).

This past year we took the first steps to move our GIS from a limited "special project" oriented tool to a region- and program-wide standard tool. These steps include making Arcview available to all staff, having all coverages converted to standard projection and "served" from a central location, and developing custom interfaces for the UGT, WIP, and TMDL programs. Over time, we expect to expand the capabilities of the system, by 1) adding new components to the system, 2) linking the data to geographic layers, 3) linking our system with others such as USEPA and 4) providing access by the public to certain information.

III.SAMO (National Park Service)Water Quality Monitoring:

National Park Service staff and interns sample water quality in 35 stream reaches each year in the Spring.[20]

---

[19] http://www.swrcb.ca.gov/~rwqcb4/html/programs/regional_programs.html

[20] from SAMO (NPS) document: "2001 Santa Monica Mountains Stream Assessments Field Sampling Procedures; Physical/Habitat and Biological Assessment, Non-Point Source Sampling Design":

"Stream assessment consists of two parts: biological assessment (amphibians and invertebrates) and physical/habitat assessment (water quality and stream structure). The stream is assessed for 500 meters.

Table 10 Stream Codes

Name	Code	Name	Code
Arroyo Sequit (Lower)	ASLW	Malibu Canyon (Lower)	MLBU
Arroyo Sequit (Upper)	ASUP	Medea Creek (N)	MDAN
Big Sycamore Canyon	BSYC	Medea Creek (S)	MDAS
Carlisle Canyon	CRLS	Newton Canyon	NEWT
Cheeseboro Canyon	CHSE	Old Topanga Canyon	OTOP
Cold Creek	CCRK	Palo Comado Canyon	PCOM
Cold Creek (Lower)	CCLW	Ramirez Canyon	RMRZ
Cold Creek (Upper)	CCUP	Rustic Canyon	RSTC
Corral Canyon	CRRL	Serrano Canyon	SRNO
Deer Creek	DEER	Solstice Canyon	SLST
Greenleaf Canyon	GRNL	Sullivan Canyon	SLVN
La Jolla Canyon	LJOL	Temescal Canyon	TMSC
Lang Ranch (N)	LNGN	Topanga Canyon	TOPA
Lang Ranch (S)	LNGS	Trancas Canyon	TRNC
Las Virgenes (N)	LVRN	Triunfo Canyon	TRNF
Las Virgenes (S)	LVRS	Wood Canyon	WOOD
Liberty Canyon (S)	LBRT	Zuma Canyon	ZUMA
Lindero Canyon	LNDR		

Chemical Quality Sampling Measures the following parameters:

1. pH
2. Total Dissolved Solids – TDS (Conductivity)
3. Dissolved Oxygen (allow 15 minutes for calibration of instrument)
4. Nitrogen
5. Phosphates
6. Salinity
7. Turbidity
8. Air Temperature
9. Water Temperature

Methods: (see Appendix VI)

"The ongoing inventory and monitoring of stream conditions at SAMO has already had fairly dramatic results. It is very obvious that streams that go through urban areas are very different than those that are in natural areas. The water quantity is much higher in urban areas, the habitat characteristics and structure of urban streams vary, and the presence of exotics is much greater. This year, the very low rainfall has resulted in reduced or no flow in many mountain streams. However, streams in urban areas are still flowing—some as much as ever—dramatically illustrating the amount of water input from urban land uses. These results are being investigated in greater detail through ongoing monitoring and the information has already been disseminated to the media and other sources. Local environmental groups and other agencies are looking to the NPS for reliable and scientifically credible information on how streams are altered when developments occur within specific watersheds."[21]

[21] "Administrative Report (FY 2002) and Workplan (FY 2003) for Biological Inventories and Vital Signs Monitoring, NPS Mediterranean Coast Network, October 25, 2002"

A. 1999-2001 RCDSMM Topanga Watershed Water Quality Study

A water quality study was conducted in the Topanga watershed from July 1999 to June 2001, funded by a grant from the State Water Resources Control Board. Five sites were sampled weekly and ten sites monthly. A grant from the CA Coastal Conservancy provided funding to continue monthly sampling at Topanga Lower Bridge and Topanga Lagoon until January 2002. These efforts sought answers to these questions:

What is the relationship of upper watershed inputs to poor water quality at Topanga Beach?

What, if any, are the relationships between water quality and the following variables: septic systems, sensitive species distributions, and implementation of Best Management Practices and land use?

1. Parameters sampled

flow	conductivity	Metals: Cadmium
pH	turbidity	Chromium
water T, 'C, top	chlorine	Copper
total sus. solids	NH3	Nickel
total coliform	NO2	Lead
total fecal coliform	PO4	Zinc
algae %	E.coli	
algae type	DO	
air T, oC	water depth, cm	
sample depth	salinity	

2. Findings

- Fecal coliform and e.coli exceeded the standards in some upper sub-watersheds. Site 14, Entrado Road culvert was especially problematic, with exceedances during wet and dry weather.
- Nitrate as nitrogen counts were relatively high at the same sites that had bacteria problems.
- Phosphate was detectable at low levels at the same sites that had problems with bacteria and nitrate.
- Ammonia was consistently detected at one site in Old Topanga Canyon.
- One site (Highvale Rd. culvert) had consistent problems with low Dissolved Oxygen. Four other sites had seasonally low readings, associated with slow flow in shallow pools.
- Entrado Rd. also had consistently higher readings of Total Suspended Solids.
- Three samplings for metals were conducted, none resulting in exceedance of standards.

3. Conclusions

- Steep topography and housing proximity to drainages probably allow for insufficient residency and uptake of treated water during wet weather.
- The inputs of bacteria and nutrients from the upper watershed were undetectable at Site 6, two miles inland from the beach. At the same time, high fecal bacteria counts were detected at Topanga Lagoon. This suggested that the fecal bacteria inputs were originating between Site 6 and the beach. In this lagoon floodplain area, 49 homes and 11 businesses existed. All properties are/were using septic systems. The new landowner, CA State Parks, has recently removed some of these homes. In addition, stormwater runoff from Pacific Coast

Highway, Topanga Beach parking lot, and Topanga Canyon Blvd drains directly to the creek and lagoon.

B. RCDSMM Water Quality Study in Topanga Watershed (2004)

The RCDSMM has obtained funding from NOAA for an additional water quality study (begun in Fall '03). Weekly sampling is conducted at the Entrado Rd. site (upper watershed), lower TC Blvd. Bridge (lower watershed) and Lagoon. Monthly sampling occurs at the ten monthly sites from the first study. PCR human bacteria and virus sampling will occur five times. The study is directed toward answering questions formed during the first study. One of these is:

What ratio of fecal coliform/*E. coli* is derived from wildlife, horses, birds or humans?

Recent technology has made it possible to use DNA sampling to determine which groups of animals are contributing to these inputs. This would be helpful in isolating human-caused impairments and working on solutions. This study allows for periodic DNA testing of bacteria in water quality samples, in hopes of answering this question.

C. Malibu Watershed Monitoring Programs

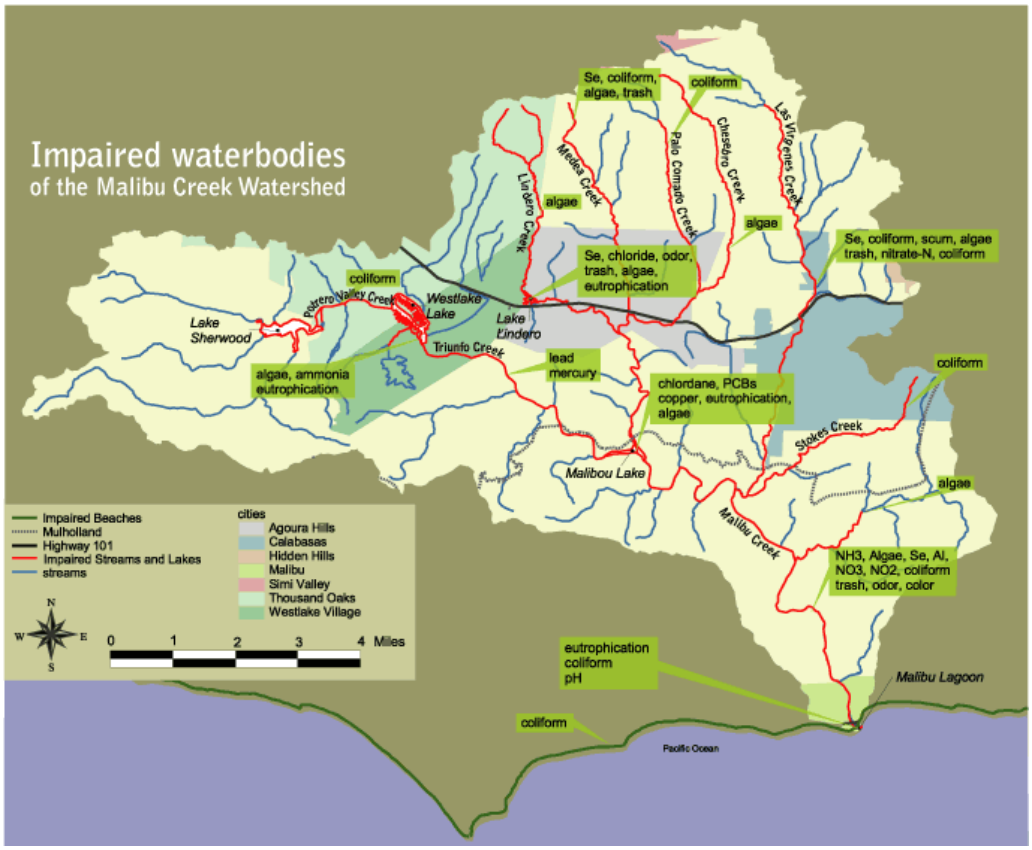

Figure 11 Impaired water bodies from the Malibu Creek Watershed[22]

[22] http://malibuwatershed.org

1. Malibu Creek Watershed (Water Quality Issues)[23]

The most recent Water Quality Assessment Report finds water quality in some streams within the Malibu Creek Watershed is impaired by nutrients and their effects, coliform and their effects, trash, and, in some instances, metals. While natural sources contribute, nonpoint source pollution from human activities is strongly implicated including ill-placed or malfunctioning septic systems and runoff from horse corrals. Nutrient inputs are also contributed by urban runoff and the POTW, which discharges tertiary-treated effluent into the Creek about five miles upstream of Malibu Lagoon.

A nutrient TMDL for the mainstem of the Creek is in progress although ecologically relevant nutrient objectives are lacking. A study recently completed by UCLA provided recommendations, which should lead to more effective management of the Lagoon and its resources as the restoration process continues.

Historically, the Lagoon was much larger than its current day size. Although the flow dynamics of the Creek as well as the ocean's influence on the Lagoon in the past can only be extrapolated, it is likely Creek flow was much less than today during the dry season, partially due to increased imported water demands upstream. Marine influence may have dominated, keeping the lagoon entrance open much of the year as occurs in the larger Mugu Lagoon to the north. An open Lagoon would have facilitated migration of the now endangered steelhead trout. And though continual Creek flow was likely less, more of the watershed was available for the trout's use, at least prior to the construction of Rindge Dam in the 1920's. Most important, during the dry season there would be access to deep shaded pools in many parts of the watershed where the fish could mature until rain created the flows needed to reach the ocean.

Today, the flow regime is quite different and now a major issue of concern. Both increased urban runoff from the more developed upper watershed and discharges from the POTW have increased baseline flows. However, recently the POTW which discharges to Malibu Creek came under a discharge prohibition starting each April 15 through November 15 of each year, except during times of plant upset, storm events, or the existence of minimal streamflow conditions that require flow augmentation in Malibu Creek to sustain endangered species. In the long run, this discharge prohibition may have many other implications on water quality and quantity in the Creek and Lagoon.

The lagoon size is much reduced from historic times and it currently remains closed much of the year except for during the winter when ocean influences breach the sandbar and Creek flows help maintain the opening. This had led to decreasing salinity or, at times, greatly fluctuating salinity, which has disturbed efforts to restore the Lagoon. This also leads to elevated groundwater levels adjacent to the lagoon, assuring failure of septic systems in the area. Additionally, surfing and swimming is popular off the beaches in the immediate area and there is considerable concern over contaminated Lagoon water reaching these people."[24]

2. Malibu Lagoon (Water Quality Issues)

"Malibu Lagoon is a coastal wetland located on the northern end of Santa Monica Bay. Total acreage of estuarine open water, tidal channels and wetlands is estimated to be 29 acres. Owned by the California Department of Parks and Recreation, the lagoon is operated as a state park for wildlife habitat and passive recreation. Like most coastal wetlands, the lagoon provides habitat for several threatened or endangered bird species, as well as spawning and nursery ground habitat for marine and estuarine vertebrate and invertebrate species. Freshwater flow into the lagoon is dominated by Malibu Creek and

---

[23] LA RWQCB Regional Programs – Santa Monica Bay Watershed Management Area. Pg. 4. RWQCB. 16 Feb.2004.
<http://www.swrcb.ca.gov/~rwqcb4/html/programs/regional_program/wmi/SANTA%20MONICA%20BAY%20WMA.pdf>

[24] Sediment Chemistry, Toxicity, and Benthic Community Conditions in Selected Water Bodies of the Los Angeles Region. August 1998. pg.12. SWRCB. Division of Water Quality. BPTCP.
< http://www.swrcb.ca.gov/bptcp/docs/reg4report.pdf >

treated wastewater discharges. Malibu Creek is considered to be the southernmost range of the endangered steelhead trout. The watershed area is approximately 109 square miles (CERES, 1998). In addition to Malibu Creek, inputs include runoff from residential development of Malibu Colony, a golf course, the Pacific Coast Highway, and commercial developments to the north. Malibu Lagoon has been put on the U.S. EPA 303(d) list of impaired water bodies by the LARWQCB due to bioaccumulation of chemicals in shellfish tissue, degraded benthic community, elevated coliforms, and excessive fresh water.

3. Malibu TMDL

The Malibu Creek watershed is impaired for nutrients and coliform bacteria. As required by Section 303(d) of the Clean Water Act, the Los Angeles Regional Water Quality Control Board (LARWQCB) is required to develop a Total Maximum Daily Load (TMDL) to restore water quality to a level that protects the beneficial uses that have been designated for the affected waterbodies.

An important component of the TMDL is establishing water quality indicators and target values that can be used to evaluate attainment of water quality standards in the impaired waterbodies. The RWQCB has selected stream numeric targets for nutrients of 2.5 mg/l NO3-N and 0.4 mg/l PO4-P. The lagoon and lake numeric targets are 0.027 mg/l P and 0.4 mg/l N. The coliform as listed below:[25]

Freshwaters designated for water contact recreation (REC1) are:
Geometric mean objectives E. Coli ≤ 126 organisms/100 mL Fecal coliform ≤ 200 organisms/100 mL Single sample objectives E. Coli ≤ 235 organisms/100 mL Fecal coliform ≤ 400 organisms/10

Water Quality – Implementation Actions: Grade D

Only limited progress has been achieved in the implementation of “on-the-ground” actions. While some measure of progress has been made to eliminate a few known sources of pathogens and nutrients, reduce sedimentation and trash, and implement confined animal BMPs, these problems are still major concerns in the watershed. Pollutants are still making their way to the creek, lagoon and surf zone, causing poor water quality conditions and creating an unhealthy environment for both humans and aquatic life. And, local storm water enforcement programs designed to control or prevent these types of pollutants from impacting local water bodies have not been aggressively implemented.

[25] Making Progress: Restoration of the Malibu Creek Watershed, Executive Summary. 26 Jan.2001. SMBRP/MCWEAC. 2 Feb.2004

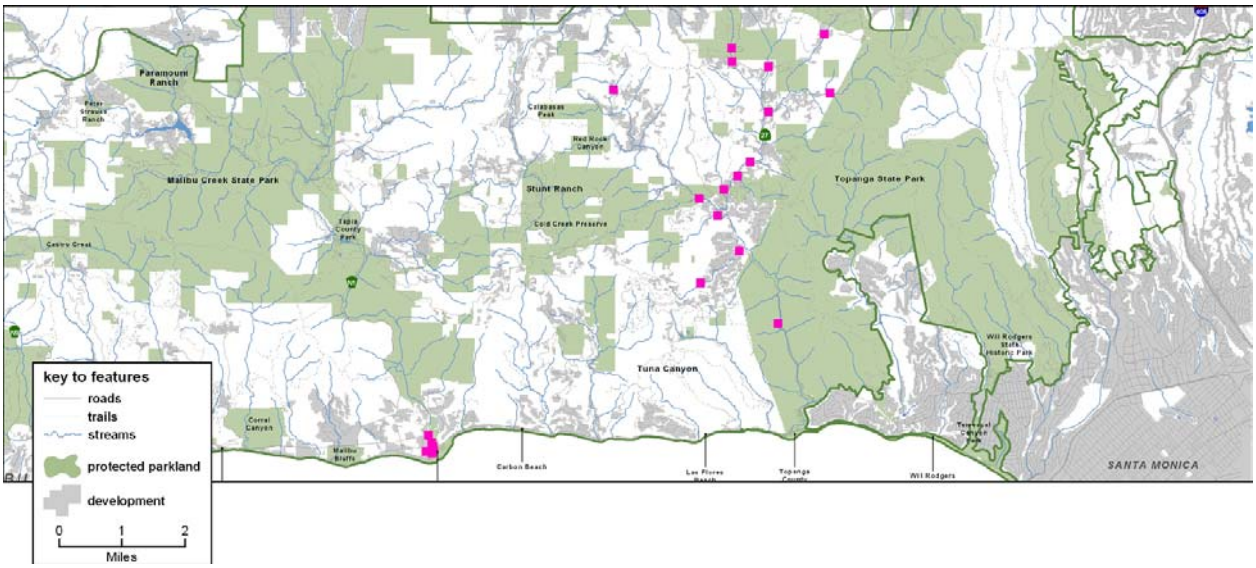

Figure 12 Impaired water bodies from the Topanga Creek Watershed including Malibu Lagoon

D. LA RWQCB Regional Programs[26]

Malibu Creek Watershed Executive Advisory Council (with subcommittees) A number of stakeholders began meeting in the late 1980's/early 1990's in the Malibu area. Through their efforts, a list of priority issues that need to be resolved was formulated. This lead to the development of a Natural Resources Plan for the watershed which was prepared by the US Natural Resources Conservation Service. Separate task forces and subcommittees were formed under the Advisory Council, which serves as the main stakeholder forum. The Malibu Creek Watershed Executive Advisory Council consists of members from State and local agencies and organizations, environmental groups, business and dischargers, special districts and the general public. Their mission is to oversee and implement actions that will protect, enhance and restore habitats of the watershed, as well as improve water quality. The Malibu Lagoon Task Force has been quite active in oversight of the UCLA report, Lagoon Resource Enhancement and Management Study, and in prioritization of its recommendations for BMPs and wetlands restoration Also currently active are several subcommittees, including the Habitat and Species Task Force, the Water Quality and Monitoring Task Force and the Education Subcommittee. Advisory Council meetings occur every other month while subcommittees may meet intermittently or regularly.
Malibu Watershed-Wide Monitoring Program

Malibu Surfrider Beach consistently has the poorest water quality of beaches in the Santa Monica Mountains. Thus, its watershed is also the most studied and regularly monitored and serves as an example of a complex impairment, involving numerous stakeholders within the inland headwater cities and at the coast. Because of this complexity and multi-city, multi-agency involvement, the Malibu Creek Watershed Advisory Committee (MCWAC) was formed to collectively work toward resolving Malibu's water quality problems. The Malibu Watershed Committee succeeded in obtaining grant funding for the Malibu Watershed-Wide Monitoring Program (MWWMP). This program is currently funded, yet has not yet been implemented (as of 6/03). The City of Calabasas, the lead agency, will hire a Watershed Monitoring Coordinator, who will oversee the program with the aid of a hydrologist and geomorphologist.

[26] Santa Monica Bay Watershed Management Area. RWQCB. 16 Feb.2004. <http://www.swrcb.ca.gov/~rwqcb4/html/programs/regional_program/wmi/SANTA%20MONICA%20BAY%20WMA.pdf>

1. Malibu Watershed-wide Monitoring Program Scope of Work

Timeline: 2003-2005

Water quality data in the Malibu Creek Watershed, especially upper watershed, is incomplete and uncoordinated. The cities of Calabasas, Agoura Hills, Westlake Village, and Malibu, along with Los Angeles County (collectively called the Watershed Management Committee, "WMC") and the Las Virgenes Municipal Water District (LVMWD) seek to implement a monitoring program based on the 1999 draft Malibu Creek Watershed Monitoring Program (Monitoring Program). The draft Monitoring Program was assembled by members from the Los Angeles Regional Water Quality Control Board (RWQCB), State Department of Parks and Recreation, City of Calabasas, Las Virgenes Municipal Water District, Heal the Bay, City of Malibu, and UCS California Sea Grant staff. The final Monitoring Program will incorporate recommendations from stakeholder groups, coordinate with the RWQCB to address TMDL data needs, and assessments from previously gathered data. Such a broad approach will provide conclusive data, eliminate redundancies, and provides cohesiveness to make the best use of limited funds.

To address scrutiny of data gathered, the Monitoring Program will provide quality State Certified, EPA method water chemistry and bioassessment data that accurately reflects conditions of the receiving waters. This program seeks to include tests that have been too expensive for other monitoring programs to conduct but are nonetheless critical to understanding water body conditions and possible causes of impairments. Water quality impairments throughout the watershed, highly impaired corresponding beaches and lagoon, and growing areas of development create the need for monitoring and reduction of nonpoint sources of pollution. The Malibu Creek Watershed is currently listed for over twenty impairments throughout the watershed. The WMC and LVMWD hope to identify problem areas, validate impairments, and assess other environmental/watershed indicators such as fish muscle tissue samples and toxicity testing. A hydrologist and geomorphologist will be on call to identify sources of pollution and opportunities for erosion control, sedimentation projects, and habitat restoration. A Watershed Monitoring Coordinator (Coordinator) will gather information from other agencies to produce a comprehensive and complete assessment of past and current monitoring. Through this process, the Coordinator will develop intimate knowledge of the gaps in data while developing working relationships with other monitoring agencies and available resource agencies.

Throughout the duration of the Monitoring Program, LVMWD will continue to monitor for over 15 parameters at an additional 7 sites via their existing monitoring program. LVMWD's monitoring program will provide a seamless complement to the program, in which the Coordinator will review, analyze, and incorporate their data into the monitoring reports.

The Monitoring Program will also play an integral role in providing critical data needs for refinement of watershed TMDLs. Data collected will reflect baseline conditions for urbanized areas as well as ambient backgrounds. Monitoring is the first step in attaining restoration of beneficial uses and compliance with TMDLs."

The WMC and LVMWD seek to monitor for the following parameters, based upon the watershed's 303(d) listed impairments, as part of the program's baseline assessment:

Table 11 MWWMP Primary Parameters:

Total and Fecal Coliform	Chloride	DDT	algae
Dissolved Oxygen	Orthophosphate	Mercury	scum
Specific Conductivity	Ammonia	Lead	trash
Nitrite	pH	PCBs	foam
Nitrate	Chlorophyll A	sedimentation	odor
Selenium (Fish Muscle Tissue)			

In addition to the 303(d) list of parameters, the following tests may be included to complete the baseline assessment:

Table 12 MWWMP Secondary Parameters:

Bioassessments	Acute and Chronic Toxicity	Zinc	Cadmium
Fish Muscle Tissue	Silver	*Enterococcus*	Temperature
Beryllium	Antimony	Hardness	Chlordane
Nickel	Arsenic	Aluminum	Copper
Chromium	Thallium	Total Nitrogen	

2. MWWMP Hot Spot Testing:

"Hot Spots," determined by reoccurring high levels of pollutants, will be monitored more intensely once first year baseline monitoring has determined these sites. For example, high levels of nutrients in residential areas may give cause to monitor for a range of pesticides. Also, positive hits in fish tissue for specific metals will allow effective monitoring of metals in the water column to trace potential sources. This two-tier setup will ensure that the most expensive tests are not used frivolously.

"Hot Spot" testing may include the following Priority Pollutants and Human Pathogens: Cyanide, Asbestos, TCDD equivalent, metals in the water column (Silver, Beryllium, Antimony, Nickel, Arsenic, Chromium, Thallium, Zinc, Cadmium, Copper, Selenium, Lead, Mercury), EPA method 624 series (25 priority pollutants), EPA method 625 series (54 priority pollutants), and EPA method 608 series (17 priority pollutants including DDT, PCBs and Chlordane)."
Calabasas Landfill (groundwater monitoring)

The Calabasas Landfill lies within the Malibu Creek Watershed. The Malibu Creek Watershed Advisory Committee has named installation of additional monitoring wells for Calabasas Landfill as an Action Plan Item.[27]

"Environmental Controls - The Sanitation Districts employ state-of-the-art environmental control technologies for all landfill operations and meet or exceed the stringent requirements of all federal, state, and local regulatory agencies. Landfill operations are designed to minimize potential nuisances such as noise, odor, litter, dust, vectors, landfill traffic, and overall visual impacts. Only nonhazardous waste is accepted for disposal, and screening programs are in effect at all facilities to ensure the exclusion of hazardous waste. In addition, the Districts have integrated the following programs into the operation of its solid waste facilities: (1) state-of-the-art environmental control and monitoring technologies to prevent the migration of landfill gas and to protect groundwater and surface water quality; (2) extensive recycling efforts; (3) landscaping of all facilities to enhance site aesthetics; and (4) provisions for long-term environmental protection and the beneficial final use of landfill sites after closure. These programs enable the Sanitation Districts to dispose of solid waste in an environmentally safe and cost-effective manner while also addressing all reasonable community concerns."[28]

"On page 68, under "Groundwater Quality," mention is made that several of the groundwater monitoring wells at the Calabasas Landfill site have detected pollution from the landfill. On page 69, last paragraph, the statement is made, "However groundwater immediately downgradient of Barriers 1,2, and 5 has

[27] Malibu Creek Watershed Advisory Committee website. 16 Feb.2004.
< http://www.malibuwatershed.org/2ndLevel/aboutActionPlan.html>

[28] G. Fred Lee, PhD, of G. Fred Lee & Associates, an independent water quality analyst, wrote a critical review of the NPS Environmental Assessment for the Calabasas Landfill (February, 1997). Excerpts from these comments follow: Comments on Calabasas Landfill Special Use Permit Environmental Assessment, G. Fred Lee, PhD, DEE. G. Fred Lee & Associates. 3 August 1997. 16 Feb.2004. <www.gfredlee.com/calabasas.html>

shown effects from the landfill." These issues should have been more fully discussed so that the readers of the EA can understand the situation for the existing groundwater pollution."

"Page 119, under "Groundwater Quality," states, "...low levels of volatile organic compounds have been detected in downgradient monitoring wells at three subsurface barriers." This is of concern since it means that the subsurface barriers are not, as expected, effective in preventing downgradient pollution."

Overall Assessment

"From an overall perspective, from the sections of the Environmental Assessment that are reviewable based on the information available, it can be concluded that the Environmental Assessment for the proposed continued operation of the Calabasas Landfill presents a highly superficial discussion of environmental impact issues pertinent to assessing the potential for the existing as well as proposed continued operation of this landfill to pollute groundwaters of the area. While based on the discussions provided, the groundwater resources of the area appear to be limited, they are still of value and must be protected in accord with State of California regulations."

3. Las Virgenes Municipal Water District[29]

Las Virgenes Municipal Water District (LVMWD) provides potable water, wastewater treatment, recycled water and biosolids composting to more than 65,000 residents in the cities of Agoura Hills, Calabasas, Hidden Hills, Westlake Village, and unincorporated areas of western Los Angeles County.

Tapia Water Reclamation Facility and Rancho Las Virgenes are operated as a joint venture between Las Virgenes Municipal Water District and Triunfo Sanitation District. Separated by the county line, these two agencies share the Malibu Creek watershed.

Table 13 LVMWD Parameters:

PHYSICOCHEMICAL	INFECTIOUS RISK	BIOLOGICAL
pH	Total / Fecal Coliform	Chlorophyll
temp	Enterococcus	Algal cover
DO	Human pathogens	Organic nitrogen
Turbidity		Ortho Phosphate
MBAS		Total Phosphate
		Nitrate
		ammonia
		metals
		Acute toxicity
		Chronic toxicity
EPA priority pollutants		Benthic invert survey

The attached file shows the Malibu Creek data LVMWD staff has collected in the last year (7/02 –7/03). Each creek site shows the analytes and frequency of collection for our current monitoring permit. (see submitted XCEL file: Malibu Creek Monit List for S. Williams 8-03.xls). The attached map shows the location of each creek site. (Las Virgenes monitoring map.pdf):

[29] Las Virgenes Municipal Water District webpage. LVMWD. 16 Feb.2004. <http://www.lvmwd.dst.ca.us/who/Who_2.html>

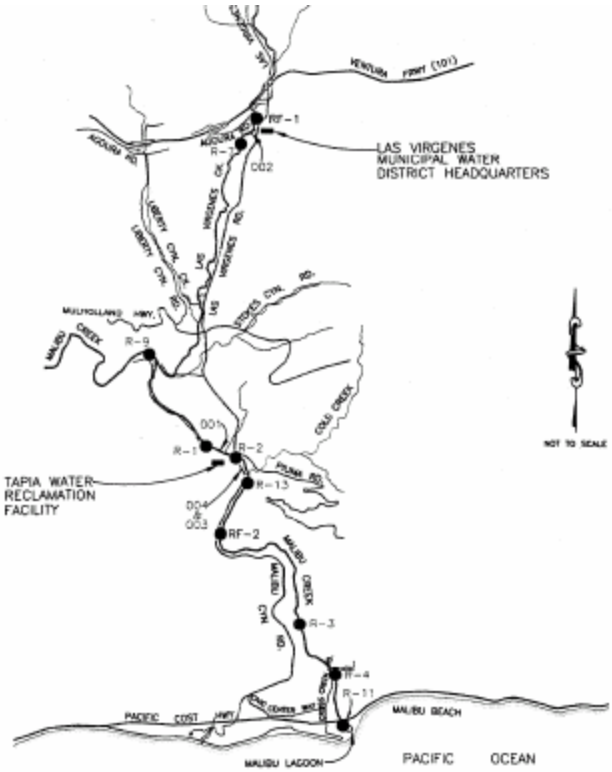

Figure 13 Receiving Water Monitoring and Tapia Effluent Discharge Sites

The number of sites, and monitoring requirements have undergone changes over the years, and are far too detailed to discuss here. The electronic records of monitoring results and observations began in 1991. Written records previous to 1991 are on file at the District Library or the LA Basin RWQCB office." (See submitted RWQCB file: "Malibu_Creek_Raw_Data.xls" for Tapia WWTP data from 7/97 to 12/99)

LVMWD has conducted or participated in many other programs that have collected Malibu Creek water quality data. These programs include:

Receiving water site (R1) testing for the California Toxics Rule constituents each month from July 2001 through December 2002.

Bio-diversity and Pathogen testing Malibu Creek and Lagoon for a study contracted with UCLA Staff in 1999.

Bio-diversity, water quality, metals (fish, crawfish), pathogens for UCLA study in 1996."
Santa Monica Bay Restoration Project Epidemiological Study

An Epidemiological Study of Possible Health Effects of Swimming in Santa Monica Bay, Executive Summary. 7 May 1996. SMBRP. 16 Feb.2004.[30]

A cohort study was conducted to investigate the possible adverse health effects of bathing in Santa Monica Bay and whether the risks of ill health outcomes were associated with urban runoff from storm drains. Exposures of primary interest were pathogens that produced acute illnesses (for reasons discussed in our original proposal, chronic health effects were not studied).

[30] <http://www.santamonicabay.org/uploads/library/texts/EpistudyExecSumm.pdf >

Three beaches with a wide range of indicator counts and high density of bathers were studied. The beaches were Santa Monica Beach (near the Ashland Avenue storm drain), Will Rogers Beach (Santa Monica Canyon Channel or storm drain) and Surfrider Beach (near Malibu Creek).

…In summary, both sets of results (the positive associations between adverse health effects and a) distance from the drain and b) bacterial indicators and presence of enteric viruses) taken together strongly suggest that there is an increased risk of a relatively broad range of symptoms caused by swimming in ocean water at the beach sites included in this study, particularly close to the drains and when indicator densities increase or ratios between selected indicators decrease.[31]

4. Stream Team Volunteer Water Quality Monitoring

"The Stream Team is a citizen monitoring program created to collect high quality useable data to help determine the environmental health of the Malibu Creek Watershed. Heal the Bay trains and certifies volunteers to collect and analyze the water quality at monitoring locations throughout the watershed. More than 5000 Stream Team volunteers have been trained since November of 1998. The data collected by Stream Team volunteers has been instrumental in creating new and more protective water quality standards in the Malibu Creek Watershed."

Table 14 Stream Team Monitoring Parameters

Event ID	Date	Site	Weather
Flow type	Clarity	Color	Odor
Floatable	Bfloatable	AlgaeFLT	AlgaeMT
BF Desc	TrashDen	TrashNote	TrashType
AvgAir C	AvgH2O	AvgPH	Avg DO mg L
Avg Turb NTU	Avg Cond US	Flow CFS	NO3 NO2 N ppm
PO4 ppm	NH3 N ppm	Entero CFU 100 ml	

Frequency: monthly
Duration: 11/98 – present
Stations/Sites: 17 in Malibu watershed + 3 reference sites located outside of watershed (Solstice Creek, Lechuza Creek and Arroyo Sequit).

Heal the Bay's Stream Team originally sampled at 7 sites (see map below), then added 13 in 2001. Sampling at sites 4,6,9,10,11,15,16 and 19 has been discontinued. They now are testing 12 sites (Feb.-04).

HtB Recommendations for Future Water Quality studies in Santa Monica Mountains:

Heal the Bay staff would like to see all Malibu watershed water quality studies scanned into digital form and available to download from a website. Currently, some of these reports are not available in digital format, so accessing this information can be difficult. Perhaps they could be accessed from the Heal the Bay, Santa Monica Bay Restoration Commission or Malibu Creek Watershed Committee website.[32] (pers comm. Mark Abramson 6-25-03)

1. Advocate for Year-Round Postings along the Entire Length of Beach Impacted by Flowing Storm Drains
2. Advocate for increased funding for California's shoreline monitoring program from EPA's BEACH program
3. Advocate for Improved Public Notification of Poor Water Quality at Open-ocean Beaches
4. Ensure best management practices are implemented and promote implementation of tidal circulation improvements at enclosed beaches

[31] Heal the Bay Water Quality Monitoring Heal the Bay home page. 16 Feb.2004. <http://www.healthebay.org/>
[32] HtB's 13th Annual Beach Report Card (2002-2003). Heal the Bay. 16 Feb.2004. <http://www.healthebay.org/brc/annual/2003/accomps_recs.asp>

5. Encourage agencies to monitor water quality at popular beaches year-round (beyond the AB411 required dates of April-October)
6. Advocate for the State to enforce Sanitary Survey Protocols as established in AB 538 and The Ocean Plan
7. Advocate for full funding of the Beach Water Quality Source Identification and Technical Assistance Projects

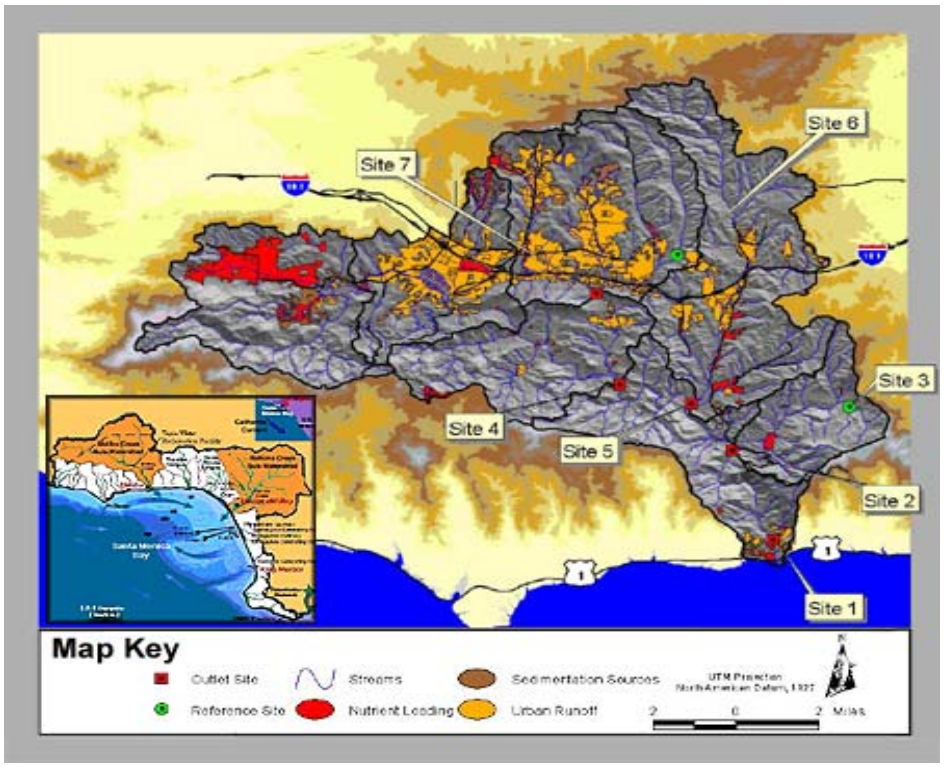

Figure 14 Locations of seven of the HTB monitoring sites

Outlet Sites	Reference Sites
• HtB-1: Malibu Creek • HtB-2: Cold Creek • HtB-4: Malibou Lake • HtB-5: Las Virgenes Creek • HtB-7: Agoura Hills • HtB-11: Cold Creek Middle • HtB-12: Rock Pool above Tapia • HtB-13: Las Virgenes Creek Middle • HtB-15: Tapia R-13 stream gauge • HtB-16: Stokes Creek • HtB-17: Triunfo Creek • HtB-20: Tapia R-11 Malibu Lagoon	• HtB-3: Cold Creek • HtB-6: Agoura Hills • HtB-8: Palo Comado Creek • HtB-9: Las Virgenes Creek • HtB-10: West Carlysle Creek • HtB-14: Solstice Creek • HtB-18: Lachusa Creek • HtB-19: Arroyo Sequit

Heal the Bay Reports:

1. The Malibu Creek Watershed Stream Team Pilot Project: Shattering the Myths of
2. Volunteer Monitoring"(provides Methods)

3. The Malibu Creek Watershed: A Framework for Monitoring, Enhancement, and Action" The Freshwater and Marine Team Field Guide

The "UCLA Malibu Resource Enhancement and Management Study" is available for download from the Heal the Bay website. This study led to the funding of the Malibu Lagoon Habitat Enhancement Plan, which seeks to restore the main lagoon and the southeastern edge at the Adamson property. HtB has currently contracted with Moffatt and Nichol Engineers for this restoration project.
City of Calabasas Monitoring Program

Summary: The City Of Calabasas performs monthly water quality monitoring of three Calabasas creeks
Location: 6 sites on Las Virgenes Creek (Malibu Watershed), 2 on McCoy Creek, 2 on Dry Canyon Creek. The last two are the headwaters to the LA River

Parameters: Copper, Selenium, Zinc, Temperature, Dissolved Oxygen, Biological Oxygen Demand, Nitrate, Phosphate, Ammonia, Total and Fecal Coliform, Enterococcus, pH, trash levels, scum and foam; 10 months of pesticide tests

Duration: Dec.1999-2003
Repository location for WQ data: City of Calabasas
Contact: Robin Hull

IV. Resource Conservation District Water Quality Monitoring Programs

A. Malibu Lagoon Baseline Study – 1989

In 1989, the Topanga-Las Virgenes Resource Conservation District (now RCDSMM) produced a report titled: "Malibu Lagoon: A Baseline Ecological Survey". This report was the result of a one-year ecological study, begun in 1987. One chapter focused on the "Physical and Chemical Parameters of Malibu Lagoon". Samples were collected at the surface and bottom when depths were over 50 cm.

The parameters tested in this study were:

- Salinity
- Temperature
- pH
- Dissolved Oxygen
- Turbidity.

Salinity was found to be generally low for a coastal estuary, attributed in part to the regular treated water releases from the Tapia Treatment Plant. This created an unnatural flow regime, which in turn was thought to affect the ability of native organisms to establish in the lagoon habitat. Temperature, DO and pH varied widely, sometimes within short time spans. CA DPR was routinely breaching the sand berm near the Colony during this time, although sometimes after the lagoon water level had risen 3.5 feet, potentially connecting the lagoon with septic system leach fields in the Colony. Although not part of this study, high coliform bacteria counts from the Tapia WWTP monitoring site near the bridge were noted. It was thought that the releases of treated water and subsequent impoundment in the closed-berm Lagoon, resulted in poor circulation. This, combined with summer temperatures created the potential for rapid bacterial growth within the lagoon..

This study asked many questions about how the Lagoon and its inputs contribute to the bacterial pollution at Surfrider Beach, which led to subsequent and ongoing studies to answer these questions.

RCDSMM Education Program- Student Monitoring @ Malibu Lagoon:

The education department of the RCD has provided naturalist-led environmental education at Malibu Lagoon for students since 1985. Basic water quality monitoring exercises have been integrated into the science curriculum.

Parameters:

LEVEL (IN FEET)	FLOW
ENTRANCE CONDITION	GENERAL pH
OCEAN TEMP ('C)	LAGOON SURFACE TEMP ('C)
LAGOON SURFACE SALINITY	LAGOON SURFACE pH
LAGOON BOTTOM TEMP ('C)	LAGOON BOTTOM SALINITY
LAGOON BOTTOM pH	ENTRANCE SURFACE TEMP ('C)
ENTRANCE SURFACE SALINITY	ENTRANCE SURFACE pH
ENTRANCE BOTTOM TEMP ('C)	ENTRANCE BOTTOM SALINITY
PLANKTON ID (FROM FOOT BRIDGE)	ENTRANCE BOTTOM pH

Duration: 1985-1991, 1994-2003 (data available on cd from RCD)
Frequency: approx. 3x/ wk. Sept-June
Methods: pH Strips (pH 5-10), salinity La Motte kit
Location: mouth of lagoon on beach, west bank by PCH bridge
Contact: Jennifer Shelstead (310 455-1030 xt. 103) email: Jshelstead@rcdsmm.org

1. Calleguas Creek Watershed Monitoring[33]

Watershed description

Calleguas Creek drains an area of approximately 343 square miles, predominantly in southern Ventura County. The Watershed includes Conejo Creek, Arroyo Los Posas Arroyo Conejo, Arroyo Santa Rosa, and Arroyo Simi, along with the Revolon Slough and the Mugu Lagoon. The Santa Susana Mountains, South Mountain, and Oak Ridge form the northern boundary of the watershed; the Simi Hills and Santa Monica Mountains form the southern boundary. Currently, approximately 50 percent of the watershed is open space, 25 percent is in agriculture and the remaining 25 percent is in urban land uses. Land uses vary throughout the watershed. Urban developments are generally restricted to the city limits of Simi Valley, Moorpark, Thousand Oaks, and Camarillo. Although some residential development has occurred along the slopes of the watershed, most upland areas are still open space. Agricultural activities, primarily cultivation of orchard and row crops, are spread out along valleys and on the Oxnard Plain.

Calleguas Watershed Water Quality Issues

Area of Special Biological Significance (ASBS) No. 24

The mouth of Mugu Lagoon and adjacent beaches are within ASBS No. 24. Section 36710 (f) of the Public Resources Code states: “In a state water quality protection area point source waste and thermal discharges shall be prohibited or limited by special conditions. Nonpoint source pollution shall be controlled to the extent practicable.”

[33] Guidelines for the Initiation of the Calleguas Creek Watershed Management Plan. 16 Feb.2004. <http://www.calleguas.com/ccbrochure/reportld.html>

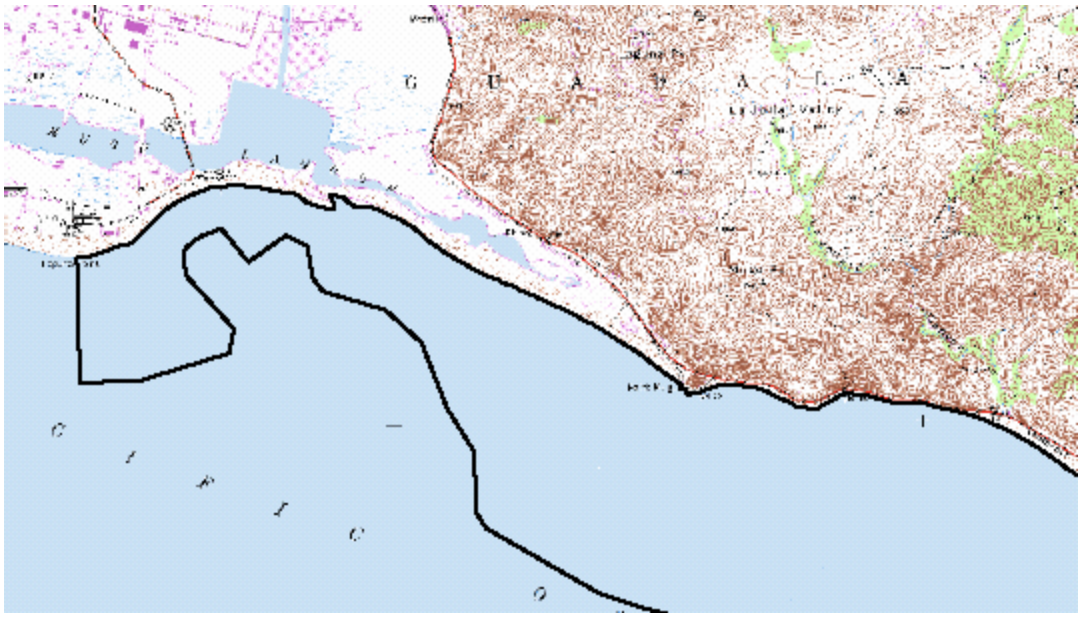

Figure 15 Area of Special Biological Significance No. 24 - Western Section Mugu Lagoon to Latigo Point

2. LARWQCB Regional Toxic Hot Spot Cleanup Plan[34]

"PCBs and several pesticides, including chlordane, dieldrin, endosulfan and DDT, were the chemicals of greatest concern in the (Mugu) Lagoon stations. Of the 33 Lagoon stations where toxicity was assessed, 58% were toxic to amphipods. All 6 of the Lagoon samples assessed (all located within Mugu Lagoon) had a degraded benthic community. Fish collected from one station in Mugu Lagoon had elevated levels of PCBs compared to EPA screening values."

Table 15 Candidate Toxic Hot Spot List:

Water body name	Segment Name	Site Identification	Reason for Listing	Pollutants present at the site	Report reference
Mugu Lagoon/ Calleguas Creek Tidal Prism	Eastern Arm, Main Lagoon, Western Arm/ Tidal Prism	BPTCP 44050.0, 44052.0, 44053.0, 44054.0; 44016.0, 48013.0, 48014.0, 48015.0, 48016.0, 48017.0, 48018.0, SMW 507.8; TSM 403.11.04, 403.12.06	Reproductive impairment; OEHHA level exceeded for Hg; NAS level exceeded for DDT; sediment concentrations + sediment toxicity; degraded benthic community	DDT, PCB, metals, Chlordane, Chlorpyrifos	[4], [5], [6], [7]

[34] Regional Toxic Hot Spot Cleanup Plan. 1999. LARWQCB. 16 Feb.2004. <www.swrcb.ca.gov/bptcb/docsr4cl99_f.doc>

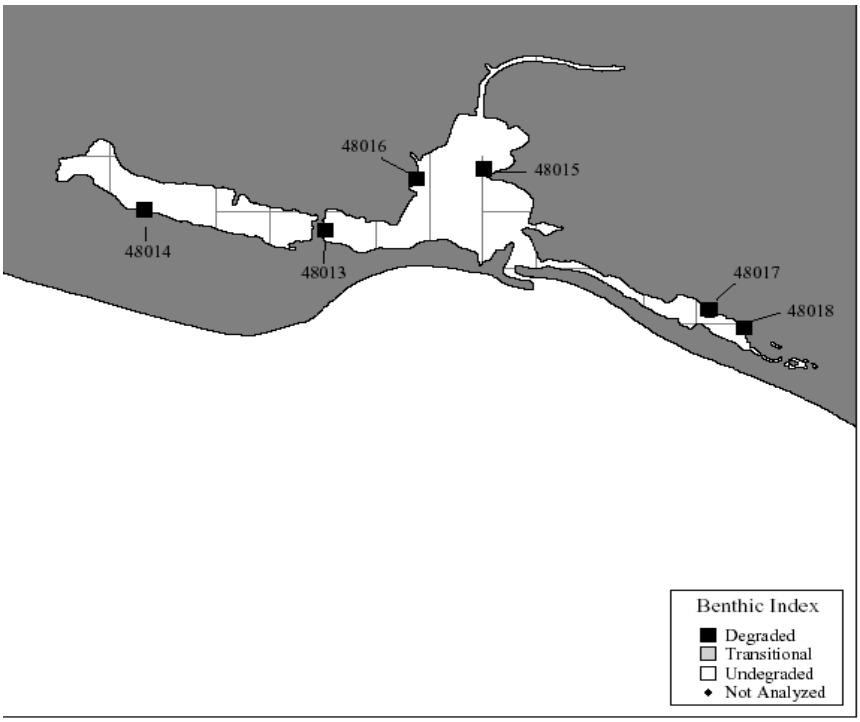

Figure 16 Distribution of Stations in Mugu Lagoon Demonstrating Benthic Community Structure

Table 16 Los Aangels region – water-bodies covered under bay protection and toxic cleanup program.

WATER BODY OR SEGMENT NAME	HYDROLOGIC UNIT	TOTAL AREAL EXTENT
ESTUARIES		
Calleguas Creek Tidal Prism	403.11	10 acres
Mugu Lagoon-East & West Arms	403.11	1500 acres

Mugu Lagoon/Calleguas Creek Tidal Prism:[35]

"Monitoring of Mugu Lagoon and the lower Calleguas Creek watershed has identified the following problems:

- Impaired reproduction in the light-footed clapper rail, a resident endangered species inhabiting the lagoon, due to elevated levels of DDT and PCBs
- Fish and shellfish tissue levels exceeded National Academy of Sciences guidelines for several pesticides
- Possible exceedances of U.S. Environmental Protection Agency water quality criteria for the protection of saltwater biota for nickel, copper and zinc at some locations
- Possible impacts to sediment and water quality, as well as aquatic community health, from operations at the Naval Air Base over many years. Several pesticides whose use has been discontinued still are found at high concentrations in the sediment and biota
- Excessive sediment loading.

The Point Mugu Naval Air Base is located in the immediate vicinity of Mugu Lagoon. The surrounding Oxnard Plain supports a large variety of agricultural crops. These fields drain into ditches which either

[35] Regional Toxic Hot Spot Cleanup Plan. February 1999. LARWQCB. 16 Feb.2004. <www.swrcb.ca.gov/bptcb/docsr4cl99_f.doc>

enter the lagoon directly or through Calleguas Creek and its tributaries. The lagoon borders on an Area of Special Biological Significance (ASBS) and supports a great diversity of wildlife, including several endangered birds and one endangered plant species. Except for the military base, the Oxnard Plain portion of the watershed is relatively undeveloped.

Calleguas Creek and its major tributaries (Revolon Slough, Conejo Creek, Arroyo Conejo, Arroyo Santa Rosa and Arroyo Simi) drain an area of 343 square miles in southern Ventura County and a small portion of western Los Angeles County. This watershed is about 30 miles long and 14 miles wide.

The Calleguas Creek watershed exhibits some of the most active and severe erosion rates in the country. Although erosion rates are naturally high in this tectonically active area, land use also is a factor in erosion and sedimentation problems. Channelization of Calleguas Creek was initiated by local farmers in Somis and downstream areas beginning about 1884, and around Revolon Slough in 1924. Following complete channelization, eroded sediment generated in the higher reaches of the Calleguas Creek watershed has begun to reach Mugu Lagoon even during minor flood events. At current rates of erosion, it is estimated that the lagoon habitat could be filled with sediment within 50 years.

Urban developments generally are restricted to the city limits of Simi Valley, Moorpark, Thousand Oaks and Camarillo. Although some residential development has occurred along the slopes of the watershed, most upland areas still are open space. Agricultural activities (primarily cultivation of orchard and row crops) are spread out along valleys and on the Oxnard Plain. The U.S. Navy maintains a Naval Air Base on much of the area around Mugu Lagoon.

The main surface water system drains from the mountains and toward the southwest, where it flows through the flat, expansive Oxnard Plain before emptying into the Pacific Ocean through Mugu Lagoon. Mugu Lagoon, situated at the mouth of the Calleguas Creek system, is one of the few remaining salt marshes in southern California along the Pacific Flyway. Threatened and endangered species that are supported by valuable habitats in Mugu Lagoon include the peregrine falcon, least tern, light-footed clapper rail and brown pelican. In addition to providing one of the last remaining habitats on the mainland for harbor seals to pup, Mugu Lagoon is a nursery ground for many marine fish and mammals.

The Eastern Arm of Mugu Lagoon is somewhat removed from the rest of the lagoon and tends to receive water from and drain directly into the lagoon mouth. The arm empties and fills rather quickly, leaving a considerable amount of sand near its western end, but moving towards finer sediments further east. The water tends to be marine in character the majority of the time.

The Main Lagoon and Western Arm are the areas most heavily used by birds (including endangered species). The Western Arm, with its slight gradient and slow water flow, has the most widespread freshwater influence during dry weather, receiving water from several drains. The Main Lagoon is affected primarily by Calleguas Creek, which may carry a considerable amount of fresh water during storms, although this flow generally is funneled into a channel which leads to the lagoon mouth.

Areal Extent of Toxic Hot Spot

Sediment contamination clearly exists throughout Mugu Lagoon and within the Calleguas Creek Tidal Prism (Figure 10). Problems appear to be worst in the Western Arm of Mugu Lagoon, particularly near the Rio de Santa Clara, which drains neighboring agricultural lands, and parts of the Eastern Arm. Although sediment contamination problems occur in the Main Lagoon, it appears that the large volume of this waterbody and good flushing is helping to keep contamination and associated effects at a lower level than might otherwise be expected. It is estimated that approximately 20% of the Western Arm and approximately 10% of the Eastern Arm of Mugu Lagoon contain contaminated sediments. The total volume of contaminated sediments is estimated to be approximately 725,000 cubic yards (based on approximately 150 acres with 3-foot depth of contamination).

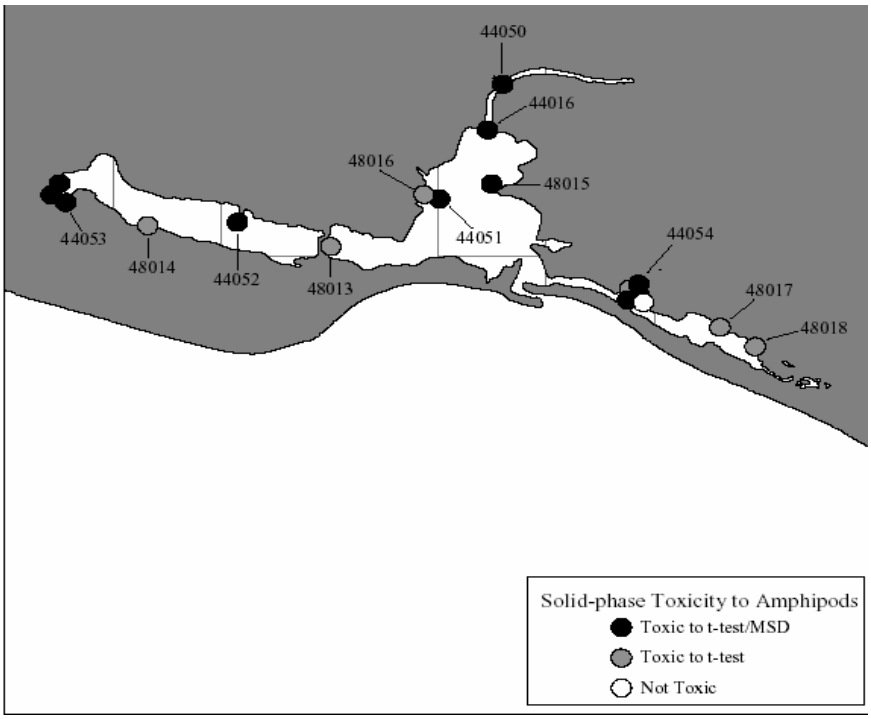

Figure 17 Toxicity of Sediment Samples in Mugu Lagoon

Twenty-two miles of Calleguas Creek are listed as impaired due to high sediment concentrations of pesticides and accumulation in fish and shellfish. However, the area with the greatest contamination problem is estimated to cover approximately 3 miles. The total volume of contaminated sediments is estimated to be approximately 50,000 to 100,000 cubic yards.

In samples collected for the Bay Protection and Toxic Cleanup Program on February 6, 1997, sediment concentrations at stations 48013.0, 48014.0, 48015.0, 48016.0, 48017.0 and 48018.0 exceeded the ERM Thresholds for p,p'-DDE and Total DDT. Station 44054.0 also exceeded the p,p'-DDE threshold on June 19, 1996. No sediment chemistry data were collected during sediment toxicity screening surveys conducted on January 12, 1993 and April 14, 1994.

Amphipod toxicity with whole sediment was observed at stations 44016.0, 44050.0, 44051.0, 44052.0, 44053.0 and 44054.0 on January 15, 1993. Amphipod toxicity was observed at stations 44053.0 and 44054.0 on April 18, 1994, and station 48015.0 on February 10, 1997. A degraded benthic community was found at all of the stations analyzed (48013.0, 48014.0, 48015.0, 48016.0, 48017.0 and 48018.0) on February 10, 1997.

Fish were collected from Mugu Lagoon for bioaccumulation analyses. Shiner surfperch exceeded the EPA guidelines for total PCB, but not for total DDT. Topsmelt did not exceed the EPA screening guidelines for total DDT or total PCB."

(From RWQCB 1991 Toxic Substance Monitoring Program Report Summary):

"A liver sample from a grey smoothhound shark from Mugu Lagoon was found to have 20.9 ppm of arsenic. In 1988, a liver sample from another shark (also in Mugu Lagoon) yielded the highest level of arsenic statewide thus far (1991) at 29 ppm."

Table 17 Mugu Lagoon BPTCP Stations With Sediment Chemistry Concentrations Exceeding ERM Threshold

BPTCP Station	Sampling Date	p,p'- DDE (ppb)	Total DDT (ppb)
44054.0	6/19/96	30.5	
48013.0	2/6/97	44.7	64.7
48014.0	2/6/97	68.1	103.4
48015.0	2/6/97	131.0	255.1
48016.0	2/6/97	112.0	166.7
48017.0	2/6/97	165.0	276.8
48018.0	2/6/97	129.0	232.6

Sources of Pollutants

Pesticides are of concern in Mugu Lagoon at the mouth of the Calleguas Creek watershed. The primary source of pesticides probably is agricultural runoff, both during dry weather and wet weather. Water-soluble pesticides currently in use, such as diazinon and chlorpyrifos, may be occurring in sediment porewater at high enough concentrations to be causing observed porewater toxicity. These pesticides are likely involved with observed upstream ambient toxicity. Historical discharges of pesticides, such as DDT, PCBs, toxaphene, chlordane and others, probably has contributed to the existing sediment contamination problem. Erosion from unlined channels in the watershed and from agricultural lands probably contributes to the excessive sediment loading in Mugu Lagoon. Metals may originate from non-point source runoff during dry and wet weather conditions.

The Regional Board has issued 37 permits for discharges of wastewater from point sources into the Calleguas Creek watershed. Of the 22 permitted discharges under the NPDES program, 7 are for municipal wastewaters from publicly-owned treatment works, accounting for a combined permitted discharge of 36.7 million gallons per day (98% of the total permitted discharges). Of the remaining NPDES permits, 11 are for discharges of treated groundwater from hydrocarbon or other contamination, and 5 are general permits for discharges of either well development water or ground water from dewatered aquifers at construction sites. In addition, 88 releases of stormwater from major municipalities, certain industrial activities and construction projects are now permitted under the Regional Board's NPDES program for storm water.

Only one landfill, the Simi Valley Landfill, is active in the watershed. Simi Valley Landfill began operating in 1970. Hazardous wastes were accepted until 1983; since that time, only Class III wastes (municipal solid waste) have been discharged at this landfill. Since operations at the landfill predate current regulations for siting waste management units, only a portion of the Simi Valley Landfill is lined in accordance with current regulations. Leaks from unlined portions of the landfill have contaminated ground water in an underlying sandstone aquifer; corrective actions are underway by the operator under the direction of the Regional Board.

Actions by Regional Board

The Los Angeles Regional Board's Water Quality Assessment identifies the following problems in Mugu Lagoon:

Aquatic life beneficial use is impaired based on water column exceedances of criteria for copper, mercury, nickel, and zinc, bird reproductivity affected (DDT), tissue accumulation (arsenic, cadmium, silver; chlordane, DDT, endosulfan, dacthal, toxaphene, PCBs); sediment concentrations (DDT, toxaphene), sediment toxicity and excessive sediment. Fish consumption beneficial use is impaired based on tissue accumulation of DDT, PCBs and toxaphene.

The Water Quality Assessment lists the following problems for Calleguas Creek (Estuary to Arroyo Los Posas):

Aquatic life beneficial use is impaired based on water column toxicity, sediment contamination (DDT, toxaphene), tissue bioaccumulation (chlordane, toxaphene, PCBs, DDT, ChemA, dacthal, endosulfan)

and sediment toxicity. Fish consumption beneficial use is impaired based on tissue bioaccumulation (DDT, toxaphene, chlordane).

Mugu Lagoon Task Force

The first large-scale stakeholder effort in the watershed was Mugu Lagoon Task Force, formed in September 1990. The purpose of the Task Force is to improve communication between agencies with various interests and specific projects in Ventura County that may impact water quality in Mugu Lagoon. All of the members share a common goal - to preserve and enhance Mugu Lagoon. The Task Force currently meets infrequently, since many of its members belong to the Calleguas Creek Watershed Management Committee. Active members of the Mugu Lagoon Task Force include the U.S. Army Corps of Engineers, University of California Cooperative Extension Service Farm Advisor, Ventura County Public Works Agency, Ventura County Planning Department, California Department of Fish and Game, California Coastal Conservancy, U.S. Navy Point Mugu Naval Air Station, Ventura County Resource Conservation District, U.S. Natural Resources Conservation Service and Los Angeles Regional Water Quality Control Board.

The Los Angeles Regional Board's Watershed Management Initiative began in late 1994 with the Calleguas Creek (and Ventura River) watersheds. Through watershed management, the Regional Board expects to regulate pollutant loads from point sources through permits that better focus on issues relevant to each watershed. The Regional Board also expects that pollutant loads from nonpoint sources can be better controlled through the participation of the public in the management of their watersheds.

The Los Angeles Regional Board renewed NPDES permits for discharges within the Calleguas Creek Watershed in June 1996. However, the Regional Board was unable to fully assess cumulative impacts to beneficial uses from all pollutant sources, particularly from nonpoint sources, during the first eighteen months of application of the Watershed Management Initiative. The Regional Board was able to develop a regional monitoring program for the inland waters of the watershed, which is currently being implemented and should provide additional information needed to assess cumulative impacts.

Thanks to the formation of the Calleguas Creek Watershed Management Committee in 1996, stakeholders will have the opportunity to structure and implement measures that will address pollutants from nonpoint sources through the development of a Watershed Management Plan. The Committee intends to hire a facilitator to help prepare a plan to develop a strategy for the preservation, enhancement and management of the watershed's resources, including identification and control of sources of pollution. The Committee has outlined a three-phased plan to accomplish this goal over a 2.5 year period, beginning in January 1998. The Regional Board plans to reassess cumulative impacts to the beneficial uses of waters in the watershed by fiscal year 2002-2003. Using this information, the Regional Board is scheduled to revise NPDES permits by June 2003.

The Regional Board is working with the Naval Air Weapons Station at Point Mugu to develop a cleanup plan for contamination at this Department of Defense site. This effort still is at the stage of characterizing historical sources of pollution and the extent of existing contamination levels. In the near future, decisions will be made concerning possible remediation and restoration activities in and around Mugu Lagoon.

Preliminary Assessment of Remediation Actions

Effects-based data has established that Mugu Lagoon sediment is more toxic than sediment from other lagoons in the region. Current agricultural and erosion control practices are likely moving soils heavily polluted with residuals of banned pesticides to drainages and subsequently into Mugu Lagoon.

Under the direction of the California Coastal Conservancy, Ventura County Resource Conservation District and other members of the Mugu Lagoon Task Force, the U.S. Natural Resources Conservation Service completed a report entitled: "Calleguas Creek Watershed Erosion and Sediment Control Plan for Mugu Lagoon (May 1995)". The primary focus of this study was to address erosion and sedimentation impacts and solutions for the watershed. The U.S. Environmental Protection Agency, State Water

Resources Control Board and the Los Angeles Regional Water Quality Control Board recently have granted additional 319(h) funds to implement specific erosion control measures for Grimes Canyon, a critical area targeted for remediation in the plan.

Existing contaminated sediments within Mugu Lagoon and the Calleguas Creek Tidal Prism are unlikely to remediate naturally within a reasonable time frame. Removal of the contaminated sediments (i.e., dredging) or treatment appear to be the most appropriate remediation alternatives, although in situ capping might be the best solution for historical deposits, particularly within the lagoon.

Cost Estimate to Implement Cleanup Plan

Given the sensitive nature of Mugu Lagoon as a habitat for endangered species, the most likely remediation alternatives would be no action or in situ treatment. The no action alternative would not have a financial cost, but the contaminated sediment could remain in the environment and continue to cause problems for several more decades. In situ treatment would be very expensive and may pose technical problems for remediation in an estuarine environment. No reliable cost estimate exists at this time for this treatment method, but it would probably exceed $100 per cubic yard. The total cost for remediation of Mugu Lagoon would be at least $72.5 million.

Dredging could be used to remove the contaminated sediments from the Calleguas Creek Tidal Prism. However, identifying a suitable and legal disposal site for contaminated sediments may be difficult. Application of this technique would cost an estimated $1 million to $5 million, based on a cost estimate of $20-100 per cubic yard (disposal costs are likely to be high, so the cost estimate probably would approach or even exceed the upper limit of the cost estimate range).

Estimate of Recoverable Costs From Dischargers

Contamination of the Mugu Lagoon sediments probably associated with historical use of the now-banned pesticide DDT. Although the United States Navy could be liable for any remediation activities required as a result of historical discharges of pollutants due to operations at the Naval Air Weapons Station at Point Mugu, there is no evidence that the Navy is responsible for the elevated concentrations of DDT in the sediments. It is unlikely that costs can be recovered from any other dischargers in this watershed.

Two-Year Expenditure Schedule

The Regional Board plans to work with the Calleguas Creek Watershed Management Committee, which already has begun development of a watershed management plan, to select the appropriate remediation alternative for Mugu Lagoon and the Calleguas Creek Tidal Prism. In addition, watershed management measures may be required to control sources of contaminants and prevent recontamination of these areas.

During Year One, the focus would be on selection of the appropriate remediation alternative for Mugu Lagoon and Calleguas Creek Tidal Prism. Additional sediment sampling may be required, particularly for Calleguas Creek Tidal Prism, to fully characterize the areal extent of the sediment contamination and prepare a plan for capping, dredging or treatment of the contaminated sediments. This sampling program probably will require approximately $100,000 - $250,000 for implementation. A source for this funding has not been determined.

During Year Two, the focus would be on implementation of the remediation alternative(s) selected for Mugu Lagoon and Calleguas Creek Tidal Prism, as well as watershed management measures to control sources of contamination and prevent recontamination of the existing hot spots. Remediation of the Calleguas Creek Tidal Prism probably could be completed within Year Two, if funding is available. However, remediation of Mugu Lagoon could require additional time, depending upon the alternative selected. A monitoring program will be required to measure the success of the remediation plans that are implemented; although a monitoring program has not yet been designed, the estimated cost would be

$50,000 - $100,000 per year, and may be required for at least three to five years following completion of the remediation activities.

Benefits of Remediation

Successful remediation of the contamination in Mugu Lagoon and the Calleguas Creek Tidal Prism could eliminate the source of impairment of the beneficial uses of these waters. However, watershed management efforts to control erosion probably would be required to prevent recontamination of these areas.

Environmental Impacts of Remediation

If in-situ treatment is implemented, it could result in short-term impacts to the benthic infaunal community. However, this community would be expected to fully recover within 2-3 years. Any remediation activity within this sensitive watershed, particularly in Mugu Lagoon, potentially could affect endangered species, such as the peregrine falcon, least tern, light-footed clapper rail and brown pelican. Prior to initiating any remediation plan, the Regional Board will consult with the California Department of Fish and Game and the United States Fish and Wildlife Service concerning potential adverse impacts to endangered species.

With proper management of dredging and disposal of dredged material, this activity would not be expected to result in adverse environmental impacts."

Calleguas Creek Watershed Management Plan Committee [36]

"Thanks to the formation of the Calleguas Creek Watershed Management Committee in 1996, stakeholders will have the opportunity to structure and implement measures that will address pollutants from nonpoint sources through the development of a Watershed Management Plan. The Committee intends to hire a facilitator to help prepare a plan to develop a strategy for the preservation, enhancement and management of the watershed's resources, including identification and control of sources of pollution. The Committee has outlined a three-phased plan to accomplish this goal over a 2.5 year period, beginning in January 1998. The Regional Board plans to reassess cumulative impacts to the beneficial uses of waters in the watershed by fiscal year 2002-2003. Using this information, the Regional Board is scheduled to revise NPDES permits by June 2003."

"The Regional Board plans to work with the Calleguas Creek Watershed Management Committee, which already has begun development of a watershed management plan, to select the appropriate remediation alternative for Mugu Lagoon and the Calleguas Creek Tidal Prism. In addition, watershed management measures may be required to control sources of contaminants and prevent recontamination of these areas."

Water Resources/Water Quality Subcommittee[37]

This subcommittee is responsible for these types of water resources:
Surface Water, Ground Water, Reclaimed Water, Wastewater Effluent and Imported Water (Quantity, Quality, Beneficial Uses, Water Rights, Water Source, Inter-relationship with other sources)

This subcommittee's responsibilities include:
researching technical and scientific data
monitoring water quality and quantity sources
identifying beneficial uses for the resource
drafting the water resource/water quality component of the plan

---

[36] Regional Toxic Hot Spot Cleanup Plan. February 1999. LARWQCB. 16 Feb.2004. <www.swrcb.ca.gov/bptcb/docsr4cl99_f.doc>

[37] From "Guidelines for the Initiation of the Calleguas Creek Watershed Management Plan", November, 1996.

Potential Sponsors: The five municipal dischargers participating in the Regional Water Quality Control Board Program are Camarillo, Camrosa, Moorpark, Thousand Oaks, and Simi Valley

These chapters may be of interest in relation to water quality:

- 3.1 Historical and Forecast Growth
- 3.2 Land Use Inventory
- 3.3 Biological Resources
- 3.10 Erosion and Sedimentation
- 3.11 Flood Control/Hydrology
- 3.12 Surface and Groundwater Resources
- 3.13 Water Quality Practices
- 3.17 Governmental Regulations/Programs[38]

Calleguas Creek Nutrient TMDLs

In the Calleguas Creek Watershed, thirty separate pollutants have been listed on the Clean Water Act Section 303(d) list of impaired waters. For each of these pollutants, a Total Maximum Daily Load (TMDL) must be developed to result in compliance with water quality standards. This document presents the TMDLs that address five of the 303(d) listings: ammonia, nitrate-N+nitrite-N, nitrogen, algae, and low dissolved oxygen/organic enrichment. These listings have been addressed through the development of separate TMDLs for ammonia, oxidized nitrogen (nitrate-N + nitrite-N), and algae/dissolved oxygen. However, because of the interconnected relationship between these listings and TMDLs, the three TMDLs have been bound together into this overall Nutrient TMDLs document with one introduction and one implementation plan for all three TMDLs."[39]

Table 18 Summary Schedule for TMDL Development (by watershed) RWQCB[40]

303(d) Listed Waterbody (Reach)	Pollutant	Type of TMDL	TMDL Start Date FY (start of monitoring)	TMDL Completion Date -Fiscal Year (Basin Plan Amendment)
Fox Barranca	nitrate +nitrite	nitrogen and its effects	1997/98	2001/02
Conejo Creek Reach 1 (confl. Calleguas to Santa Rosa Rd)	toxicity	water-soluble pest. and effects	1997/98	2003/04
Fox Barranca	Boron, sulfate, TDS	salts	1997/98	2003/04
Arroyo Simi Reach 1 (Moorpark Fwy (23) to Brea Canyon)		chloride		2001/02
Arroyo Las Posas Reach 1 (Lewis/Somis Rd. to Fox Barranca)	DDT	Historic pest. and its effects	1997/98	2004/05
Arroyo Simi Reach 1 (Moorpark Fwy (23) to Brea Cyn.)	Cr, Ni, Ag, Zn	Metals	2002/03	2005/06
Calleguas Creek Reach 1 (estuary to 0.5 mi. S of Broome Rd.)	PCBs	PCBs	2001/02	2004/05

[38] (Excerpts from "Calleguas Creek Watershed Mgmnt. Plan" Table of Contents: <http://www.calleguas.com/ccbrochure/reportld.html>

[39] Executive Summary Calleguas Creek Nutrient TMDLs. Calleguas Watershed Management Plan. <http://www.calleguas.com/ccbrochure/reportld.html>

[40] <http://www.swrcb.ca.gov/~rwqcb4/docs/table7_wmi_appdx.pdf>

Rio de Santa Clara/Oxnard Drain #3	PCBs	Sediment-bound organics and effects	2005/06	2008/09
Mugu Lagoon	Hg	mercury	2005/06	2008/09
Mugu Lagoon	Cu, Ni, Zn	other metals	2005/06	2008/09
Revolon Slough Main Branch (Mugu Lagoon to Central Ave.)	trash	trash	2005/06	2008/09
Rio de Santa Clara/ Oxnard Drain #3	nitrogen	nitrogen	2005/06	2008/09
Arroyo Simi Reach 1 (Moorpark Fwy (23) to Brea Cyn)	Se	Selenium	2005/06	2008/09

Calleguas Creek Watershed Sampling and Analysis Plan for Historic Pesticides & PCBs
Sampling and Analysis Plan for Historic Pesticides & PCBs – DRAFT, November 2003.[41]

Study Objective

"The primary objective of the Sampling and Analysis Plan for Historic Pesticides and PCBs is to collect additional ambient water quality data, sediment quality data, fish tissue data, and related information necessary to identify the extent and magnitude of pesticide/PCB contamination in the Calleguas Creek Watershed. Data collected will be used in support of the development of the Pesticide/PCB TMDL. If the data collected through this SAP in combination with historical data are not sufficient to complete a source analysis, a source identification and assessment plan will be developed.

Background

Eleven out of the fourteen reaches within the Calleguas Creek Watershed, in southern Ventura County, California, appear on the 2002 Clean Water Act (CWA) Section 303(d) list of water quality limited segments as impaired due to the presence of historic pesticides and/or PCBs in water, sediment, and/or fish tissue. In response to these listings, local stakeholders, organized through the Calleguas Creek Watershed Management Plan, developed this Pesticides/PCBs Sampling and Analysis Plan (PSAP).

The historic pesticides and PCBs addressed in this SAP possess unique physical and chemical properties that contribute to their ability to concentrate in biota, magnify in the food chain and persist in soils and sediment. In addition to their toxicity to aquatic organisms, organochlorine pesticides and PCBs bioaccumulate in fish tissue and other aquatic life, posing cancer risks to humans consuming these organisms as food and potentially impairing wildlife reproduction. Although organochlorine pesticides and PCBs have been banned from use in the United States, concentrations of these chemicals have been detected in the water column, sediment, and fish tissue in various reaches within the Calleguas Creek Watershed. The primary sources are assumed to be sediment loading associated with watershed runoff and resuspension and transport of previously deposited in-stream sediments. The 303(d) listings require the State to develop Total Maximum Daily Loads (TMDLs), which establish the maximum amount of pollution a water body can receive without exceeding established water quality criteria. The data collected through this SAP will be used in support of the development of the TMDL for historic pesticides and PCBs.

Eleven sampling sites are shown in the map on page 10.

[41] Calleguas Watershed Mangement Plan. 16 Feb. 04. <http://www.calleguas.com/ccbrochure/reportld.html>

3. Ventura County Storm Water Monitoring Program

Ventura Countywide Stormwater Monitoring Program 2000-2001 Monitoring Status Report. Ventura County Flood Control District. Jan.03.[42]

Analysis Performed:

Sampling methods and sample handling procedures used in the 2000/01 monitoring year are based on the procedures described in the Ventura Countywide Stormwater Monitoring Program: Standard Operating Procedures 2000-2005 Stormwater Monitoring (LWA, 2001) and Ventura Countywide Stormwater Monitoring Program: Standard Operating Procedures Mass Emission Monitoring (LWA, 2001). The monitored parameter requirements are described as a part of NPDES Permit No. CAS004002.

The City of Oxnard Laboratory primarily performed the conventionals, microbiological, and nutrient analyses. FGL Environmental of Santa Paula performed the metals (except mercury), bromide, TRPH, TOC and oil & grease analyses. Frontier Geosciences, Inc. of Seattle was used to perform low detection limit analyses for mercury samples for all events. APPL, Inc. of Fresno performed the EPA 8141 and 8151 analyses for pesticides and herbicides and EPA 8020 analyses for MTBE for all events. CRG Marine Laboratories, Inc. of Torrance performed the 8270 analyses for chlorinated pesticides, PCBs, and semi and non-volatile organics. The toxicity tests were conducted by Aquatic Bioassay & Consulting of Ventura under the guidelines prescribed in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (EPA 600/4-85/013).

Quality Assurance/Quality Control (QA/QC) samples analyzed by the laboratories included field duplicates, field blanks, control samples, and spikes. For each storm event, the laboratories analyzed matrix spikes/matrix spike duplicates (MS/MSD), blank spikes/blank spike duplicates (BS/BSD), method blanks, and laboratory control samples (LCS) where appropriate for the type of constituent."

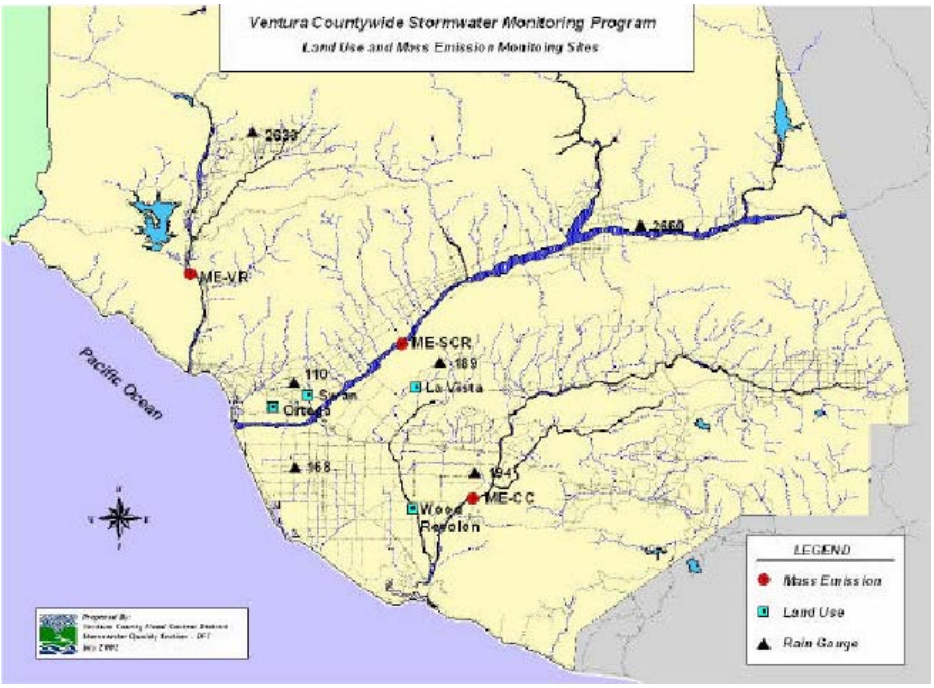

Figure 18 Ventura Countywide Storm-water Monitoring Sites- Mass Emissions and Land Use Sites

[42] <http://www.vcstormwater.org/publications.htm>

Mass Emission Monitoring Stations			
Station Code	Location	Primary Land Use	Drainage Basin Area (acres)
ME-CC	Calleguas Creek – CSUCI north side of Hueneme Road, just east of Lewis Road at the old Camarillo State Hospital bridge	Mixed Use	160,640

"…ME-CC and ME-VR mass emission samples are collected using automated flow proportional composite samplers (ISCO 6712)."

Mass Emission Monitoring

"The purpose of mass emissions monitoring is to identify pollutant loads to the ocean and identify long-term trends in pollutant concentrations. Mass emissions sites are located at the lower reaches of major watersheds allowing the monitoring program to analyze the cumulative effects of stormwater and other discharges to the watershed prior to discharge to the ocean. One major difference between mass emissions and receiving water monitoring are the sources of discharge. Receiving water monitoring strategically looks at sources of pollutants as opposed to looking at mass loadings at the end of a system. The mass emissions monitoring area however, is much larger than receiving water and has other sources of discharge such as wastewater treatment plants and groundwater discharges. Mass emissions stations monitor receiving waters in three major Ventura County watersheds, Calleguas Creek (ME-CC), Ventura River (ME-VR) and Santa Clara River (ME-SCR). A total of three mass emissions stations, one for each watershed, were monitored this season. Two of these stations (ME-CC and ME-VR) were monitored for the first time in the 2000/01 monitoring season and the ME-SCR was installed and monitored for the first time in the 2001/02 monitoring season.

Table 19 Environmental Samples and QA/QC Samples Collected at the Mass Emission Site ME-CC (Calleguas)

Parameters:

Metals, Total Recoverable (As, Cd, Cr, Cu, Pb, Ni, Se, Ag, Th & Zn)	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
Metals, Dissolved	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
Conventionals	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
Total Organic Carbon	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
Nutrients (TKN, Nitrogen-Nitrate, Orthophosphate & Phosphorus (total & dissolved)	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
EPA 8270 Semi/Non Volatiles	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
EPA 8270 Chlorinated Pesticides and PCBs	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
EPA 8141	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
EPA 8151	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
Mercury3	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
Oil & Grease	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
Microbiological1	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
pH/ Conductivity	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
Ammonia	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
Total Recoverable Petroleum Hydrocarbons (TRPH)3	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)
Bioassay1	□	□ (MS/MSD)	□	□ (FB) □ (MS/MSD)

Notes:
"□" indicates that the analysis was performed.
"FB" indicates that a field blank was performed.
"MS/MSD" indicates that a matrix spike/matrix spike duplicate was performed.
Conventionals are: TDS, Hardness, TSS, BOD, Bromide & Chloride.
Nutrients are: TKN, Nitrogen-Nitrate, Orthophosphate & Phosphorus (total & dissolved).

Metals are: As, Cd, Cr, Cu, Pb, Ni, Se, Ag, Th & Zn.
Unless noted otherwise, all analyses performed by FGL Environmental.
1. Performed by Aquatic Bioassay & Consulting
2. Performed by Associated Laboratories.
Performed by Frontier Laboratories

Table 20. Conventional and Nutrient Results from the Mass Emission Stations

Constituent	Units	ME-CC, Calleguas Creek			ME-VR, Ventura River		
		2/13/01	2/26/01	3/5/01	2/13/01	2/26/01	3/5/01
BOD5	mg/L	27	16 *	10	30	3	4
Conductivity	µmhos/cm	356	438	388	455	631	263
Hardness as CaCO3	mg/L	184	204	142	184	272	122
pH	STD UNITS	8	7.8	8	7.7	8	8.1
Solids, Total Dissolved	mg/L	216	224 *	242	328	420	172
Solids, Total Suspended	mg/L	1620	3900 *	2100	920	190	3500
Bromide	mg/L	<0.5	<0.5	<0.5	0.04 *	<0.5	<0.5
Chloride	mg/L	21	29	18	16	13	4
Fecal Coliform	MPN/100 mL	2200	30000	28000	5000	800	2300
Fecal Streptococcus	MPN/100 mL	2300	240000	140000	3000	17000	13000
Total Coliform	MPN/100 mL	30000	170000	500000	160000	13000	70000
Carbon, Total Organic	mg/L	5.2	12.9 *	7.3	5.9	6.9	5.7
Oil & Grease	mg/L	<3	<3	<3	<3	<3	<3
Ammonia as N	mg/L	0.1	0.3	0.3	0.1	<0.1	0.1
Nitrate as N	mg/L	2.35	2.26	2.23	2.22	1.32	2.19
Orthophosphate-P	mg/L	0.37	0.44	0.5	0.29	0.14	0.15
Phosphorus, Total	mg/L	2.42	3.07	4.12	1.73	0.17	3.72
Phosphorus, Dissolved	mg/L	0.45	0.47	0.6	0.35	0.17	0.35
TKN	mg/L	2.5	7.6	4.5	6.2	2.5	5.6
TRPH	mg/L	<0.5	<0.5	<1	0.17 *	<0.5	<1

* See Appendix 2 for a description of the data qualifiers associated with this sample result.

Table 21 Metals Results from the Mass Emission Station (ME-CC)

Arsenic	Dissolved	µg/L	3	4	< 2	3		3
Cadmium	Dissolved	µg/L	0.3	0.3	< 0.2	0.3		< 0.2
Chromium	Dissolved	µg/L	4	3	3	2		1
Copper	Dissolved	µg/L	5	4	5	4		5
Lead	Dissolved	µg/L	0.7	0.2	< 0.2	< 0.2		< 0.2
Mercury	Dissolved	ng/L	1.08	1.77	1.54	0.81		0.97
Nickel	Dissolved	µg/L	6	6	5	5		6
Selenium	Dissolved	µg/L	2	3	4	2		3
Silver	Dissolved	µg/L	<1	< 1	< 1	< 1		< 1
Thallium	Dissolved	µg/L	<0.2	< 0.2	< 0.2	< 0.2		< 0.2
Zinc	Dissolved	µg/L	18	10 *	20	20		10
Magnesium	Total	mg/L	Not Tested	44	46	41		41
Mercury	Total	µg/L	2.11	0.006	5.33	1.32		1.56

Arsenic	Total	µg/L	3	6		3	2	*	2
Cadmium	Total	µg/L	4	0.9		< 0.2	0.3	*	< 0.2
Chromium	Total	µg/L	7	23		3	4	*	4
Copper	Total	µg/L	9	18		5	6	*	5
Lead	Total	µg/L	1.8	8		0.6	0.6	*	0.5
Nickel	Total	µg/L	11	19		6	7		7
Selenium	Total	µg/L	5	4		3	< 2	*	2
Silver	Total	µg/L	<0.001	< 1		< 0.25	< 1		< 1 *
Thallium	Total	mg/L	<0.0002	< 0.0002		< 0.0002	< 0.0002	< 0.0002	
Zinc	Total	µg/L	23	70	*	30	30		20

Receiving Water Monitoring

Receiving water monitoring is designed to characterize the quality of receiving waters rather than discharges to the receiving waters. This type of monitoring covers smaller tributaries to the main river systems. Monitoring smaller tributaries allows the program to focus on smaller sub basins of the watershed that are not impacted by discharges from wastewater treatment facilities. Monitoring a localized section of the watershed allows the program to better examine the impact of stormwater on the watershed than mass emissions monitoring. During this monitoring season, two receiving water sites, (Revolon Slough and La Vista) were monitored. Receiving water monitoring at these sites was first implemented during the 1997-98 season. Receiving water monitoring for 2001/02 received stormwater runoff from the Revolon sub basin.

Receiving Water Monitoring Stations			
W-3	La Vista Avenue south of Center Road	Agricultural/ Open Space	752
W-4	Revolon Slough at Wood Road	Mixed Use	28,800

4. Ventura River Bioassessment Program

The Ventura County Storm Water Monitoring Program also includes the bioassessment-monitoring program. A Work Plan for in-stream bioassessment monitoring in the Ventura River watershed was developed and submitted in January 2001 to the Regional Board as part of the revised Stormwater Management Plan. In addition to the preparation of the work plan, the County conducted a March 2001 training session on bioassessment monitoring techniques and participated in the Heal the Bay bioassessment training program. The Sustainable Land Stewardship Land Institute (Monique Borne) has also provided assistance to this program. The actual bioassessment monitoring was accomplished on September 24-26, 2001 and will be included in the 2001/02 Annual Report.

Volunteer Program

In January 2001, the Ventura County Flood Control District (VCFCD) began participating in the Ventura River volunteer monitoring effort. This effort is ongoing and the VCFCD provides technical guidance and assistance for volunteer monitoring at thirteen sites on the Ventura River and it's tributaries in the Ventura River watershed. The VCFCD continues to participate with volunteer groups such as the Santa Barbara Channel Keepers, Stream Team and Surfrider organization."

Figure 19 Ventura River Bioassessment Monitoring Program Sites

Ventura Coastkeeper

The Ventura Coastkeeper is undertaking the monumental task of developing a Citizen Monitoring Program for the Calleguas Creek Watershed. The U.S. Environmental Protection Agency considers Calleguas Creek - which supplies more than a quarter of the county's needs for drinking and irrigation water - as one of the region's most seriously damaged watersheds. Our watershed flows through five cities and their wastewater facilities, and the vast agricultural properties of Ventura County, where huge amounts of pesticides are utilized for crops. There are also unknown impacts of concrete channelization. Many pesticides have not been regulated, and agriculture has been exempt from pollution laws, which govern most other industry. Agribusiness has continually increased the amounts of chemicals used in production of foods and sod. Our program will gather water quality statistics, which will be reported to the Regional Water Quality Control Board (RWQCB). This is just one of the many tasks a Keeper undertakes in the effort to clean up and maintain our regional waters.[43]

[43] Ventura Coastkeeper Water Quality Monitoring. 16 Feb.2004. < http://www.wishtoyo.org/vck-water-quality-monitoring.html>

Point Mugu: The Ventura CoastKeeper takes special interest in the health of the Mugu Lagoon because of its location as the endpoint of the Calleguas Creek Watershed, its designation of an Area of Special Biological Significance (ASBS), the ongoing environmental cleanups the military is undertaking within the wetlands, and, because the lagoon is a historic traditional Chumash Village site. In order to ensure that the strictest environmental standards are applied to one of the Southern California's largest remaining wetlands, the Ventura CoastKeeper has joined the Restoration Advisory Board to participate in decision-making, which will affect the future health of this important site.

On February 5th, 2003, Ventura Coastkeeper was elected to the Calleguas Creek Watershed Management Plan Steering Committee, which oversees all watershed sub-committees regarding issues, plans and budgets. Coastkeeper has already been involved on the water quality sub-committee and TMDL Special Task Force.

In addition, we have been working with the Ventura County Watershed Protection District to help determine monitoring sites and obtain permits to monitor their flood control channels. We are looking at sites beyond the Calleguas Creek Watershed that will include various tributaries in Ventura County.

5. SAMO Area Ocean/ Beach/ Nearshore monitoring

This section includes the beaches and lagoons from Santa Monica Canyon to Point Mugu. Point Mugu Lagoon in the Calleguas watershed is mostly considered in a separate section of this report.

In the table below, the DDT and PCB impairments are fish consumption advisories.

Santa Monica Bay 303d List Impairments - Beaches				
Waterbody Name	State Impairment(s)			
Amarillo Beach	DDT	PCB's		
Big Rock Beach	DDT	PCB's	Beach Closures	High Coliform Count
Carbon Beach	DDT	PCB's	Beach Closures	
Castlerock Beach	DDT	PCB's	Beach Closures	
Dan Blocker Beach				High Coliform Count
Escondido Beach	DDT	PCB's	Beach Closures	
Las Flores Beach	DDT	PCB's		High Coliform Count
Las Tunas Beach	DDT	PCB's	Beach Closures	
Leo Carrillo Beach			Beach Closures	High Coliform Count
Malibu Beach	DDT		Beach Closures	
Malibu Surfrider Beach	DDT	PCB's	Beach Closures	High Coliform Count
Nicholas Canyon Beach	DDT	PCB's	Beach Closures	
Paradise Cove Beach	DDT	PCB's	Beach Closures	High Coliform Count
Point Dume Beach	DDT	PCB's	Beach Closures	
Santa Monica Bay Offshore and Nearshore	DDT	PCB's	Chlordane	Cadmium, Copper, Lead, Mercury
	Zinc	Nickel	Silver	Debris, PAHS, Sediment Toxicity, Fish Consumption Advisory
Santa Monica Beach (@S.M.Canyon)			Beach Closures	High Coliform Count
Topanga Beach	DDT	PCB's	Beach Closures	High Coliform Count
Trancas (Broad) Beach	DDT	PCB's	Beach Closures	High Coliform Count
Will Rogers Beach (W of Bay Club)			Beach Closures	High Coliform Count
Zuma Beach	DDT	PCB's	Beach Closures	

AB538 Source Investigations of Bacteriological Exceedances
Source Investigations of Storm Drain Discharges Causing Exceedances of Bacteriological Standards", Report to the Legislature December 2001. SWRCB, CA EPA. 16 Feb.2004. [44]

"In the year 2000, approximately 160 public beaches in California, mainly in the southern part of the State, were either closed or posted with warnings for water-contact recreation due to the presence of

[44] http://www.swrcb.ca.gov/beach/docs/ab538rpt_finalfinal.pdf

indicator bacteria in excess of the water quality standards. The main reasons for this large number are that California has a stringent set of bacteriological standards and the beaches are extensively monitored. According to the year 2000 beach water quality bacteriological monitoring data, only 36 beaches meet the AB 538 criteria for source investigation. AB 538 requires that, at a minimum, source investigations of storm drains should be conducted when bacteriological standards are exceeded in any three weeks of a four-week period, or for areas where testing is done more than once a week, 75 percent of testing days produces exceedance of those standards. It should be noted that a source investigation of storm drains that produce exceedances of bacteriological standards may not be necessary in every instance for the following reasons:

The test bacteria may not be the right indicator of pathogens in shoreline waters.

The indicator bacteria assay may take 18 to 36 hours or longer to complete. During this time the beach goers may be potentially exposed to harmful pathogens. By the time a beach is posted based on the monitoring data, the indicator bacteria may no longer be present in the shoreline waters. Thus, a beach may potentially be open when it is contaminated and posted when it is clean.

There are many sources of variability in shoreline bacteriological monitoring. Research conducted by SCCWRP revealed that different laboratories reported different bacterial counts for the same sample (inter-laboratory variability). Water samples collected from very close locations in the surf zone had different bacterial counts (spatial variability). Further, water samples collected from the same location but at different times of the day had different bacterial counts (temporal variability).

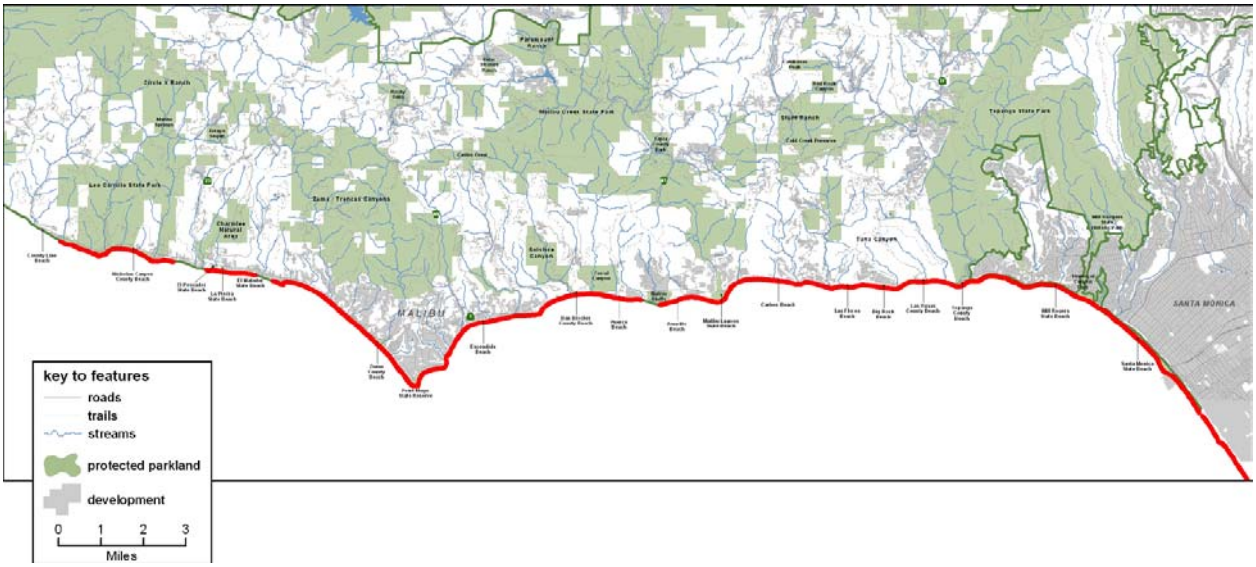

Figure 20 303d listed beaches along the Santa Monica Mountains and Santa Monica Bay.

The Governor's Clean Beach Initiative provided $1.5 million to the SWRCB in Fiscal Year (FY) 2001-02 to develop simple, rapid, and inexpensive indicators to provide timely information to beach goers on the quality of water for recreational activities. This would solve the problem listed in Item 2 above. Much research is underway to develop a reliable method to differentiate between human and nonhuman sources of fecal contamination of surface waters. Currently, the two most widely used methods are genetic fingerprinting and multiple antibiotic resistance technique. The SWRCB is partially funding a comparative study of these two methods. Although both of these methods seem promising, neither is considered to be a reliable source identification method at this time. The FY 2001-02 Budget Act has appropriated $32,298,000 from Proposition 13 (Safe Drinking Water, Clean Water, Watershed Protection, and Flood Protection Bond Act of 2000) funding for local projects addressing beach water quality problems. These grant funds will be used for implementation of BMPs to mitigate the bacteriological contamination of some of the beaches that have chronic problems of beach postings and closures.

Implementation of these BMPs would be the next logical step of the successful completion of source investigation studies.

California Beaches (in SAMO Study Area) Meeting AB 538 Source Investigation Criteria Based on Year 2000 Monitoring Information:

Big Rock Beach,
Malibu Pier,
Paradise Cove,
Surfrider Beach,
Topanga Beach,
Will Rogers State Beach

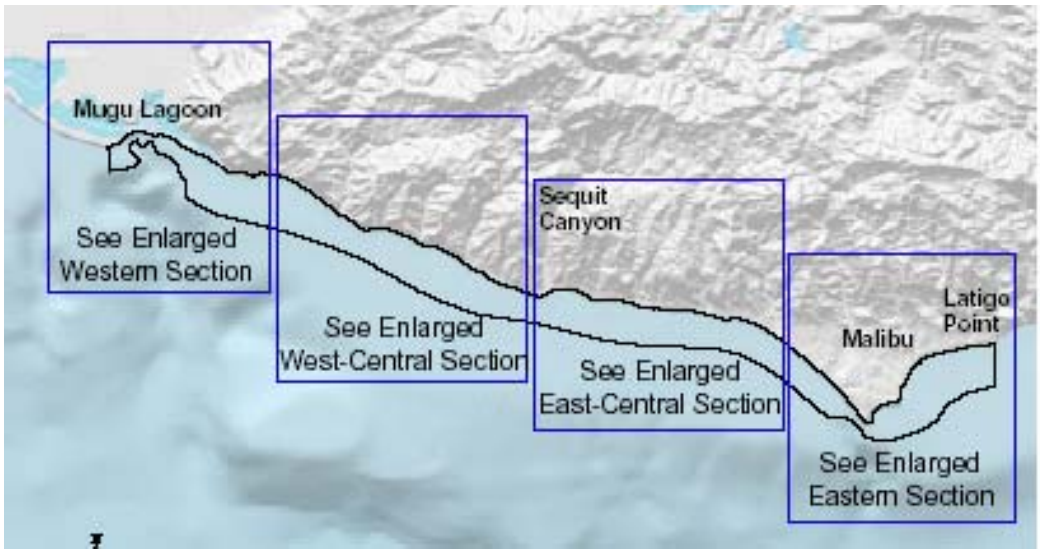

Figure 21 State Water Quality Protection Area No. 24 (SWQPA) aka Areas of Special Biological Significance (ASBS)

Los Angeles Regional Water Quality Control Board, State Water Quality Protection Area, Area of Special Biological Significance No. 24, Mugu Lagoon to Latigo Point

Areas of Special Biological Significance, California's Marine State Water Quality Protection Areas. June 2003. SWRCB. 16 Feb.2004.

Assembly Bill 2800, approved by the Governor on September 8, 2000, added sections to the Public Resources Code (PRC) that are relevant to Areas of Special Biological Significance (ASBS). Section 36700 (f) of the PRC defines state water quality protection area (SWQPA) as "a nonterrestrial marine or estuarine area designated to protect marine species or biological communities from an undesirable alteration in natural water quality, including, but not limited to, areas of special biological significance that have been designated by the State Water Resources Control Board through its water quality control planning process." Section 36710 (f) of the Public Resources Code states: "In a state water quality protection area point source waste and thermal discharges shall be prohibited or limited by special conditions. Nonpoint source pollution shall be controlled to the extent practicable." The change of the term Area of Special Biological Significance to State Water Quality Protection Area occurred on January 1, 2003 as required under Section 36750 of the PRC.[45]

[45] http://www.swrcb.ca.gov/plnspols/oplans/docs/asbs_swqpa_publication03.doc

Mitigation of Storm Water Impacts from New Development in Environmentally Sensitive Areas Technical Report. October 2001. LARWQCB. 16 Feb.2004.

Selected areas in California already merit a higher standard of protection from development impacts because of location. The California Ocean Plan prohibits the discharge of "waste" to Areas of Special Biological Significance (ASBS), and requires discharges to be located far enough away to allow maintenance of natural water quality conditions in ASBS20. The State Board recently issued a decision regarding storm water discharges where it determined that discharges to ASBS are prohibited. 20 SWRCB, 1997. California Ocean Plan: water quality control plan – ocean waters of California. California Environmental Protection Agency, Sacramento, California. 21WRCB, 2001. In the matter of the Petition of California Department of Transportation (Cease and Desist Order No. 00-87 for Crystal Cove), issued by California Regional Water Quality Control Board, Santa Ana Region. SWRCB file A-1350.[46]

Table 22 The seven beaches in ASBS No.24 listed as impaired for beneficial uses

Nicholas Canyon Beach	DDT	PCB's	Beach Closures	
Paradise Cove Beach	DDT	PCB's	Beach Closures	High Coliform Count
Point Dume Beach	DDT	PCB's	Beach Closures	
Trancas (Broad) Beach	DDT	PCB's	Beach Closures	High Coliform Count
Zuma Beach	DDT	PCB's	Beach Closures	
Escondido Beach	DDT	PCB's	Beach Closures	
Leo Carrillo Beach			Beach Closures	High Coliform Count

The Santa Monica Baykeeper has compiled water quality sampling data from 281 point source discharges in this zone. Santa Monica Baykeeper Storm Drain Report 2001. SM Baykeeper. 16 Feb.2004. [47]

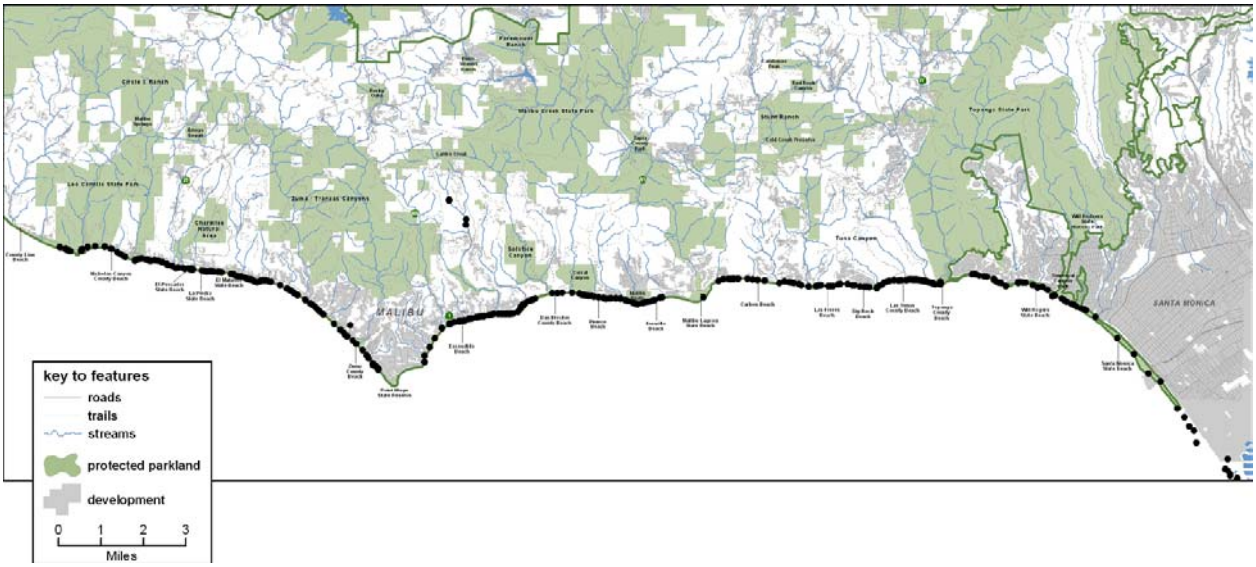

Figure 22 Locations of Storm Drains along the Santa Monica Mountains and Santa Monica Bay

6. Los Angeles County Department of Health Services - Beach Sampling

[46] http://www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/la_ms4_tentative/ESApaper.pdf
[47] http://www.smbaykeeper.org/smbay/news/SMBayAnnual1.pdf

LACDHS Ocean Water Quality Monitoring Program LACDHS.[48]

"The LA County Department of Health Services Recreational Health program routinely collects ocean water samples every Monday, at 26 sampling sites extending from the Ventura/Los Angeles County border to south of the Redondo Beach pier. Seventeen of these sites occur in the study area, from Leo Carrillo to Santa Monica Canyon.(see chart below) Samples are collected in the surf zone and analyzed by the Department of Health Service's laboratory."

Parameters: Total coliform, *E. coli*, and *Enterococcus*

DHS also compiles weekly beach monitoring data from LA City Bureau of Sanitation and LA County Sanitation District. This info is given a monthly report card grade (see Methods below) and added to their website.

Table 23 LA County DHS Beach Water Quality Sampling Stations:

(in SAMO study area from Ventura County Line to Santa Monica Canyon)

DHS 010	Leo Carrillo State Beach 35000 Pacific Coast Hwy. , Malibu [in front of beach restrooms]
DHS 009	Nicholas Beach , Malibu [100 feet west of the lifeguard tower]
DHS 008	Trancas Beach , Malibu [50 yards east of Trancas bridge]
DHS 007	Westward Beach , Malibu [just east of Zuma Creek]
DHS 006	Paradise Cove 28128 Pacific Coast Hwy. , Malibu [adjacent to west side of pier]
DHS 005	Near Dan Blocker State Beach 26610 Latigo Shore Drive. , Malibu [in front of Tivoli Cove Villa treatment plant]
DHS 004	Puerco Beach 25500 Pacific Coast Hwy. , Malibu [at lifeguard station by bridge]
DHS 003	Malibu Beach Malibu Colony Dr. , Malibu [in front of lifeguard tower]
HYP S1	Surfrider Beach , Malibu [50 yds. east of breech]
DHS 002	Surfrider Beach Malibu Pier , Malibu [50 yards east of pier]
DHS 001	Big Rock Beach 19948 Pacific Coast Hwy. , Malibu [off point]
HYP S2	Topanga State Beach Topanga Point , Malibu [in front of lifeguard station]
DHS 101	Will Rogers State Beach 17200 Pacific Coast Hwy. , Pacific Palisades [1/4 mile east of Gladstone's restaurant parking lot and the Sunset storm drain]
DHS 102	Will Rogers State Beach Bel Air Bay Club, 16801 Pacific Coast Hwy. , Pacific Palisades [at the chain link fence just east of the Bay Club]
HYP S3	Will Rogers State Beach Pulga storm drain , Pacific Palisades [50 yards east of storm drain]
DHS 103	Will Rogers State Beach Temescal Canyon storm drain , Pacific Palisades [25 yards east of storm drain]

[48] http://lapublichealth.org/eh/progs/envirp/rechlth/ehrecocdescrip.htm

HYP S4	Will Rogers State Beach Santa Monica Canyon storm drain. , Pacific Palisades [50 yards east of flow]

Table 24 Key to Sampling Agencies

DHS	Department of Health Services
HYP	Los Angeles City, Bureau of Sanitation
CB	Los Angeles City, Bureau of Sanitation
SD	Los Angeles County Sanitation District

LACDHS Beach Grade Methodology
LACDHS Ocean Water Quality Monitoring Program LACDHS.[49]

"The log mean for the past 30 days of data for each sampling station is calculated for total coliform, fecal coliform or *E. coli* and *Enterococcus* bacteria. Sampling data that are influenced by rainfall are excluded.

The 30 day log mean is applied to the tables below to arrive at a grade. Since a grade is generated for each of the 3 types of bacteria tested at each station, the lowest of the three grades is used as the assigned grade.

If there are less than 4 test results in a 30-day period for a any of the 3 bacteria tests, the results are considered insufficient to assign a grade. If all 3 bacteria tests fall into this category the sampling station is assigned an "ID" (insufficient data to assign a grade).

The table for *E. coli* is used in place of Fecal Coliform for sampling data from the Department of Health Service's due to the method of testing performed."

Total Coliform	Fecal Coliform
A <=500 (org/100ml.)	A <=100 (org/100ml.)
B 501 - 1000	B 101 - 200
C 1001 - 2000	C 201 - 400
D 2001 - 3000	D 401 - 600
F >3000	F >600
E. coli	*Enterococcus*
A <=80 (org/100ml.)	A <=18 (org/100ml.)
B 81 - 160	B 19 - 35
C 161 - 320	C 36 - 70
D 321 - 480	D 71 - 105
F >480	F >105

Los Angeles Department of Public Works Bureau of Sanitation
Los Angeles Department of Public Works Bureau of Sanitation - Environmental Enhancement Projects. LADPW. 16 Feb.2004.[50]

Environmental Monitoring (Laboratory sampling, testing and analysis)

Sanitation formed the Environmental Monitoring Division (EMD) in the late 1980's to provide independent testing and analysis of air and water samples from wastewater and solid waste facilities. EMD is currently a fully-accredited laboratory with a staff of nearly 170 employees involved in process, as well as discharge testing, and analysis of impact on receiving waters.

Formed Environmental Monitoring Division (EMD) as an independent division.

[49] http://www.lapublichealth.org/eh/progs/envirp/rechlth/ehrecocgrade.htm
[50] http://www.cityofla.org/san/sanenv.htm

Outfitted EMD with state-of-the-art equipment needed to perform the full range of analyses required by our permits and other mandates. Encouraged development of working relationships with others involved and interested in LA's environment. These relationships include Heal the Bay, American Oceans Campaign, Surfrider Foundation, the County Lifeguard Association, the Regional Water Quality Control Board, EPA Region IX and the County and State Departments of Health Services regarding ocean contamination issues and the Southern California Air Quality Management Division regarding air emissions from our liquid and solid waste facilities. Joined with EPA Region IX, State Water Resources Control Board, Regional Water Quality Control Boards of Los Angeles, Santa Ana and San Diego, County Sanitation Districts of Los Angeles and Orange Counties, and the City of San Diego in the Southern California Coastal Water Resources Project. This project is a compliment to existing marine monitoring research, striving to improve monitoring methods by examining data assessments and investigating how man's activities and waste production affect marine life.

7. Santa Monica Baykeeper

Beachkeeper Monitoring Program and Storm Drain Sampling
Santa Monica Baykeeper Storm Drain Report 2001. SM Baykeeper. 16 Feb.2004.[51]

The Santa Monica Bay Keeper's Beach Keeper program is a volunteer-based beach, storm drain, creek, and marine life monitoring effort centered along the Santa Monica Bay. On a monthly basis Beach Keeper volunteers monitor the 46 miles of coastline, as well as selected adjacent waterways. This program divides the Bay into 16 sections, with approximately one or two volunteers assigned to each section. On a quarterly basis, these volunteers mobilize to collect water samples from flowing drains and creeks in their areas.

Table 25 BeachKeeper Monitoring Locations (in SAMO Study Area):

Section 1	Point Dume to North end of Malibu Road
Escondido Creek	Creek mouth to one mile upstream
Section 2	North end of Malibu Road and PCH to North side of Malibu Pier
Section 3	North side of Malibu Pier to Big Rock Drive
Section 4	Big Rock Drive to Tuna Canyon Road
Section 5	Tuna Canyon Road to Sunset Boulevard
Section 6	Sunset Boulevard to north side of Santa Monica Pier

1. The Goals of this program are to:
2. Monitor and collect samples from discharges along the entire Santa Monica Bay and selected adjacent waterways with consistent full coverage.
3. Identify drains in the Santa Monica Bay that have the most contaminated discharge.
4. Locate sources of point source pollution and eliminate them.
5. Identify trends in water contamination within Santa Monica Bay.
6. Supplement the data of state and federal water quality regulatory agencies.

These objectives are accomplished through the following actions:

BeachKeeper volunteers strive to identify the most polluted or "hot" drains. In doing so, they determine whether contaminants are flowing from a particular drain and therefore have the potential to pollute the surrounding water body. For purposes of this report, the levels set in the Ocean Plan, adopted by the State Water Resources Control Board (State Board) and approved by the EPA, are used as thresholds for the levels of pollutants that are excessive when found in coastal waters. Biological contaminants from humans or other animals are indicated by high colony counts of total coliforms, fecal coliforms, E. coli and enterococci. The human health water contact standards for marine bathing waters are described in the Ocean Plan (1997) as well as implementing regulations for Assembly Bill 411 (AB411).12 For fresh water such as Ballona Creek these standards are contained in guidance from the DHS.13 In addition, other

[51] http://www.smbaykeeper.org/smbay/news/SMBayAnnual1.pdf

contaminants of concern discussed in this report include heavy metals such as lead and copper, which can be harmful to marine life and humans.

Particular BeachKeeper program objectives

1. Compiling and analyzing baseline data collected.
2. Recruiting and maintaining a dedicated volunteer base and making participation fun and easy.
3. Producing quality data by adhering to the guidelines and requirements of regulatory agencies and by implementing a Quality Assurance Project Plan.
4. Providing this data to regulatory agencies to fill in data gaps.
5. Investigating possible sources of pollution in conjunction with the Santa Monica Baykeeper regulatory and enforcement program.

Methods

One of the most critical steps in water quality QA/QC methods is the water sample analysis step. The Program currently utilizes the Southern California Quality Assurance Project Plan (QAPP) as its guide for testing and analysis. Between January 1996 and January 2000 we analyzed water samples for total coliform and E. coli using the membrane filtration technique. Since February 2000 we have been utilizing the Quanti Tray™ method by IDEXX to analyze total coliform, E. coli and enterococci discussed in more detail below. Metals analysis of our water samples is conducted by Castaic Lake Water Agency.

Originally, BayKeeper utilized the widely accepted membrane filtration method, EPA Method 10029, to estimate the total coliform and E. coli populations in stormwater samples. This method was time consuming and expensive. Since February 2000, the program has utilized a new method known as the IDEXX Quanti-Tray™ medium to find the most probable number of coliform colonies in a water sample. This new method is currently being used by the Southern California Coastal Water Research Project (SCCWRP), the Hyperion Sewage Treatment Facility, SCMI, and by other volunteer organizations. The IDEXX method is quick, accurate and cost effective. See e.g., DHS, Recommended Methods for the Analysis of Recreational Marine Water to Comply with AB 411 (March 28, 2000).20

Parameters:
Over the years the BeachKeeper Program has collected samples and tested the waters for many physical, chemical, and biological parameters.

Table 26 Beachkeeper Pollutants of Concern

Total Coliforms	E. coli
Enterococcus	pH
Total Dissolved Solids	Total Suspended Solids
Temperature	True and Apparent Color
Metals	Detergents
Dissolved Oxygen	Total Organic Carbon

List of Metals		
Aluminum	Chromium	Molybdenum
Antimony	Cobalt	Nickel
Arsenic	Copper	Phosphorus
Barium	Iron	Selenium
Beryllium	Lanthamum	Strontium
Boron	Lead	Vanadium
Cadmium	Manganese	Zinc

Baykeeper Snapshot Sampling Events 1999-2001

Over 1,635 station observations were made over the six sampling events with an average 75.7% overall coverage of the drains in our Bay. The intent of the snapshot is to have every inch of coastline from Point Dume to Palos Verdes and portions of Ballona Creek and Escondido Creek monitored within a two and a half hour period. Grab samples are obtained from these flows and are brought back to our in-house lab to be analyzed. Drains that were not flowing were noted in the field reports. The purpose in having this kind of sampling event was to get an overall picture of which drains are flowing during a particular time of year. Moreover, by taking the samples within the same time frame, one can ensure consistent weather and tidal conditions along the coast. Although the Bay Keeper has been collecting water samples for years, in November 1999, the Bay Keeper had its first Bay-wide snapshot sampling event. Including that day, volunteers have successfully completed six snapshot sampling events, four during dry weather (November 6, 1999, February 5, 2000, May 6, 2000 and August 26, 2000) and two wet weather sampling events (January 9, 2001 and April 7, 2001).23

Over 1635 station observations were made over the six sampling events with an average 75.7% overall coverage of the drains in our Bay. The variability in coverage is due to the availability of volunteers to cover given sections. For example, the January 9, 2001 snapshot sampling was a wet weather event for which little notice was possible. Volunteers were given less than 24-hour notification of the sampling event during the middle of the workweek. Wet weather samplings are important because they provide valuable information about the types and amounts of pollutants that collect on our city streets over periods of dry weather. Our second wet weather snapshot, in April 2001, had a higher percent coverage because we were fortunate to have planned a weekend snapshot event well in advance and it just happened to rain the day before this scheduled event.

Specific regulatory recommendations based on the findings in this report include the following:

- Utilize the drain location information from this report to serve as a baseline for source identification under the TMDL program. Each of these drains is a potential source of pollution and should be considered as such in the evaluation of waste load allocations. In wet weather, these load allocations should ensure compliance with AB411 standards at the mouth of the drain or discharge point.
- The BayKeeper recommends that during dry weather all storm drains in the Bay should be diverted to a sewage treatment plant or to water recycling systems (e.g., SMURRF). All non-stormwater drains should be eliminated year round, as they are most likely illegal discharges (unless covered by a separate NPDES permit).
- The ASBS in the northern portion of Los Angeles County must be protected and all discharges to this area must be eliminated.
- The BeachKeeper program should strive for full coverage, especially during rain events. This information will be critical to assessing the absolute number of drains discharging as well as the quality of those discharges.
- Continue monitoring no flow drains to determine whether discharge ever occurs, particularly during wet weather, and assess whether these drains are a problem at all. If individual drains are never flowing, they should be removed by municipalities so as to improve the aesthetics of the beach and prevent potential injury (e.g., from rusted metal
- pipes).
- Expand laboratory parameters to include more enterococci analysis. This would provide a complete data set of AB411 bacterial indicators and more comprehensive pollution information. Recent studies show that enterococci are the most efficient bacterial indicator of water quality.3 6
- Expand the program further into Ballona Creek. This creek is an important waterway to the Santa Monica Bay watershed and continues to be one of the largest sources of contamination to the Bay. Steps need to be taken to stop this pollution and to preserve our creek. The BayKeeper is currently working on structuring this expansion and plans to have it underway by January 2002. Monitoring schedules and parameters will be based on upcoming regulatory and agency needs. The BayKeeper is also working closely with other stakeholders

in the Ballona Creek Watershed Task Force to produce a tangible management plan for the watershed as a whole.

- Utilize the baseline data to create a more focused monitoring program for the drains and sections highlighted in this report. The BayKeeper can also use upcoming regulatory needs (e.g., TMDLs) to help focus on specific parameters for these areas.

(See Santa Monica Baykeeper Storm Drain Report 2001) This report features GPS data of drain locations (in Appendices). A total of 281 drains were mapped in the ASBS "zone of no discharge", from Latigo Point to Mugu Lagoon. Four of the "dirty dozen" sites (fecal bacterial exceedances in four out of six snapshot samples) are located within this zone.

8. Southern CA Bight '03 Study:

As part of the Southern California Bight 2003 Study of ocean and bay waters between Point Conception and Baja California, Mexico, a series of region wide sampling events are planned for the fall and winter (2003/ 2004) to answer some questions on water quality and stormwater flows at beaches next to large drainages. Participating organizations include local health departments, City water/ wastewater agencies, environmental organizations, and private and academic researchers.

Santa Monica Baykeeper is the lead agency for a shoreline/surf zone water sampling comparison.

One aspect of this study is to compare water quality at the shoreline (where routine testing is performed in 4 -12" depth water) to the wave impact zone where most people surf, kayak, body surf, etc. This study will utilize volunteers to paddle their boards or kayaks into the surf zone and collect samples. Surfrider Foundation sent an email to their member list to solicit volunteers. The study will include sampling during the incoming tide (high) and outgoing tide (low).

Sampling locations in Santa Monica Bay will include: Ballona Creek/Venice and Playa del Rey beaches, Malibu Creek/Surfrider Beach."

Surfrider Foundation Malibu Chapter:

Although the Malibu Chapter of the Surfrider Foundation is an advocate of volunteer water quality monitoring, they feel that Heal the Bay, Baykeeper, LA County Public Health and others have nearshore monitoring covered in their area. They occasionally provide some of their volunteers to assist with Baykeeper monitoring events. They recently helped to recruit volunteers for a Baykeeper surf zone water quality study for the Southern CA Bight '03 report.

Beachscape beach-mapping program

Surfrider recently had a "Beachscape" beach-mapping program that was similar in design to the Baykeeper Drain study. Volunteers mapped sections of beach across the entire chapter area (Marina del Rey to Ventura County Line), recording pipe outfalls, streams, coastal armoring, etc.

Aerial Deposition Study

Measuring and Modeling of Atmospheric Deposition on Santa Monica Bay and the Santa Monica Bay Watershed. UCLA/SCCWRP/AQMD.[52]

SUMMARY OF FINDINGS:

1. Aerial deposition is a significant contributor to the overall pollutant load to the Bay for trace metals such as lead, chromium, and zinc.

[52] http://www.santamonicabay.org/uploads/library/texts/AtmoDepSMBSumm.pdf

The contribution of atmospheric to total metal loading to the Bay for the five metals studied varies from 13% to 99% (see Table 1). These percentages are computed based on the hypothesis that the deposition on the watershed (land) also reaches the Bay as runoff during the wet season. This hypothesis is supported by the fact that the predicted deposition on the watershed is the same order of magnitude as the measured metal loading in the runoff. The actual contribution of air deposition to urban runoff will be evaluated in future research.

Table 27 Comparison of atmospheric and non-atmospheric trace metal inputs to Santa Monica Bay (mt/year)

Trace Metal	Atmospheric Input	Non-Atmospheric Input	Percent Atmospheric
Chromium	0.77	0.76	50%
Copper	5.1	16.0	24%
Lead	4.2	0.02	99%
Nickel	0.79	5.24	13%
Zinc	17.7	23.6	43%

2. On an annual basis, daily dry deposition of metals on Santa Monica Bay and its watershed far exceeds the amount deposited during rain events. Chronic daily dry deposition is also far greater than deposition occurring during Santa Ana conditions when large volumes of polluted air blows from inland out to sea.

Dry deposition of metals on Santa Monica Bay and its watershed occurs throughout the year, with the deposition during the summer season only slightly higher than during the winter. Chronic dry deposition of metals on the surface of Santa Monica Bay is significantly enhanced by the presence of a diurnal offshore wind. This results in an onshore-offshore gradient of deposition over the scale of the Bay that is evident in the samples of trace metals taken from the sea surface microlayer (see Figure 3). The daily quantities of metals deposited on Santa Monica Bay and its watershed during Santa Ana and rainfall events are comparable to the chronic daily deposition. It is interesting to note that the infrequency of Santa Ana events and the region's relatively low rainfall totals do not make them significant factors in determining the total deposition load

3. Most of the mass of metals deposited by dry deposition on Santa Monica Bay and its watershed originates as relatively large (bigger than 10 microns) aerosols from area sources (off-highway vehicles such as construction equipment and small businesses) in the Santa Monica Bay watershed.
The breakdown of metal emissions by size and source category in the 1988 SCAQMD emission inventory indicates that for all of the metals studied, the largest mass is typically in the larger aerosol size fractions, vehicles and small businesses, Figure 4). A major result of the presence and predominance of larger aerosols is that most of the deposition is composed of aerosols greater than 10 microns in size (Figure 5) and most deposition occurs relatively close to the emission source. For example, 75% of zinc deposition originated from sources within the Bay watershed; only 4.5% of zinc deposition is from sources outside of Los Angeles County.

MANAGEMENT IMPLICATIONS AND ACTION RECOMMENDATIONS

The conclusions summarized in the preceding section have several implications for the management of non-point sources in the Santa Monica Bay watershed, and for other coastal watersheds exposed to urban air pollution:

- At least for metals, atmospheric deposition, primarily chronic daily dry deposition, must be considered as a significant non-point source in establishing TMDLs for Santa Monica Bay and waterbodies in the Bay's watershed.

Reductions of non-point source inputs may require a coupling between air quality and water quality regulatory actions and policies. For metals, the most important sources of emission to the atmosphere are non-permitted area sources (e.g., small businesses and off-highway vehicles such as construction equipment) which may be relatively difficult to regulate.

Further research should be carried out in the following areas:

- Pinpoint the sources of aerial deposition in the Bay watershed.
- Study the deposition of other pollutants of concern such as nutrients, pesticides, mercury, etc.
- Determine how aerial deposition is transformed into urban runoff, and how much of it is transformed into runoff.

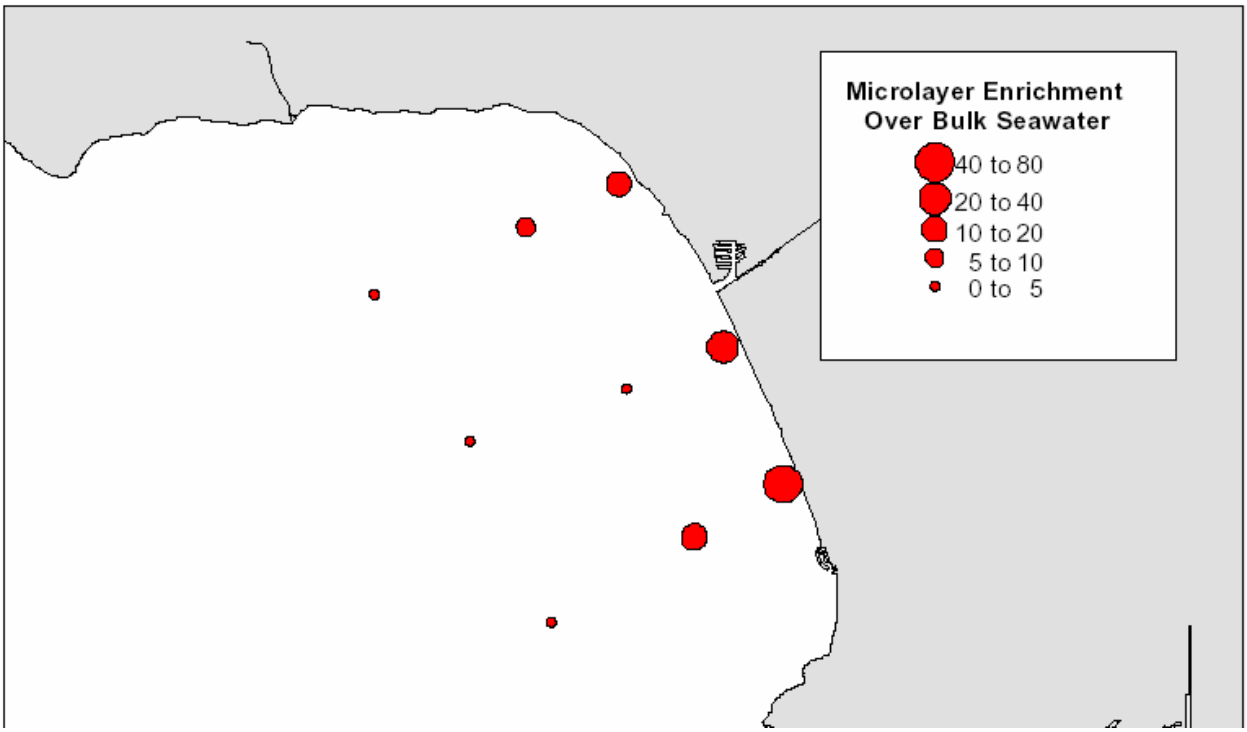

Figure 23 Spatial distribution of zinc enrichment measured in the sea surface microlayer (ratio of the zinc concentration in the microlayer to the zinc concentration in the bulk water).

V. Channel Islands NP Freshwater Water Quality Monitoring

Background:

Mediterranean Coast Network FY2001 Budget and Projected FY2002 Budget for Water Quality Monitoring. 9 August 2001. National Park Service. 16 Feb. 2004[53]

"Channel Islands National Park is part of an island chain lying just off California's southern coast. The five park islands and their surrounding one nautical mile of ocean comprise Channel Islands National Park. These islands and the adjacent submerged lands were set aside as a national park because of their outstanding and unique natural and cultural resources. Channel Islands National Park was designated an

[53] http://www.nature.nps.gov/im/units/nw29/Reports/MCN_Workplan_WQ_01.pdf

International Biosphere Reserve in recognition of its genetic diversity and importance as an environmental baseline for research and monitoring. In addition, Congress declared the waters surrounding the park islands out to six nautical miles as a National Marine Sanctuary.

Maintaining and/or improving water quality in both marine and freshwater ecosystems is an important objective of the Park. Though the islands lie 14 to 40 miles from the coast, the large population and industrial activities of the area have affects on the water quality. Relatively heavy boat traffic around the islands, natural seeps, boat groundings, or, rarely, major catastrophes such as the 1969 oil spill of Santa Barbara are sources of petroleum pollution. The extensive oil production facilities and tankering through the area pose a concern of future catastrophic oil spills. Other potentially serious water pollution sources include discharge from ships, sewage disposal or thermal pollution from nuclear plants, but none of these has been found to significantly impact island resources. Urban runoff brings debris, pesticides, nutrients, and potentially harmful bacteria to coastal waters that easily reach the islands during storms. Over a billion gallons of urban waste is discharged daily into the southern California Bight. Heavy metals and organochlorine pesticides still persist from past dumping in the ocean waters here. This resulted in reproductive failure of California brown pelicans, bald eagles, cormorants, and peregrine falcons, and caused problems with seals and sea lions. Banning of DDT in the United States in 1971 has resulted in substantial recovery of pelicans, cormorants, and peregrine falcons."

Figure 24 Channel Islands National Marine Sanctuary map, showing the five Islands of Channel Islands National Park[54]

Horizon Report for Channel Islands NP

In March 1999, the Baseline Water Quality Data Inventory and Analysis "Horizon Report" was completed for Channel Islands National Park. The study queried six of the EPA's national databases:

1. (STORET) Storage and Retrieval water quality database management system
2. (RF3) River Reach File

[54] http://www.cinms.nos.noaa.gov/pcw2/pcwproject.html

3. (IFD) Industrial Facilities Discharge
4. (DRINKS) Drinking Water Supplies
5. (GAGES) Water Gauges
6. (DAMS) Water Impoundments

Of these, only STORET and RF3 resulted in data retrievals. The study identified 15 monitoring stations sampled for a total of 14 parameters from 1983 to 1994. Eleven of the stations are located on Santa Rosa Island. Eight of the stations represent either one-time or single year intensive sampling efforts by the collecting agencies.

This study located freshwater water quality data for only two park islands, Santa Cruz and Santa Rosa Islands. The Santa Cruz Island sampling was a single–sample event in Joyce Spring Canyon. The Santa Rosa Island data reflects monitoring done in four canyons in 1993-94. These sites were re-sampled in 2001-02.

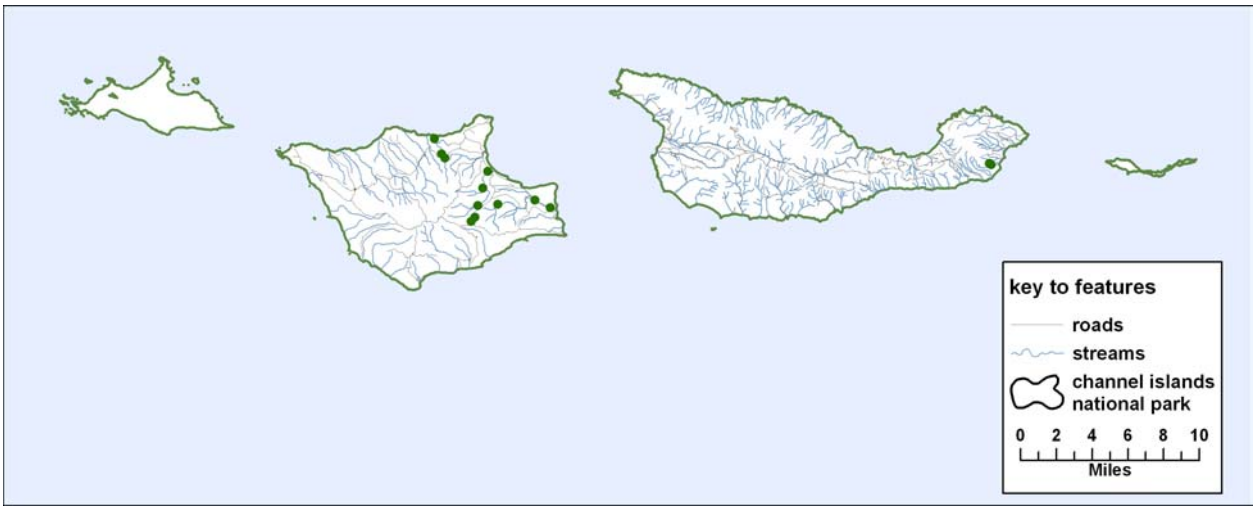

Figure 25 Water Quality sampling locations on Santa Rosa and Santa Cruz Islands

Santa Rosa Island Studies:
Freshwater water quality monitoring within Channel Islands National Park has focused on Santa Rosa Island because of the degradation of valley bottoms and riparian areas as a result of livestock grazing. The watersheds of Santa Rosa Island have been the focus of two water quality studies. A baseline inventory of water quality on Santa Rosa Island was completed in 1995. The second study concluded recently (2003), and is a follow-up study of water quality since the cattle were removed.

Mediterranean Coast Network FY2001 Budget and Projected FY2002 Budget for Water Quality Monitoring. 9 August 2001. National Park Service. 16 Feb. 2004.[55]

"Santa Rosa Island is the second largest island within Channel Islands National Park (54,000 acres). Purchased in 1986 from the Vail and Vickers Company, the island supported domestic livestock grazing (sheep and cattle), and a managed herd of deer and elk. It is estimated that the most severe degradation of the stream bottoms occurred during the sheep era where between the years 1850-1900 as many as 125,000 sheep grazed the island at one time. However, water quality degradation continued throughout the 20th century as cattle replaced sheep grazing from 1902-1998. Cattle grazing on Santa Rosa Island degraded water quality to the point where the State of California (Central Coast Regional Water Quality

[55] http://www.nature.nps.gov/im/units/nw29/Reports/MCN_Workplan_WQ_01.pdf

Control Board) issued a Cleanup or Abatement Order (CAO) against the Park. Under this CAO the Park is required to do intensive water quality monitoring (bacti and inorganic) and reduce non-point water sediment from roads. Rescission of the CAO requires intensive monitoring to demonstrate improvement in water quality conditions following the post-grazing era. For Santa Rosa Island the major perturbation has been removed, but the Park has not been able to systematically document recovery of the island's freshwater ecosystems."

CHIS will soon complete a water-quality monitoring project assessing vegetation and stream morphology on Santa Rosa Island with the goal of documenting changes in water quality since cattle were removed from the island in 1998. The project includes conducting Level II characterization of the Old Ranch Watershed (Rosgen Channel Classification); monitoring fifty-six nested-rooted frequency and cover riparian transects established in the Quemada Stream drainage; re-surveying nine precise cross-section profiles in the Old Ranch stream to measure changes in channel morphology; and establishing a 1,000 meter stream condition assessment transect (using R5 Forest Service Stream Condition Assessment Protocol) in Arlington Stream. Components of the project included inorganic and bacteria water sampling, measurement of channel morphology, vegetation sampling, and installation of photopoints.[56]

A. Scheduled FY 2003 Activities and Products:

CHIS completed a report on the Santa Rosa Island water quality monitoring project (see 7.3b, above). The report will be given to the Central Coast Regional Water Quality Control Board as part of the Park's effort to rescind a Cleanup or Abatement Order. Road improvements will also be documented and presented as part of the rescission package.

Complete baseline inventory of estuaries on Santa Rosa and Santa Cruz Islands. Complete laboratory analysis of marine water quality samples for CHIS."

Santa Cruz Island
The "Horizon Report" study identified four stations on Santa Cruz Island. These stations are: Joyce Spring Upper Pool, Joyce Spring Lower Pool, Joyce Spring 100m downstream from spring, and Joyce Spring Canyon Mouth

These were all single samples on 8-23-83. The following parameters were tested: Water temperature (°C), Conductivity (specific conductance, (umhos/cm @ 25c), and Total Dissolved Solids (Residue, total filterable, dried at 180c), (mg/l)

B. CHIS Ocean / Beach/ Nearshore Water Quality Monitoring[57]

There are plans within the park to expand water quality monitoring to marine ecosystems, including conducting baseline inventories on estuaries which have yet to be described or have been minimally described on Santa Rosa and Santa Cruz Islands. Laboratory analysis of marine water quality samples will also be completed in an effort to demonstrate the importance of conservation efforts within the park and Channel Islands National Marine Sanctuary.

Currently, in the marine environment, the park monitors intertidal organisms and kelp forests.

---

[56] Administrative Report (FY 2002) and Workplan (FY 2003) for Biological Inventories and Vital Signs Monitoring. 25 Oct. 2002. Pg.18. NPS Mediterranean Coast Network. 16 Feb. 2004.
http://www.nature.nps.gov/im/units/nw29/Reports/MCN_Report_02-03.pdf

[57] Mediterranean Coast Network FY2001 Budget and Projected FY2002 Budget for Water Quality Monitoring. 9 August 2001. National Park Service. 16 Feb. 2004.
http://www.nature.nps.gov/im/units/nw29/Reports/MCN_Workplan_WQ_01.pdf

1. FY 2002 Accomplishments:

(a) CHIS and CABR worked with seven other partners from the government, academic institutions, and the private sector as part of a monitoring group, MARINE, to develop and implement a regional program for rocky intertidal monitoring. Comprehensive baseline surveys were conducted. The group also created standardized protocols and developed a centralized database for the regional monitoring data.

(b) The CHIS kelp monitoring program was expanded to include San Clemente Island through contract with the US Navy.

2. Channel Islands NP Areas of Special Biological Significance

Section 36710 (f) of the Public Resources Code states: "In a state water quality protection area point source waste and thermal discharges shall be prohibited or limited by special conditions. Nonpoint source pollution shall be controlled to the extent practicable."

ASBS No. 17: San Miguel, Santa Rosa, and Santa Cruz Islands, Areas of Special Biological Significance, Santa Barbara County
DESCRIPTION: Waters surrounding San Miguel, Santa Rosa, and Santa Cruz Islands to a distance of one nautical mile offshore or to the 300-foot isobath, whichever is the greatest distance.

ASBS No. 22: Santa Barbara Island, Santa Barbara County and Anacapa Island Areas of Special Biological Significance, Ventura County
DESCRIPTION: Waters surrounding Santa Barbara and Anacapa Islands to a distance of one nautical mile offshore or to the 300-foot isobath, whichever is the greater distance.

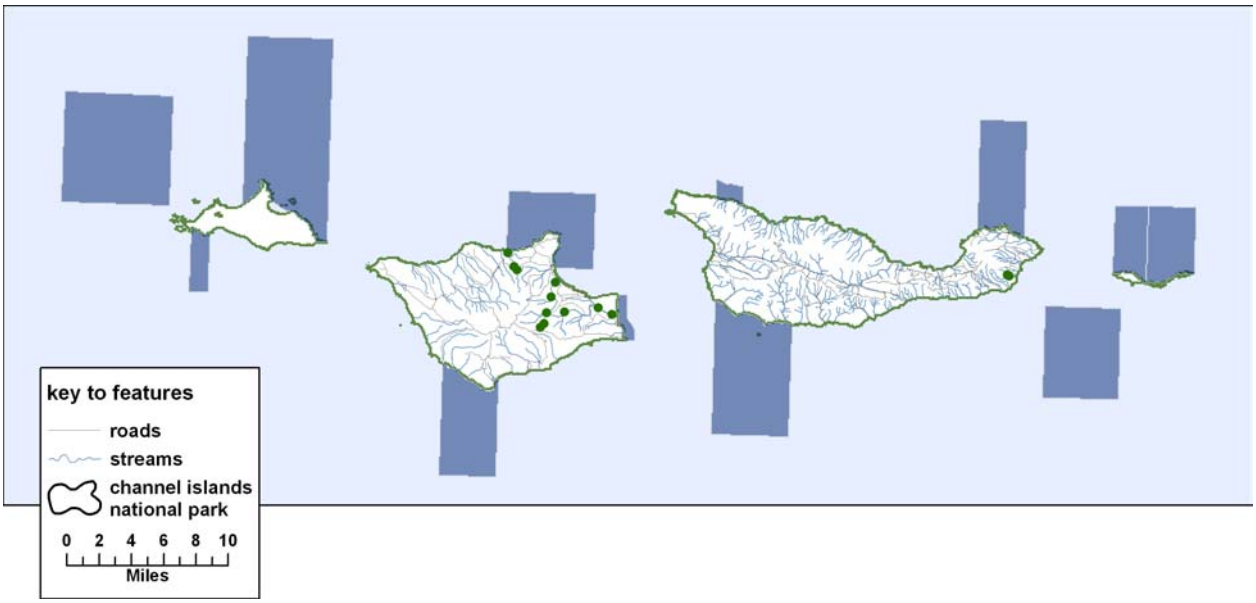

Figure 26 Marine Protected Areas within the four northern islands of Channel Islands National Park

3. Channel Islands National Marine Sanctuary

In general, there are prohibitions against taking or disturbing any bird, sealife, or minerals in the Sanctuary, disturbing the seafloor unless incidental to anchoring or bottom trawling; and exploring or drilling for oil except if the oil lease was executed prior to March 30, 1981. Activities conducted by the

Department of Defense necessary for national defense are exempted from the prohibitions. Other activities, such as exercises, conducted by the Department of Defense that are not deemed necessary for national defense are generally subject to prohibitions unless specifically permitted. Operations conducted during an emergency are also generally exempted from prohibitions. Discharge of water and other biodegradable effluents incidental to vessel use, including effluent from marine sanitation devices, deck wash down, engine exhaust or meals on board vessels is allowed. Disposal of bilge water with any concentration of oil is prohibited within these Sanctuaries. Disposal or discharge of any harmful substance is prohibited.[58]

4. SWRCB Cruise Ship Wastewater Regulation Report

In August of 2003, the State Water Resources Control Board released a report by the multi-agency Cruise Ship Environmental Task Force titled Regulation of Large Passenger Vessels in California. This report provides a background for the environmental regulation of the cruise ship industry in California. Following is an excerpt from this report:

Regulation of Large Passenger Vessels in California. Aug. 2003. Cruise Ship Environmental Task Force. 16 Feb. 2004. <www.swrcb.ca.gov/legislative/docs/cruiseshiplegrpt.pdf>

Cruise Ship Wastewater

The operation of cruise ships, like other oceangoing vessels, generates a significant amount of wastewater. These waste streams can come from lavatory use by passengers, galley functions in preparation and handling of foods, dishwashing and laundry facilities, ship maintenance, deck washing, and swimming pool and spa operation. Some of these waste streams are treated on-board ship for removal of harmful substances and human waste products. Many vessels have installed sewage treatment facilities, which are required to be certified by USCG. These MSDs are used to treat the sewage produced on-board ships. The quality of the effluent produced from MSDs installed on vessels may vary significantly, depending on the type of system installed and the maintenance performed.

Graywater – the water generated from showers, galley, or other non-sewage waste streams – is unregulated except in Alaska. Some ships treat graywater to remove pollutants, and some do not.

Unlike shoreside facilities, vessels are exempt from NPDES permitting requirements. NPDES permits are required in order to discharge wastewater effluent from municipal or industrial sources into the waters of the state. The unregulated discharges of wastewater from cruise ships have caused concerns over water quality of the oceans and coastal waters. Beach closures are a daily occurrence because of sewage or other forms of pollution. Most species of fish, many of commercial value, have suffered severe reductions in numbers to the extent that many species cannot be commercially harvested. Public health restrictions have been placed on most species of edible fish due to the bioaccumulated toxins in the flesh of the fish. Consumption of fish with these accumulated toxins can adversely affect human health.

5. Santa Barbara Channelkeeper

Mission

Santa Barbara Channelkeeper's mission is to protect and restore the Santa Barbara Channel and its watersheds, through enforcement, citizen action, and education. To carry out this mission, Santa Barbara Channelkeeper has established five essential goals for the organization:[59]

---

[58] Regulation of Large Passenger Vessels in California. Aug. 2003. Cruise Ship Environmental Task Force. 16 Feb. 2004. http://www.swrcb.ca.gov/legislative/docs/cruiseshiplegrpt.pdf

[59] Santa Barbara Channelkeeper's Mission and Goals webpage. SB Channelkeeper. 16 Feb.2004. http://www.sbck.org/aboutsbck/goalsandaccomplishments.htm

(1) Eliminate industrial and other pollution to the Channel;
(2) Eliminate beach closures;
(3) Protect local wetlands;
(4) Monitor water quality; and
(5) Restore aquatic ecosystems.

SB Channelkeeper Water Quality Monitoring Programs

During 2000-2001, Channelkeeper designed and implemented a comprehensive water quality monitoring program along the length of the Ventura River, from near the ocean to above Matilija Dam. Each month, staff and community volunteers test the water at 15 sites throughout the Ventura River watershed. We monitor for temp, turbidity, dissolved oxygen, conductivity, bacteria and nutrients.

Channelkeeper staff and volunteers regularly monitor runoff from Santa Barbara's storm drain system because storm drain discharges represent the single largest source of ocean pollution. Samples are tested in ChannelKeeper's in-house lab. We are currently in the process of identifying the worst storm drains. When we complete this investigation, we will present recommendations to the City on how to eliminate pollution from this major source.

Channelkeeper's boat, "the Magic," makes regular forays into the Channel. We use our boat to implement our "Rig Watch" program, which is designed to involve the local community in keeping an eye on the oil industry's activities in and around the Channel.

6. Potential Threats to Park Waters

(pers. comm. Jessie Altstatt 5-5-03):

Container ship traffic: There are many large ships that very closely pass Santa Cruz and Anacapa Islands. Slicks have been seen behind container ships.

Illegal pleasure craft waste dumping: There are questions about how local areas are affected by pleasure craft dumping -- considering doing some surveys for bacteria at several anchorages during the summer.

Military dump sites to the south of Anacapa and Santa Cruz: Not sure if the information is declassified yet, or what exactly was dumped.

7. Ventura County Stormwater Monitoring Program

Stormwater discharges are of potential concern for the Channel Islands because of the possibility that sediment plumes carrying nutrients and possible contaminants could affect Island waters after a large storm. (see Plumes and Blooms Study info in following section)

The Ventura Countywide Stormwater Monitoring Plan (Plan) includes both stormwater management and scientific elements. The collection and analysis of stormwater samples across Ventura County and the analysis and interpretation of the resulting data are the central activities of the Plan. The Plan is currently comprised of four major objectives:[60]

1. Characterizing stormwater discharges by monitoring sites representative of different land uses: industrial, agricultural, and residential.
2. Establishing the impact of stormwater discharges on receiving waters by conducting receiving water quality, mass emission, and bioassessment monitoring.

[60] Ventura Countywide Stormwater 2002/03 Monitoring Report. July 2003. http://www.vcstormwater.org/sitemap

3. Identifying pollutant sources based on analysis of monitoring data, inspection of businesses, and investigation of illicit discharges.
4. Defining stormwater program effectiveness using data collected before and after implementation of pollution prevention programs.

In the 2000/01 monitoring year, wet weather and dry weather water samples were collected at three types of monitoring locations: land use, receiving water and mass emission. Stormwater quality monitoring was conducted at three specific land use discharge characterization sites and two receiving water monitoring sites. In addition, two mass emission sites were sampled for the first time during dry and wet weather events.

The Plan also includes a bioassessment monitoring program. In 2000/01, a Work Plan for instream bioassessment monitoring in the Ventura River watershed was developed as part of the revised Stormwater Management Plan (SMP) submitted to the RWQCB in November 2001. In addition to the preparation of the work plan, the Ventura County Flood Control District (VCFCD) conducted a March 2001 training session on bioassessment monitoring techniques and participated in the Heal the Bay bioassessment training program. The actual bioassessment monitoring was accomplished on September 24-26, 2001 and is included in the 2001/02 annual report.

In January 2001, VCFCD began participating in the Ventura River Stream Team volunteer monitoring effort. VCFCD provides technical guidance and assistance for volunteer monitoring at thirteen sites on the Ventura River.

The Program is also in the process of upgrading the land use and receiving water monitoring station to include remote access and state of the art telemetry equipment. In addition, automated sampling equipment was added to the new mass emission stations and at a receiving water station.

Discharge characterization sites monitor industrial, residential, and agricultural discharges. The receiving water sites monitored during the 2000/01 season include one site located on Santa Clara Drain (at La Vista Ave.), which drains to upper Revolon Slough, and one site located lower on Revolon Slough (at Wood Road). The mass emission monitoring stations were located at the lower end of the Calleguas Creek watershed at the California State University at Channel Islands Bridge and at the lower end of the Ventura River watershed at Foster Park

8. UCSB Plumes and Blooms Study

Scientists from the University of California, Santa Barbara (UCSB) are very interested in the impacts of the sediment plumes and phytoplankton blooms on the marine environment. In order to study this phenomenon they have organized the "Plumes and Blooms" project, which began in 1996. The organizations involved include UCSB and their Institute for Computational Earth System Science (ICESS), the National Oceanic and Atmospheric Administration (NOAA), and the Channel Islands National Marine Sanctuary (CINMS).[61]

David A. Siegel, R.C. Smith, M. Brzeziniski, L. Mertes, L. Washburn, M.J. Neumann. Plumes and Blooms: Studying the Color of the Santa Barbara Channel. Project website. Institute for Computational Earth System Science. UC Santa Barbara.[62]

Each year, winter rains wash sand, mud and other debris into the Santa Barbara Channel. During the spring and summer tiny, single-celled plants, called phytoplankton, increase their populations dramatically and provide the primary energy source for the entire marine food web. This creates an alternating pattern of brown terrestrial sediments and green marine algae suspended in the surface waters of the Santa

[61] Channel Islands National Marine Sanctuary Online Classrooms-Plumes and Blooms Project. CINMS. Feb. 2004. http://www.cinms.nos.noaa.gov/pcw2/pcwproject.html
[62] http://www.crseo.ucsb.edu/PnB/Overview.html

Barbara Channel and also in the sediments in the Santa Barbara Basin. This pattern mimics a "tree ring" structure which gives scientists the rare opportunity to examine the historical records for important climatic processes such as rainfall and forest fire occurrence which can affect important ocean processes such as fishery abundances. An understanding of the sources of sediment plumes and how the sediment geochronology relates to upper ocean productivity is critical for the interpretation of this important sedimentary record. For UCSB ocean color scientists, the alternating patterns of brown sediment plumes and green algae blooms provide an excellent field laboratory for understanding and modeling the color of the sea. This is particularly timely since several satellite sensors will be deployed in space over the next year, each having the potential to make detailed maps of ocean color. The spectral characteristics of the reflected light from the sea will be directly related to the particulates and dissolved materials in it. The primary goal of the Plumes and Blooms research program is to develop numerical algorithms to relate the satellite-sensed ocean color signal to useful quantities for ocean scientists and coastal zone managers.

The Plumes and Blooms project conducts most of its research on every other Monday of each month. These cruises are called core cruises because they are conducted on a regular basis & provide the bulk of the data that is collected. The cruise involves a transect of seven sample stations in the Santa Barbara Channel beginning at Santa Barbara harbor and continuing across the channel to San Miguel Island.

AVHRR IMAGE OF SANTA BARBARA CHANNEL

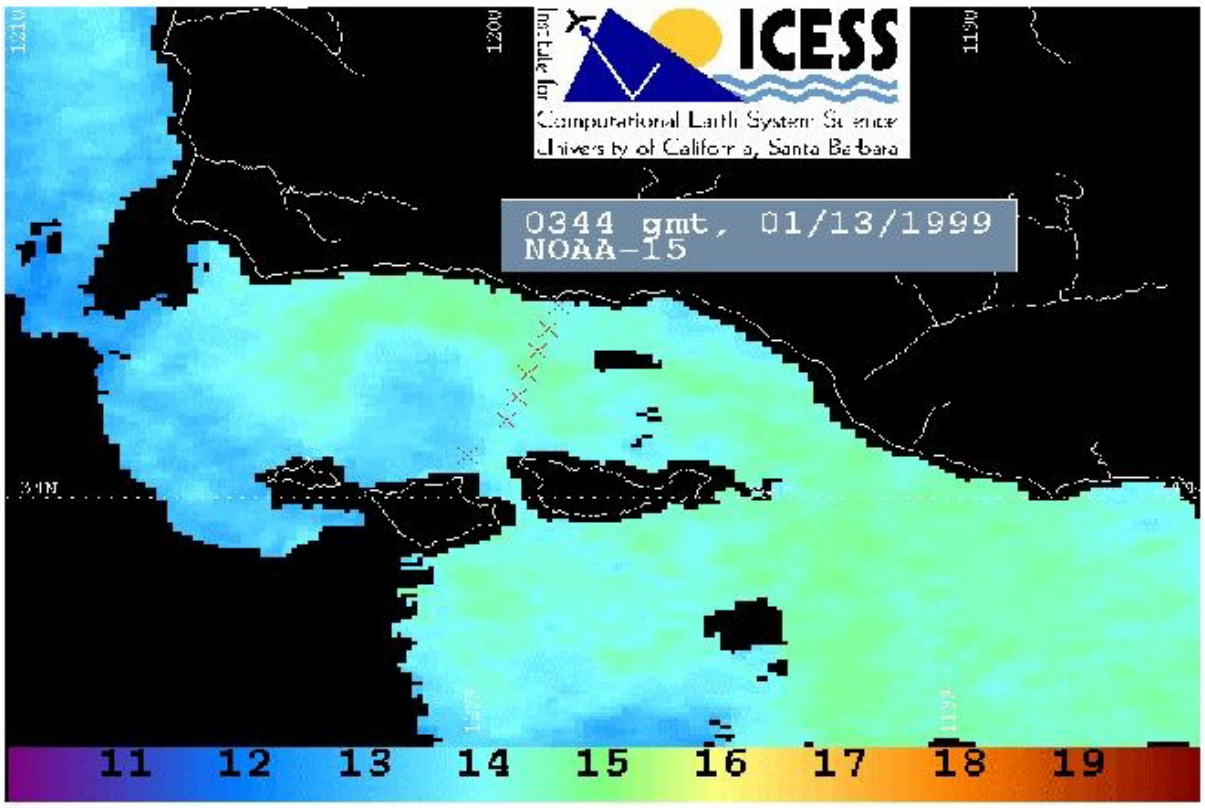

Figure 27 AVHRR SST image showing the location of Plumes and Blooms Stations.[63]

Station 1 is located nearshore. Station 7 is located off Santa Rosa Island. SST pattern suggests gyre-like circulation.

[63] http://www.icess.ucsb.edu/PnB/projects/water_mass/wtr_mass.html

In addition to the core cruises the project also goes out during storms and takes water samples at the mouth of the Ventura harbor. These cruises are called process cruises - A cruise that is conducted during a significant event in the channel such as a winter storm or a period of heavy rain.

Sampling methods: see Plumes and Blooms Methods Manual[64]

9. Surfrider Foundation - Ventura Chapter Monitoring Programs

Having monitored the progress of SCCWRP the last few years and the daunting task ahead, this opportunity for volunteer involvement from our chapter is most definitely within the mission of Surfrider. Correlation of data needs to be established to determine the nexus between on shore, near shore and offshore pollution levels if we are to be effective in our quest for clean oceans. Now all that being said, gearing up to help will take a bit of doing but the template has already been shaped by the Blue Water Task Force model.[65]

10. Southern California Coastal Water Research Project Volunteer Opportunities:

Shoreline-Offshore Bacterial Survey

In conjunction with the Bight '03 water quality committee, a preliminary plan is being generated to survey the relationship of the on-shore, off-shore bacterial concentration, specifically in the areas of fresh water discharges. Eight fresh water systems (4 large and 4 small systems) in the Bight have been selected for study. They are: The Tijuana River, the L.A.River/Domiguez Channel/ Santa Ana and San Gabriel River system, Ballona Creek, and the Santa Clara/Ventura systems (large discharge systems), and @San Diego Bay/Mission Bay, San Alejo Lagoon, Aliso Creek, and Surfrider Beach/San Luis Rey Creek (small discharge systems). The plan consists of collecting at least seven (7) shoreline, and seven (7) surf zone water samples at each site. The test locations are planned to be spaced approximately proportional to the volume of water discharged from each site, and aligned temporally and spatially with the off-shore survey being conducted by the Bight water quality team. It is planned to conduct this exercise twice during dry weather (one low tide, and one high tide) late this summer/fall (September 10th, October 24th). Four (4) similar exercises are planned at the "first flush" next season at days 1, 3, 4, and 5 following the first rain event. Three (3) bacterial indicators will be measured; total, fecal (E-coli), and enterococcus. Ancillary data may include water temperature, salinity, turbidity, toxicity and field observations (wind, weather, birds etc.). SCCWRP staff will generate appropriate chain of custody forms, and maintain a data bank for this survey. Volunteers will be relied upon to help collect the in-water samples, and transport them, in accordance with established protocol, to the nearest Bight test laboratories. More information on the details of this project can be obtained by contacting the local watershed participating agency; Sanitation District, or Health Care Agency, or NGO; (Southern California Marine Institute, Surfrider Foundation, Algalita Marine Research Foundation and Santa Monica Baykeeper).

Bacterial Indicator Intercalibration Survey.

Participating laboratories from each of the five Counties in the Bight have been invited to bring a quantity of water quality samples from chronic polluted sites in their watershed to Orange County Sanitation District (OCSD) on June 10th to share with other laboratories. A test matrix would then be made up consisting of polluted samples from marine, urban runoff, and mixed (lagoon) water. The test samples would then be transported back to the participating laboratories for evaluation by the test methods that they most commonly employ (MF, MPN, or multiple tube). At least three (3) replicates of all three indicators; total, fecal (E-coli), and enterococcus, are requested. The results would then be reviewed for both inter-laboratory and intra-laboratory consistency and precision. It is anticipated that any problems

[64] http://www.icess.ucsb.edu/PnB/MethodsManual.html
[65] Surfrider Blue Water Task Force Newsletter. May 03. Ventura Surfrider Foundation.
From: http://www.west.net/%7Esrfrdrvc/html/news/may_03_news.htm#volunteer

arising from this exercise that would preclude participating laboratories from contributing valid survey data, will be resolved in advance of the Shoreline-Offshore Bacterial Survey.
Volunteer monitor staffed laboratories are invited to participate to the limit of their respective laboratory capacity. This is an excellent opportunity for those volunteers having this capability to validate their laboratory procedures, and gain credibility in their reported results.

Microbiological Source Tracking (MST)

MST technologies offer the promise of identifying the source of the microbial pollution (bacteria). Is it human or animal? This distinction is important because it would help our policy makers reach a more informed decision regarding where to effectively spend our resources (for example, sewer systems or urban runoff).

A recent comparative study, involving 21 researchers and 12 classes of samples indicated that several methods showed promise, although none were completely successful. The biggest problem was the high percentage of false positives. Most methods could not reliably identify the predominant organism from a sample containing several bacterial sources. In general, genotype technologies scored better than phenotype technologies. For our applications, technologies that do not require large sample libraries would be preferred. At the present time, no practical, cost-effective method of direct pathogen (virus) detection in marine waters exists, although there continues to be research directed towards this goal.
Because of the wide variability of the technologies, it was decided by our committee that the MST investigation would be put in abeyance until a suitable study plan within the capacity of our collective laboratory resources could be arrived at.

11. Ventura County Dept. of Environmental Health[66]

In September 1998, the Ventura County Board of Supervisors directed the Environmental Health Division to develop a program to monitor the bacteriological quality of ocean water at Ventura County beaches. The Ocean Water Quality Monitoring Program was developed with the primary purpose of providing the public with accurate and timely information about the bacteriological quality of ocean water. This information is conveyed via:

- Web site updates
- Beach warning sign postings
- Information hotline
- Press releases

Over 50 beach locations along the entire 42 miles of Ventura County coastline are sampled each week. Maps of these locations can be found on our web page: Beaches and Sampling Results.

Our sampling sites have been selected based on the numbers of public use and their proximity to storm drain outflows. Storm drains include pipes, culverts, rivers, creeks and streams. Ocean water samples are collected in ankle-to-knee deep water and tested for three different "indicator" bacteria: total coliform; fecal coliform; and *Enterococcus*. These three "indicators," at sufficient concentrations, indicate the potential presence of other bacteria (pathogens) in the ocean water that may cause human illness.

[66] County of Ventura Environmental Health website. Program mission. 16 Feb. 04.
http://www.ventura.org/envhealth/programs/ocean/mission.htm

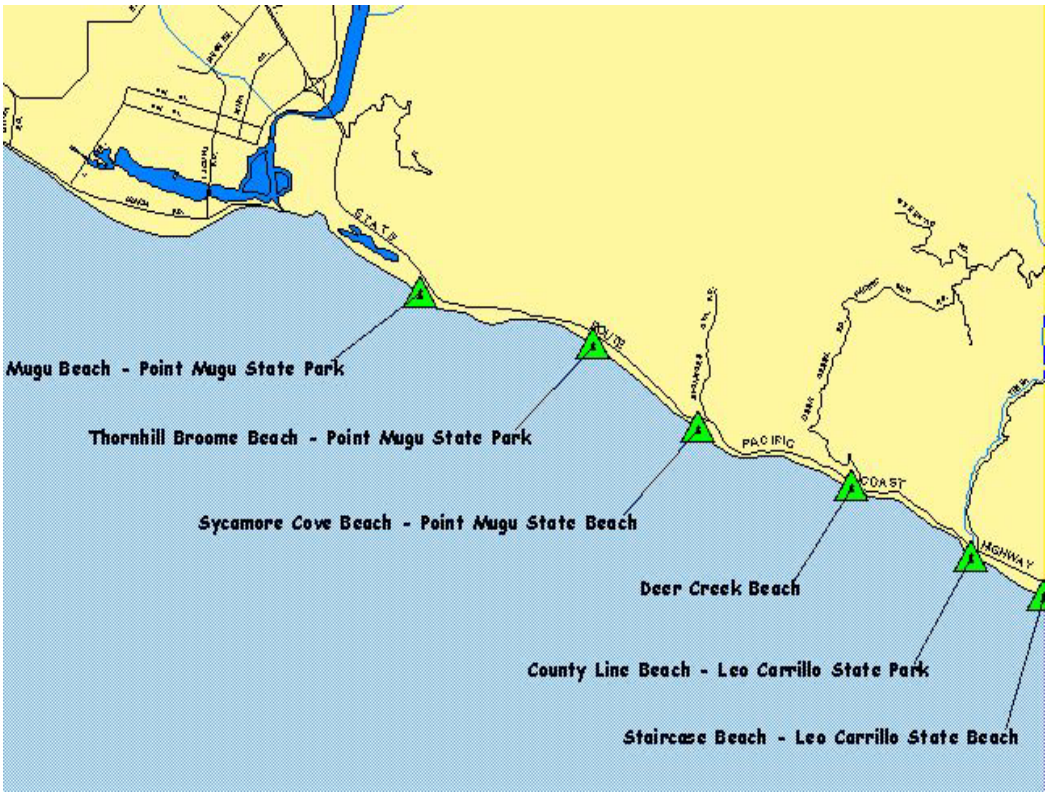

Figure 28 These Ventura County DEH monitoring sites fall within ASBS No.24 Mugu – Latigo

VI. Cabrillo National Monument Water Quality Monitoring:

Background

Cabrillo National Monument (CABR) is a small (160 acres of land area) urban national park site. CABR is located at the end of Point Loma (San Diego, CA), a long peninsula that is bordered by the Pacific to the west and San Diego Bay to the east. The oceanside of the peninsula coastline is mostly undeveloped, consisting of rocky intertidal habitat, with isolated sandy and cobble beaches. Most of the bayside of the peninsula shoreline is highly developed for various military and shipping activities. The jurisdiction of CABR includes approximately 120 acres of rocky intertidal and subtidal habitat. The rest of the coastline of the peninsula is owned by the U.S. Navy, the US Coast Guard or the City of San Diego (Point Loma Wastewater Treatment Plant). The small CABR tidepool area receives over 100,000 visitors every year, and is an important educational and recreational resource for the city of San Diego. Access to the rest of the shoreline on Point Loma is restricted.

Due to the geology of Point Loma, there are few freshwater resources in CABR. There are some freshwater seeps in the park which support a markedly different vegetation community than is found elsewhere in the park, including ferns and herbaceous plants. Very is little known about these communities, including the total number and specifics of their location, and given the lack of fresh water sources on the peninsula, they could have a critical role in the ecology of this arid ecosystem. A basic inventory and characterization of seeps at CABR and throughout the Point Loma Ecological Reserve would be an important first step toward filling this information gap.

Over 300 species of marine algae and invertebrates have been documented in the CABR tidepools, including unusually large owl limpets (*Lottia gigantea*) and abundant juvenile spiny lobsters (*Panulirus*

interruptus). A number of fish, such as opaleye (*Girella nigricans*) and garibaldi (*Hypsypops rubicundus*) use the tidepools as a nursery ground. Various shorebirds and seabirds use the CABR intertidal as a foraging ground. Great blue herons (*Ardea herodias*), which are protected under the federal Migratory Bird Treat Act, actively nest on Point Loma. They are often seen feeding in the CABR tidepools. Occasionally, seals or sea lions will haul out within CABR jurisdiction.

NPS has been conducting ecological monitoring in the CABR tidepools since 1990. After the first five years of monitoring, it was determined that seven out of the thirteen invertebrate and plant species that were being monitored had either declined or disappeared entirely from the area. Abalone, mussels, and boa kelp populations were of particular concern. Ochre seastars (*Pisaster ochraceus*), commonly found throughout the rest of San Diego County, have essentially disappeared from Point Loma. As a result of this study, one third of the CABR intertidal was closed to all visitors, a small no-use reserve commonly referred to as "Zone III". The purpose of this restriction is to allow the area to recover.

The causes of these declines are unknown. Some of the anthropogenic threats to tidepools include the effects of heavy visitation, sand inundation from upcurrent beach replenishment, climate change, and pollution. The effects of poor water quality are potentially quite serious in Point Loma. San Diego Bay is a very active harbor with various shipping, industrial, and military activities. It is the second-most toxic harbor in the nation, according to a 1998 study by NOAA and the California State Water Resources Control Board. CABR is located at the mouth of the bay and is bathed in bay water during daily tidal flushing. Marine organisms within CABR are likely exposed to heavy metals, persistent organic compounds and hydrocarbons originating in the bay. Zone III, the no-use area, is located at the southern tip of Point Loma and is most exposed to bay water. California mussel (*Mytilus californianus*) populations, which have declined from approximately 30% to close to 0% cover in the past ten years, have been hardest hit in the no-use area. The source of this decline is unknown, but this pattern indicates that pollution is a potential cause.

Although San Diego Bay is likely to be the most significant source of pollutants to CABR, additional sources include local surface runoff, sewage, and Mission Bay, to the north of Point Loma. The Point Loma Wastewater Treatment Plant is adjacent to CABR boundaries, although the discharge pipe is located 7 km offshore in approximately 100 m of water and is unlikely to directly affect the area. In 1992, a large sewage spill caused the closure of the CABR tidepools. No direct effects of this spill were detected.

Although San Diego Bay is monitored for water pollution, the water quality of Point Loma is relatively unknown. Beginning in 1986, the NOAA Mussel Watch Program used the soft tissues of mussels and other bivalves to monitor pollution all over the United States. One of their sites was the Point Loma Lighthouse (i.e. Cabrillo National Monument). This site was listed, along with 20 other sites nationwide, for having "high and increasing concentrations" of mercury and nickel in 1993. Mussel Watch stopped using the Point Loma Lighthouse site, since the mussel populations had crashed and taking samples was no longer possible. Currently, little is known about the heavy metal exposure of the habitat within CABR boundaries. The City of San Diego monitors bacterial counts in Zone III.[67]

A. FY 2002 Accomplishments

The CABR rocky intertidal monitoring program has directly resulted in significant researcher interest in related issues. New projects initiated in just the last year include an investigation of the effects of trampling and sand on turf communities (Tonya Huff, Scripps Institution of Oceanography), study of the size and growth rates of owl limpets and a full inventory of CABR's mollusk populations (Dr. Kaustav Roy and students, University of California San Diego), and research into the disappearance of ochre seastars at CABR (Corrina Marote, University of California Los Angeles), lobster life history and habitat use (Dr.

[67] Administrative Report (FY 2002) and Workplan (FY 2003) for Biological Inventories and Vital Signs Monitoring. Mediterranean Coast Network. 25 Oct. 2002. NPS. 16 Feb. 2004. http://www.nature.nps.gov/im/units/nw29/Reports/MCN_Report_02-03.pdf

Kevin Hovel and students, San Diego State University), and population genetics of surfgrass limpets (Emina Begovich, University of California Berkeley).

Conducted monitoring of tidepools, vegetation communities, and air quality at CABR.

A tidepool monitoring workshop was held in November, 2001. Funding support for the workshop came from the Cabrillo Marine Institute. A report will be available in FY 2003.

B. Scheduled FY 2003 Activities and Products:

Continue to monitor tidepools, vegetation communities, and air quality as described in monitoring plan…

…Tidepool monitoring has detected a large decline in California mussel populations at Cabrillo National Monument and the disappearance of a once-common predator, the ochre seastar. Documentation of these and other changes that have lead to the closure of a third of the parks tidepools to all visitors. (See article below for more details.)

Local citizens protect tide pools at Cabrillo National Monument

Tide pools at Cabrillo National Monument in San Diego, CA, draw people from all over to see the last remnants of these fascinating windows on the sea. More than 100,000 visitors explored the sea's edge here every year in the 1980s. Concern about trampling and other visitor disturbance on tide pool health prompted the National Park Service to start monitoring tide pool vital signs in 1990 with community volunteers.

Three years later community attention was riveted on Monument tide pools when the city's municipal sewage outfall pipe broke adjacent to the monument. Treated effluent covered the tide pools twice a day for two months. The area was closed during this period to protect human health, and many feared the worst for the tide pools. When the pipe was fixed and people could safely return, they found an amazing sight. Far from ruined by the effluent, the tide pools sported plush carpets of algae and an "Emerald City of Oz" look. After two month's respite from visitor trampling and probing, the improved tide pool vital signs allowed people to see what effect they had been having on the fragile veneer of algae and anemones, mussels and barnacles, and myriad other critters. As a result, the public has supported the park's decision to close 1/3 of the tidepools in 1996. This small marine reserve allows for the replenishment of species within it, and is utilized as a vital tool in determining the effects of human impacts. Currently all marine monitoring in the park is done by volunteers. Since the program's inception in 1990, over 200 volunteers have helped out with the assistance of only one paid NPS staff member. Additionally, over 50 volunteer docents create a constant presence in the park during weekends and good daytime low tides. Their job is to protect the resource by enforcing park rules and acting as educators to teach the public about the resource and explain why the rules exist. A team of more specialized volunteers helps with different marine projects, studying invertebrate settler monitoring, vouchering our species lists, monitoring visitation, office work, and individual research. Community leaders recognized their opportunity to restore monument tide pools and provide valuable educational and recreational opportunities. They are now actively engaged with the National Park Service and other agencies in tide pool restoration and continued monitoring to assure that future generations can enjoy unimpaired tide pools.

C. Reports, Publications and Presentations

Becker, Bonnie. 2002. Using Trace Element Signals in Mytilid Mussel Shells to Determine Larval Sources. (Presentation given at Larval Biology meetings, September 2002, Vigo, Spain and Western Society of Naturalists, November 2002, Monterey, CA.)

Becker, Bonnie. 2001. Rocky Intertidal Monitoring at Cabrillo National Monument.
(Presentation given at West by Northwest, March 2001, Seattle, WA; Western Society of

Naturalists, November 2001, Ventura, CA; and Scripps Student Seminar Series, December 2001, La Jolla, CA.)

Becker, Bonnie. 2001. Mussels, Lasers, and Marine Reserves. (Presentation given to North County Sierra Club, September 2001, Escondido, CA.)

D. CABR Freshwater water quality monitoring

There are no surface water resources within the boundaries of CABR or the PLER. There are a few freshwater seeps that have been identified within the monument, and the Park would like to complete basic inventory and characterization of these areas.

E. CABR Ocean / Beach/ Nearshore water quality monitoring

1. San Diego County Department of Environmental Health

San Diego County Department of Environmental Health Ocean Water Quality in San Diego County. Information page for lifeguards and public. SD County DEH. 16 Feb. 2004.
<http://www.sdcounty.ca.gov/deh/lwq/beachbay/lifeguards.html >
The San Diego Department of Environmental Health tests weekly at county beaches for the following parameters: Total Coliform, Fecal Coliform and *Enterococcus* Bacteria.

Laboratories use either the Membrane Filtration (MF) or the Most Probable Number (MPN) method to determine the density of fecal coliform bacteria in water samples. Fecal coliform bacteria in sewage are indicators of more harmful organisms associated with water contaminated by fecal matter from warm-blooded animals. The State standard used to determine water contamination is 400 fecal coliform bacteria per 100 milliliters of sample water. Results can be read 2 to 3 days after samples are taken.

Sunset Cliffs Park

Bermuda Avenue Station

Ladera Street Station

Woodward Road Station

Point Loma Treatment Plant Station

Lighthouse Station

The legend above corresponds to the five monitoring stations below, from top to bottom.

The map below is from the "Earth 911" website for San Diego County. It portrays water quality monitoring locations in the CABR area:[68]

[68] Earth 911 Beach Water Quality website. SD County. 16 Feb. 2004.
http://www.earth911.org/WaterQuality/default.asp?beach_id=27&cluster=1

Figure 29 Heal the Bay posts the weekly results of the sampling at these stations on its Beach Report Card webpage.

At the Point Loma Treatment Plant station, the period from 6-9-00 to 1-23-04 only had four grades that were not an A+ (four F's from 12-7-04 to 1-2-04). The Lighthouse Station near the tip of Point Loma also had mostly A+ grades, except for one F, a D and two C's (for the period between 8-17-00 and 9-9-00).[69]

2. City of San Diego Storm Drain Sampling

Storm drain sampling is conducted weekly by the City of San Diego. The city Stormwater Pollution Prevention Program includes a Receiving Water Monitoring Department. The program samples, monitors and records the health of recreational waters throughout the City of San Diego. The data accumulated will assist the City in setting priorities, determining appropriate remedies and identifying education.

Storm drains in San Diego are not a part of the wastewater system. This important distinction means that materials emptied into storm drains do not go to a wastewater treatment facility. Whatever enters the storm drain system from City streets - such as oil from automobiles, fertilizers from yard runoff and dirty water from washed cars - empties directly into the nearest body of water, such as the San Diego River or the Pacific Ocean.[70]

Currently, the one exception is the Mission Bay Sewer Interceptor System. This system operates during dry weather to divert storm drain flows away from Mission Bay and into the sewer system for treatment

[69] http:www.healthebay.org/brc/gradehistory.asp?beach=359
[70] City of San Diego Metropolitan Wastewater District webpage – Storm Drains. 16 Feb. 2004 http://www.sannet.gov/mwwd/environment/stormdrains.shtml

and disposal at the Point Loma Wastewater Treatment Plant. Using City funds and a 2003 Environmental Protection Agency grant of $6.1 million, an additional 28 interceptors will be built along the coast from La Jolla south to Pacific Beach by 2005.[71]

Municipalities in San Diego County collect and discharge storm water and urban runoff containing pollutants through their storm water conveyance systems. The San Diego Regional Water Quality Control Board (Regional Board) issued the required NPDES permit (commonly referred to as the Municipal Storm Water Permit for San Diego Co-permittees) to local jurisdictions including the City of San Diego, which requires the implementation of programs to reduce pollutants in storm water and urban runoff. This permit, originally issued in 1990, was significantly revised when it was renewed on February 21, 2001 as Order No. 2001-01, NPDES No. CA0108758, "Waste Discharge Requirements for Discharges of Urban Runoff From the Municipal Separate Storm Sewer Systems (MS4) Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District".

3. Pt. Loma Wastewater Treatment Plant Outfall Monitoring

The San Diego Water Utilities Department conducts an Ocean Monitoring Program as part of the environmental monitoring requirements for the Point Loma Sewage Outfall. The City released the report: "Annual Receiving Waters Monitoring Report for the Point Loma Treatment Plant Outfall, 2001".[72] This report provides detailed accounts of the offshore monitoring program. The program includes chemical and biological testing of ocean waters, sediments, fish and benthic infauna. Most of the monitoring stations are close to the sewage outfall; however, stations range geographically from the shoreline to six miles offshore and from La Jolla to the Mexican border.

Figure 30 Pt. Loma Treatment Plant

[71] City of San Diego Stormwater Pollution Prevention Program webpage. Overview/ background. 16 Feb. 2004. http://www.sannet.gov/stormwater/overview/background.shtml
[72] http://www.sannet.gov/mwwd/pdf/ploorpt01.pdf

Figure 31 Pt. Loma Outfall

4. Point Loma Ocean Outfall

The Point Loma Ocean Outfall was built in 1963 for the discharge of treated wastewater into the ocean. In 1993, the Outfall was extended from a length of two miles off the coast of Point Loma to its present length of 4.5 miles. Twelve feet in diameter and operating via gravity-feed, the Outfall ends in 320 feet of water and splits into a Y-shaped diffuser to ensure wide dispersal of effluent into ocean waters.The Point Loma Outfall is one of the longest and deepest in the world. Approximately 180 million gallons of wastewater treated at the Point Loma Wastewater Treatment Plant are discharged through the Outfall each day.

The Point Loma Wastewater Treatment Plant is adjacent to CABR boundaries, although the discharge pipe is located 7 km offshore in approximately 100 m of water and is unlikely to directly affect the area. In 1992, a large sewage spill caused the closure of the CABR tidepools. No direct effects of this spill were detected.[73]

5. State Impairments for San Diego Bay

Table 28 USEPA 1998 TMDL's for Dan Diego Bay[74]

State Impairment	Parent Impairment	Priority Rank	Targeted Flag	Anticipated TMDL Submittal
COPPER	METALS	HIGH	N	JUL-31-2003
BENTHIC IMPACTS	GENERAL WQS (BENTHIC)	HIGH	N	JUL-31-2003
SEDIMENT TOXICITY	UNKNOWN TOXICITY	HIGH	N	JUL-31-2003

[73] Mediterranean Coast Network FY2001 Budget and Projected FY2002 Budget for Water Quality Monitoring, 9 Aug. 2001. NPS. 16 Feb.2004.
http://www.nature.nps.gov/im/units/nw29/Reports/MCN_Workplan_WQ_01.pdf
[74] http://oaspub.epa.gov/pls/tmdl/enviro.control?p_list_id=CAB900%2E00S%2E%20DIEGO%20BAY&p_cycle=1998

F. SD Regional Water Quality Control Board Programs

1. State Mussel Watch program (SMWP)

APPENDIX D
State Mussel Watch Program
Station Sampling History

Station Number	Station Name	Sample Year* 78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
744.0	San Onofre Nuclear Plant Outfall	--	--	--	--	--	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--
744.1	San Onofre 1	--	--	--	--	--	--	--	--	--	--	--	EO	--	EO	EO	--	--	--	--	--
744.2	San Onofre 2	--	--	--	--	--	--	--	--	--	--	--	EO	EO	EO	EO	--	--	--	--	--
744.3	San Onofre 3	--	--	--	--	--	--	--	--	--	--	--	--	EO	EO	EO	--	--	--	--	--
744.4	San Onofre 4	--	--	--	--	--	--	--	--	--	--	--	EO	EO	EO	EO	--	--	--	--	--
744.5	San Onofre 5	--	--	--	--	--	--	--	--	--	--	--	EO	EO	EO	EO	--	--	--	--	--
744.6	San Onofre 6	--	--	--	--	--	--	--	--	--	--	--	EO	EO	EO	EO	--	--	--	--	--
748.0	Oceanside/Harbor	--	--	--	--	--	--	--	E	E	E	E	--	--	--	--	EO	--	--	--	--
750.0	Oceanside	EO	EO	EO	EO	EO	EO	EO	EO	EO	EO	EO	EO	EO	EO	EO	EO	--	EO	O	EO
751.0	Oceanside/Transplant	--	--	--	E	--	--	--	--	--	--	--	--	--	EO	--	--	--	--	--	--
753.0	Inner Agua Hedionda	--	--	--	--	--	--	--	--	--	EO	O	--	--	--	--	--	--	--	--	--
800.0	Ingraham Street/North	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
830.0	Torrey Pines	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
831.0	Scripps Oceanographic Inst Pier	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
832.0	La Jolla	EO	EO	EO	--	--	--	--	--	--	--	--	--	--	EO	EO	EO	--	--	--	--
833.0	Boomers Point	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
834.0	Bird Rock	--	--	E	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
835.0	Pacific Beach	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
836.0	Mission Bay/North Jetty	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
837.0	Mission Bay/South Jetty	--	--	--	E	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
838.0	Crystal Pier	--	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
838.2	Point Loma/Sunset Cliffs	--	--	--	--	--	--	--	--	E	E	E	E	E	EO	E	E	--	--	--	--
839.0	Point Loma/Pink House	--	--	--	E	EO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
839.2	Point Loma/STP Outfall	--	--	--	--	--	--	--	--	E	E	--	--	--	--	--	--	--	--	--	--
840.0	Naval Ocean Sys Cntr/Dolphin Tanks	--	--	--	E	E	EO	--	EO	E	--	--	E	--	--	--	E	--	--	--	--
840.2	Point Loma/Coast Guard Station	--	--	--	--	--	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--
841.0	Coronado Hotel	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
842.0	Imperial Beach	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
849.0	Point Loma/A9d	--	--	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--
849.5	Point Loma/A9s	--	--	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--
850.0	Point Loma/STP/A8s	--	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
850.5	Point Loma	--	--	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--
852.0	Point Loma/A10s	--	--	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--	--
864.0	Mission Bay/Yacht Club	--	--	--	--	--	--	E	--	--	--	--	--	--	--	--	--	--	--	--	--
865.0	Mission Bay/Hilton Docks	--	--	--	--	E	--	EO	--	--	--	--	--	EO	--	--	--	--	--	--	--

* Sample Year = State Fiscal Year (July 1 - June 30). For example, Sample Year 78 = 1977-78 Fiscal Year.
-- = Not Sampled. O = Synthetic Organics Only. E = Trace Elements Only. EO = Trace Elements and Synthetic Organics.

This chart from <http://www.swrcb.ca.gov/programs/smw/docs/9597/appendix_d.pdf>shows nine stations listed for Point Loma. Most of these were sampled between 1981 and 1983 for trace elements.

Although San Diego Bay is monitored for water pollution, the water quality of Point Loma is relatively unknown. Beginning in 1986, the NOAA Mussel Watch Program used the soft tissues of mussels and other bivalves to monitor pollution all over the United States. One of their sites was the Point Loma Lighthouse (i.e. Cabrillo National Monument). This site was listed, along with 20 other sites nationwide, for having "high and increasing concentrations" of mercury and nickel in 1993. Mussel Watch stopped using the Point Loma Lighthouse site, since the mussel populations had crashed and taking samples was no longer possible. Currently, little is known about the heavy metal exposure of the habitat within CABR boundaries. The City of San Diego monitors bacterial counts in Zone III.[75]

Excerpt from the SD Bay Natural Resources Management Plan (September, 1999) Table of Contents:

2.3 Water and Sediment Quality
2.3.1 Historical Conditions

[75] http://www.portofsandiego.org/sandiego_environment/nrmp/Titleinformation.pdf

2.3.2 Current Conditions
2.3.2.1 Contaminants
2.3.2.2 Coliform Contamination
2.3.2.3 Other Water Quality Conditions
2.3.3 Regional Comparisons
2.3.4 Ecological Effects
6.1 Concepts and Models for Monitoring and Research
6.1.1 Tenets for Design of a Monitoring and Research Program
6.1.2 Key Management Questions
6.2 Program Elements
6.2.1 Long-term Monitoring for the Bay's Ecological Condition and Trend
6.2.2 Project Monitoring
6.2.3 Research to Support Management Needs
6.3 Data Integration, Access, and Reporting

Excerpts from SD Bay Natural Resources Management Plan -Chapter Two:

2.3.2 Current Conditions

Present day water quality concerns for San Diego Bay focus mainly on the quantities of contaminants found in the sediments, shellfish, and other marine organisms (Lapota et al. 1993). Monitoring studies and research are continuing to seek answers to the many questions about the Bay's water and sediment quality condition. The entire San Diego Bay is listed as an impaired water body (under Clean Water Act (CWA) Sec. 303[d]) by the California State Water Resources Control Board (SWRCB) due to benthic community degradation and toxicity. Some ecological effects of impaired water quality are discussed in Section 2.3.4 "Ecological Effects".

2.3.2.1 Contaminants

Contaminants that are currently of concern in San Diego Bay include:

- chlordane (total)
- chromium
- copper
- mercury
- TBT
- zinc
- PAH compounds
- PCBs (total)

2. Bay Protection and Toxic Cleanup Program

As part of California's (RWQCB) ongoing Bay Protection and Toxic Cleanup Program (BPTCP), San Diego Bay's sediment was evaluated for chemical and biological conditions between October 1992 and May 1994 (Fairey et al. 1996). Results indicated chemical pollution based on established sediment quality guidelines, developed by National Oceanic and Atmospheric Administration (NOAA) and the State of Florida and used as a substitute for absent US Environmental Protection Agency (EPA) and California guidelines. Major chemicals or chemical groups most often found to exceed threshold quality values were copper, mercury, zinc, total chlordane, total PCBs, and the PAH compounds. Seven stations (representing four sites) in this Program were given high priority ranking based on toxicity, chemical and benthic community data: Seventh Street channel area, two Naval installation areas near the Coronado Bridge, and the downtown Anchorage area west of the airport. Forty-three stations were given moderate priority ranking, mostly commercial and Naval installation areas in the vicinity of the Coronado Bridge.

PAH pollutants are organic compounds that are among the heaviest molecular fraction of petroleum hydrocarbons (Woodward-Clyde 1996). Because they are not very soluble in water and tend to accumulate as particulates in aquatic systems, they can become persistent as well as concentrated within the aquatic food chain. Commonly found at high levels in estuarine and marine sediments near industrial centers, they serve as a continual source of contamination for biotic communities (Kennish 1997). PAHs are released through fossil fuel combustion, asphalt production, leaching of creosote oil, and spills of oil, gasoline, diesel, and other petroleum products. An overall criticism of the available literature on PAHs is the absence of enough high quality data to estimate mass loadings. Ultra-low PAH detection methods are necessary, yet there is still a major void in knowledge on atmospheric fallout of pyrogenic PAHs and the pathways to receiving waters (P. Michael, California Regional Water Quality Control Board, pers. comm.). Recent studies evaluated the sources of two contaminants, copper and PAHs, for San Diego Bay (PRC 1996; Woodward-Clyde 1996). While not peer-reviewed, these studies suggest the relative amounts estimated to come from various sources (Figures 22 and 23). Copper's major origin appears to derive from ship and boat hulls (77%), with the leaching of copper-containing antifouling hull paints the primary cause and in-water hull cleaning the secondary cause. In contrast, PAH origins are the leaching of creosote from pier pilings in the Bay (61%), followed by in-place sediments introduced to the water column, mainly through dissolved molecules (27%).

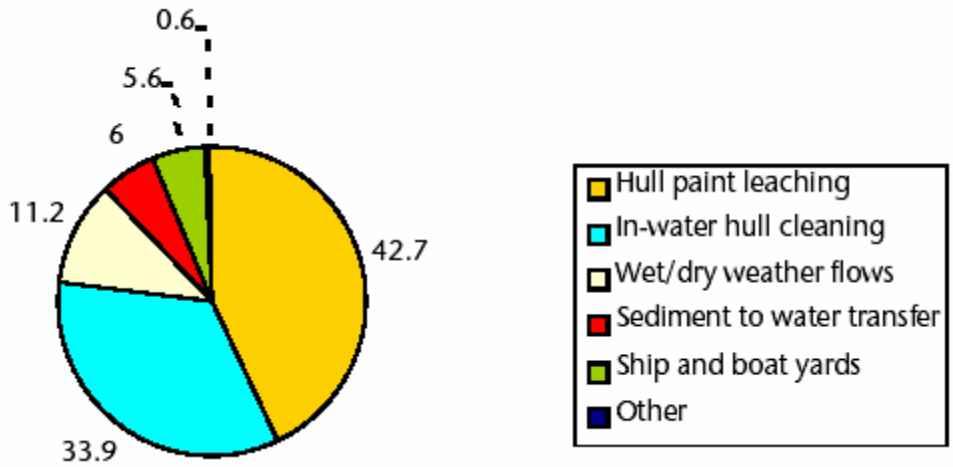

Figure 32 Percent Total Copper Loading to San Diego Bay

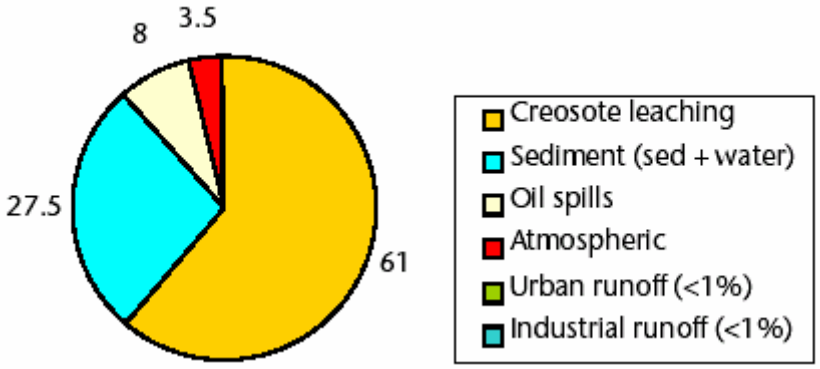

Figure 33 Percent Total PAH Loading to San Diego Bay

The Navy measured PAH and copper concentrations in 1997 to assess the effects of its recent changes in bilge water operations and the removal of creosote impregnated pier pilings at NAVSTA (US Department of the Navy 1998). Total PAH concentrations ranged from 24 to 200 micrograms per liter (µg/l) during two surveys, reaching maximum levels near NAVSTA. Sources of PAH appeared to be from weathered creosote and fuel product sources. Copper concentrations ranged from 0.41 to 4.18 µg/l. Increased copper levels were found in semi-enclosed basins and at NAVSTA. PAH levels were the lowest measured in the Bay in the past eight years, and significantly lower by a factor of nine at NAVSTA sites, which was attributed to the operational changes by the Navy there. However, copper levels at NAVSTA were not significantly lower, though the remainder of the Bay had significantly lower copper concentrations.

Levels of TBT, formerly a serious problem in the Bay's marinas, have decreased significantly since this component of antifouling paints was restricted to Navy ships in 1988 (Valkirs et al. 1991). TBT also naturally degrades to tin. However, TBT still remains a serious concern in areas of high vessel density and low hydrologic flushing (California Regional Water Quality Control Board 1994). Sediment concentrations at commercial and Naval basin areas have declined but are still higher than other areas in the Bay (Fairey et al. 1996).

PCBs are extremely persistent in the environment and can cause various carcinogenic and adverse effects to marine life and people. Total PCB pollution was most prominent in sediments along the Naval installation waterfront as well as several locations along the downtown waterfront and small boat harbors. Chlordane, an insecticide discontinued in the mid-1970s, has caused extensive contamination along the north shore of the Bay and in areas receiving storm runoff (Fairey et al. 1996).

Since several pollutants are known to bioaccumulate in the tissues of marine species, a tissue contamination study was recommended for PCBs, chlordane, and possibly methylmercury to determine potential human health problems associated with consuming resident species of finfish and shellfish (Fairey et al. 1996). Contaminants of uncertain concern in regard to bioaccumulation include tin, cadmium, silver, lead, and organotin. Of these, tin, cadmium, and lead have all been detected at elevated levels in San Diego Bay's sediments (Mearns 1992). PAHs are known to be absorbed and to accumulate in marine organisms and have the potential to cause cancer, mutations, and abnormal growth (Kennish 1997).

Contaminant levels are being reduced through sediment remediation projects at priority sites. Since 1990, the Port has removed contaminated marine sediments from Tenth Avenue Marine Terminal (TAMT), National City Marine Terminal (NCMT), America's Cup Harbor (ACH), and East Harbor Lagoon (San Diego Unified Port District 1995). Regional Board Cleanup and Abatement Orders require that remaining sediments in boatyards achieve a copper level below 530 ppm and a mercury level below 4.8 ppm.

According to the RWQCB, San Diego Region, the following sites have been cleaned up as of September 1998:

1. PACO Terminals at 24th St. Marine Terminal (copper)
2. Kettenburg boatyard (copper, mercury, TBT)
3. Bay City Marine boatyard (copper, mercury, TBT)
4. Driscoll boatyard (copper, mercury, TBT)
5. Mauricio boatyard (copper, mercury, TBT)

The following sites have cleanup agreements with RWQCB:

1. Campbell Marine shipyard,
2. National Steel and Shipbuilding shipyard
3. Southwest Marine shipyard.

The following sites were capped:

1. Teledyne Ryan Aeronautical storm drains (PCBs)
2. Stennis Ocean Control Carrier (CVN) site (PCBs, copper, zinc).

Coliform Contamination

Coliform contamination of the Bay can become a problem near stormwater outfalls and streams following rain storms. The first major rainfall of the season contributes high levels (Macdonald et al. 1990; San Diego Unified Port District1995). High levels of bacteria were measured in the 1993–1994 wet weather season at the receiving waters of Chollas and Switzer Creeks (San Diego Unified Port District 1995). Sources of this contamination most likely include leaking or broken sewer lines, illegal dumping of sewage, and domestic animal feces. The County of San Diego has monitored recreational sites in the Bay for indicator bacteria for several years, with many exceedances of state recreational water contact standards near storm drains and in poor circulation areas (San Diego Bay Interagency Water Quality Panel 1998).

The City of San Diego's Public Health Department has had to close beaches in recent years due to sewage spills ranging from 1,300 to 3,000 gal (Rodgers 1997). Sewage from broken lines enters storm drains and contaminates the Bay during dry weather as well as wet. Another source of coliform contamination is illegal dumping of sewage from recreational boats and live-aboard boats.

Other Water Quality Conditions

Nutrient levels compared favorably in 1993 to those from 1980 (Lane 1980; Lapota et al. 1993). January had the highest concentrations of phosphate (0.2 to 3.1 µg technical atmosphere per liter [at/l], nitrate (12.0 to 31.9 µg-at/l), and ammonia (3.5 to 9.3 µg-at/l). Chlorophyll concentrations ranged from 1.8 to 18.9 µg/l at their highest in January. These levels correlate with maximum algal production that month, with measured nutrients higher in south Bay than north Bay. High chlorophyll levels in 1993 were thought to be the result of increased nutrient loading from the freshwater runoff into the Bay.

With its large watershed, the Bay receives drainage from the cities of San Diego, National City, Chula Vista, Lemon Grove, El Cajon, Bonita, Imperial Beach, and Coronado, and from surrounding communities as far east as the Cuyamaca Mountains (San Diego Unified Port District 1995). Storm drains and streams deliver pollution from many nonpoint sources: automobile oil and grease that build up on roads and parking lots, fertilizer runoff from lawns, illegal dumping of chemicals, yard debris, garbage, and soil erosion. The National Sediment Quality Survey identified San Diego Bay's watershed as an Area of Probable Concern in 1997 because 32 sampling stations showed sediment contamination where associated adverse effects to aquatic life were probable (Tier 1) (US Environmental Protection Agency 1997).

Regional Comparisons

Within the Bight, a review of the long-term findings reveals that most contaminants increased during the 1950s and 1960s, but decreased during the 1970s and 1980s (Mearns 1992). Metals in fish have not elevated and have not changed, despite significant pollution controls. Pesticide levels are 100 times lower today. Overall, the levels of most pollutants in the open coastal zone are now declining compared to their levels of 30 to 40 years ago. However, sediments of bays and harbors are more contaminated than the open coast. Major gaps are evident in trend monitoring for bays and harbors where "long-term monitoring has been virtually nonexistent," according to Mearns (1992).

.

In a 1987 regional survey, PAHs in sediments collected at southern California stations between Santa Monica Bay and San Diego Bay found the Seventh Street (Paleta Creek) and Chollas Creek stations to contain the highest levels of these hydrocarbons of all stations sampled (Anderson and Gossett 1987). Comparing ten coastal sites in southern California, a 1988 study revealed samples from San Diego Bay to have the highest concentrations of metals, PAHs, and hydrocarbons of all stations sampled and were the most toxic in two out of three toxicity tests used (Anderson et al. 1988). The 1997 National Sediment Quality Survey determined that San Diego Bay, San Francisco Bay, and offshore areas around San

Diego and Los Angeles appear to have the most significant sediment contamination in the EPA's Region 9 (US Environmental Protection Agency 1997).

The Southern California Coastal Water Research Project (SCCWRP) regional monitoring effort should be able to provide some valuable comparable data among the various southern California bays and ports in a few years (P. Michael, pers. comm.).

Ecological Effects

The effects of the historically high sewage pollution levels on the Bay's flora and fauna were partially documented in the 1950s and 1960s (San Diego Regional Water Pollution Control Board 1952; Terzich 1965). The CDFG and the Federated Sportsmen of San Diego County reported great changes in the numbers and types of fish and wildlife using the Bay. By 1952, the Bay only supported a few of the "particularly sturdy rough fish," with no evidence of croaker, corvina, sand bass, halibut, or sea trout and few bait fish. Razor clams, cockles, and scallops had disappeared and migrating waterfowl only used the Bay occasionally for a brief stopover. A die-off of hundreds of ducks, gallinules, cormorants and other shorebirds, and large numbers of cockle clams and fish in the south Bay in the spring of 1952 was attributed to the discharge of toxic metal processing wastes (San Diego Regional Water Pollution Control Board 1952). A zone of about 373 acres (151 ha) on the east shore was devoid of benthic invertebrates due to the toxic effects of thick sludge deposits. Laboratory tests by CDFG showed that crabs were more susceptible to the toxic effects than molluscs or worms.

After the regional sewage treatment plant, with its ocean disposal outfall, became operational in 1963, the effect of improved water quality on fish and wildlife in the Bay became apparent almost immediately. Observers noted in April 1964 the return to its waters of sculpin, sole, sand bass, octopus, shark, seal, porpoise, bonito, and other fish while returning birds included cormorants, "bluebills," scoters, and mergansers (Terzich 1965). A 1968 study described the south Bay as supporting a diversity of marine species representative of the inner sections of relatively undisturbed bays and estuaries in California and Baja California (Ford 1968). However, central Bay and its shoreline still showed the ecological effects of sludge deposits with bottom organisms reduced to only a few of the most pollution tolerant species; a polluted site was indicated by less than five kinds of organisms or more than 200 polychaete worms per square foot (Parrish and Mackenthun 1968).

By 1973, the CDFG noted that "healthy fish and invertebrate populations again flourish in many areas," with eelgrass beds becoming reestablished on dredged sites and ecologically desirable marine plants beginning to grow on pilings and rock structures (Browning et al. 1973). The "ecologically undesirable" algal mats that had previously covered the bottom of portions of the central and south Bay areas were also greatly reduced.

Thermal pollution from the SDG&E south Bay power plant's discharge was found to cause adverse effects on marine life within 1,801 to 3,901 ft (549 to 1,189 m) of the discharge point (Ford et al. 1970). Only marine invertebrate and algae species tolerant of the temperature conditions were found in this zone, although adverse effects to the Bay outside the cooling channel were determined to be minimal, mainly affecting decapod crustaceans and gastropod molluscs. Impacts were apparently greatest from the late summer cooling water discharge, with additional species occupying the channel area during cooler periods. Beneficial effects of the thermal plume included significant biomass increases for several major groups and the creation of favorable year-round habitat for the endangered green sea turtle (Macdonald et al. 1990). Ecological effects of the thermal effluent on certain marine species at the site were also studied in several master's theses at San Diego State University (SDSU) (Kellogg 1975; McGowen 1977; Merino 1981). High winter runoff in 1980 caused sediment changes of increased grain size and decreased total organic nitrogen levels in the south Bay. The species composition and benthic community structure of infaunal invertebrates remained very similar to pre-storm conditions (Lockheed 1981).

The effects of high (>3.0 ppb) and low (<1.0 ppb) copper levels on phytoplankton communities in San Diego Bay were studied for one year (Lane 1980). Phytoplankton samples taken from high copper level

areas showed less species diversity but maintained high biomass and productivity. The effects of excessive copper levels have been evaluated nationally for various marine organisms: sea anemones, mussels, softshell clams, snails, zooplankton, amphipods, crabs, sandworms, algae, and topsmelt (Atherinops affinis). As a result, copper criteria to protect marine life and human health are proposed in a new federal review of copper hazards (Eisler 1998).

G. SD Surfrider Foundation /SD Baykeeper

Surfrider Foundation San Diego webpage. 16 Feb.2004. <http://www.surfridersd.org/BWTFproc.php>
As part of the effort to grow citizen monitoring in San Diego, BayKeeper recently teamed up with the San Diego County Surfrider Foundation to form the BayKeeper-Surfrider Citizen Water Quality Lab, located at their new office in Point Loma. The joint lab now has capabilities to conduct temperature, pH, salinity, turbidity, metals and organics screening, total coliform, fecal coliform, and enterococcus testing. Samples are collected weekly by volunteers and delivered to the lab for testing using the method described below.

Currently there is one monitoring site in the vicinity of CABR at Sunset Cliffs Park ABS.

Testing Protocol for Enterococcus and Total Coliform. Surfrider Foundation. 16 Feb. 2004

Turn on the Quanti-tray sealer.
-Green light must be lit prior to use.
Measure 90 ml of distilled water into a small plastic bottle.
Measure 10 ml of ocean water sample and add to distilled water.
Add 1 packet of Enterolert (for Enterococcus) or Colilert (for Total Coliform) reagent to the 100 ml reagent-sample mixture.
Shake well to completely dissolve reagent
Label the paper side of the empty Quanti-tray with Date, Location of Collection, and Time.
Pour the reagent-sample mixture from the plastic bottle into the tray, avoiding contact with the foil side of the tray. Allow foam to settle.
Place the Quanti-tray upside-down on a rubber insert and run through the sealer to distribute the reagent-solution mixture into the wells and to seal the tray.
Place the Quanti-tray in an incubator at 41 degrees Celcius for Enterococcus and at 35 degrees Celcius for Total Coliform.
Incubate sample for 24 hours for Enterococcus testing
Incubate sample for 18 hours for Total Coliform testing.
Repeat procedure for each sample.[76]

California Standards

Enterolert, the testing method we use, is a rapid method used for detection and quantification of enterococci and indicator bacteria in water. It is sensitive to 1 enterococci/100ml. The results for Enterococcus take 24 hours to incubate. The MPN number (Most Probable Number), which is used to determine the density of bacteria in water samples, should be below 104 in order to conform to the CA standard.

Colilert is a method used for detection and quantification of Total Coliform and E. Coli. The results for Total Coliform take 18 hours to incubate. The MPN number, which is used to determine the density of bacteria in water samples, should not exceed 400 in order to conform to the CA standard.

Results: *Enterococcus*

[76] http://www.surfridersd.org/BWTFproc.php#testing

To read the results, the Quanti-trays are removed from the incubator after 24 hours, and a 6-watt UV lamp is held 5 inches above the wells. Any fluorescence within a well indicates the presence of contamination. The number of contaminated wells is counted and is read against the Most Probable Number (MPN) Table to determine the level of contamination for the area where the sample was collected. The value from the Table is multiplied by 10 to get the true MPN number. If fluorescence is not detectable after 24 hours of incubation, the sample is considered negative for contamination. After more than 28 hours of incubation, positives are not valid due to heterotrophs in the water, which can render a false positive. Results are then recorded and posted on the San Diego Chapter and National Surfrider Foundation websites.

Results: Total Coliform

To read the results, the Quanti-trays are removed from the incubator after 18 hours. Contamination is indicated by a yellow coloration in the wells. A comparator shows what the yellow should look like. The number of positive yellow wells is counted and the level of Total Coliform is determined by the Most Probable Number (MPN) Table. The value from the Table is multiplied by 10 to get the true MPN number.

The results for E. Coli are determined with the presence of fluorescence in the positive wells of the samples for Total Coliform. A 6-watt UV lamp is used and the MPN is calculated by the same method.

VII. Bibliography

Hannah, Lee, John L. Carr, and Ali Lankerani. 1995. Human disturbance and natural habitat: a biome level analysis of a global data set. Biodiversity and Conservation 4: 128-155.

Appendix I: RWQCB SWAMP Methods/ Sampling Protocols:

(from: http://www.swrcb.ca.gov/swamp/docs/qapp_sectionB2.pdf):

Surface Water Ambient Monitoring Program Section B2
Quality Assurance Management Plan Revision No. n/a
Date: 12/22/02 Page 77 of 144

Summary of Typical Procedure for Collection of Water Samples for Analyzing Trace Metals, Organics, Conventional Constituents, and for Toxicity Testing

All water samples collected for analyzing trace metals, organics, conventional constituents, and for toxicity testing in water will be collected using clean techniques that minimize sample contamination. Sampling methods will generally conform to EPA "clean" sampling methodology described in Method 1669: Sampling Ambient Water for Trace Metals (USEPA 1995a). Specific methods are also documented in Appendix D. Samples will generally be collected from shore or in-stream in wadeable waters, or by boat in non-wadeable waters (such as larger rivers, lakes, estuaries, and open coastal waters), in most cases by using a near-surface grab sample, but in those cases where depth-integrated sample collection is desired for water samples, a peristaltic pump and acid-cleaned polyethylene or Teflon™ tubing is used. Grab samples will be collected into appropriate pre-cleaned containers and aliquoted into glass, polyethylene, or Teflon™ sample containers appropriate for the analyses to be performed (see Sample Handling Requirements Tables in Section B3), or will be collected directly into the sample containers, if appropriate. Samples to be analyzed for dissolved (filtered) trace metals (including mercury) will be filtered to 0.45 µm in the field using Gelman in-line filtration capsules (in the case of pumped samples) or syringe filters (in the case of grab samples).

After collection, field-collected samples will be stored at 4°C until arrival at the contract laboratory. Samples to be analyzed for mercury will be preserved at the contract laboratory, immediately on arrival. Samples to be analyzed for other constituents will be preserved in the lab (in most cases) or field, as appropriate and as described in the SWAMP Sample Handling Summary Tables (Tables 6 and 7, Section B3).

This sample collection method requires that the sample collection tubing, and the sample bottle and lid come into contact only with surfaces known to be clean, or with the water sample. Additionally, mercury samples must have no air bubbles or head space present in the bottle immediately following sample collection. If air is present in the sample container for mercury analyses, additional sample will be aliquoted into the same sample bottle. If the performance requirements for specific samples are not met, the sample will be re-collected. If contamination of the sample container is suspected, a fresh sample container will be used.

Collection of Water Samples for Analyzing Bacteria (Methods)
Pathogen monitoring in SWAMP will typically include sampling for pathogen indicator organisms (fecal and total coliform bacteria, *E. coli*, and *Enterococcus* bacteria). Note: Samplers must wear gloves when collecting any pathogen samples in order to prevent introduced bacterial contamination. In addition, please refer to Appendix H (Recommended Minimum Health and Safety Guidance for SWAMP Field Activities), which provides a summary of protective measures that should be employed when sampling areas where there is potential exposure to biohazards (e.g., in some areas with known high levels of bacteria and pathogenic activity). In addition, a detailed protocol specifically dealing with health and safety measures for field and laboratory personnel is in the process of being developed for just such situations. This will be distributed upon completion in the near future.

Samples analyzed for bacteria will be collected as near-surface grab samples. Sampling for bacteria will in most cases be performed according to the sampling procedures detailed for Standard Methods 9221B and 9221E (APHA et al. 1998). In brief, the sampling procedures are summarized as follows:

• Sample containers should be cleaned and sterilized using procedures described in Standard Methods 9030 and 9040 (APHA et al. 1998). In most cases, these containers are provided by the laboratories conducting the analyses. Alternatively, Whirl-pak bags may also be used, per protocol

• For waters suspected to contain a chlorine residual, sample bottles should contain a small amount of sodium thiosulfate ($Na_2S_2O_3$) sufficient to neutralize bactericidal activity. In most cases, bottles provided by contract laboratories already contain the sodium thiosulfate as a precautionary measure. For water containing high concentrations of copper or zinc, sample bottles should contain sufficient EDTA solution to reduce metal toxicity. Note: These conditions are rare in surface waters.

• Sample bottles may be glass or plastic (e.g. polypropylene) with a capacity of at least 100 ml., or again, Whirl-pak bags. After sterilization, sample bottles should be kept closed until they are to be filled.

• When removing caps from sample bottles, be careful to avoid contaminating inner surface of caps or bottles.

• Using aseptic techniques, fill sample bottles (or Whirl-pak bags), leaving sufficient air space to facilitate mixing by shaking. Do not rinse bottles.

• Recap bottles tightly.

If at any time the sampling crew suspects that the sample or sampling container has been contaminated, the sample should be re-collected into a new sample container. If bacteriological samples are to be used for regulatory compliance purposes, then samples must be kept at 4°C (dark) and transported to the laboratory so that the analysis begins within 6 hours of collection. If bacteriological samples are non-regulatory in nature (ie, non-drinking water samples analyzed for non-compliance purposes), after collection, store samples at 4°C (dark) until analysis, which must begin within 24 hours of collection. The 20th edition of Standard Methods (APHA et al. 1998) recommends analysis of samples as soon as possible, but specifies that non-drinking water samples analyzed for non-compliance purposes may be held for up to 24 hours (below 10°C) until time of analysis. For this reason, data from these samples should not be used for assessment of regulatory compliance.

Appendix II: RWQCB Toxic Substance Monitoring Program Methods

(from http://www.swrcb.ca.gov/swamp/docs/qapp_sectionB2.pdf):
Surface Water Ambient Monitoring Program Section B2
Quality Assurance Management Plan Revision No. n/a
Date: 12/22/02 Page 87 of 144:

COLLECTION OF SAMPLES FOR CONTAMINANT ANALYSIS
IN TISSUES (FISH, CRABS, BIVALVES, ETC.)
Fish Tissue Collection Procedures for Contaminant Analysis

Fish tissue samples will be collected by DFG and SJSUF contract field crew staff, using protocols detailed in Appendix D. Details of the protocols are summarized below. Collection of fish for analysis of contaminants in tissue may be accomplished by a variety of methods, including hook and line, seines, gill nets, and electro shocking. Species collected will, in most cases, be non-migratory species that are most representative of a given location. Efforts will be made to collect fish of a similar (medium) size for each composite. Fish will be wrapped in trace metal- and organic-free Teflon™ sheets and frozen for transportation to the laboratory. The tissue samples are prepared in the laboratory using non-contaminating techniques in a clean room environment.

Collection, handling and storage of tissue samples will be performed in a manner consistent with other large scale tissue contaminant monitoring programs, such as the Regional Monitoring Program (RMP) protocols (SFEI 1999, SFRWQCB 1995), CALFED DFG protocols, and toxic substances monitoring protocols (see Appendix D), to assure the collection of representative, uncontaminated tissue chemistry samples. Field crews must rigorously follow sampling procedures and complete all necessary documentation according to the SOPs. As a general rule, five fish of medium size or three fish of larger size are collected as composites for analysis. The smallest fish length cannot be any smaller than 75% of the largest fish length. Five fish provides sufficient quantities of tissue for the dissection of 100 grams of fish flesh for organic and inorganic analysis. The medium size is more desirable to enable similar samples to be collected in succeeding collections.

When only small fish are available, sufficient numbers are collected to provide 100 grams of fish flesh for analysis. If the fish are too small to excise flesh, the whole fish, minus the head, tail, and guts are analyzed as composites. Fish collected that are too large to fit in our clean bags (>500 mm) are initially dissected in the field. At the dock, the fish are laid out on a clean plastic bag and a large cross section from behind the pectoral fins to the gut is cut with a cleaned bone saw. The bone saw is cleaned (Micro™, DI, methanol) between fish and a new plastic bag is used. The internal organs are not cut into, to prevent contamination. For bat rays, a section of the wing is cut and saved. These sections are wrapped in Teflon™, double bagged and packed in dry ice before transfer to the freezer.

During lab dissection, a subsection of the cross section is removed, discarding any tissue exposed by field dissection. Field data recorded include, but are not limited to site name, sample identification number, site location (GPS), date of collection, time of collection, names of collectors, method of collection, type of sample, water depth, water and atmospheric conditions, fish total lengths (fork lengths where appropriate), photo number and a note of other fish caught. The fish are then wrapped in cleaned Teflon™ sheets. The wrapped fish are then double-bagged in Ziploc™ bags with the inner bag labeled.

The fish are put on dry ice and transported to the laboratory where they are kept frozen until they are processed for chemical analysis. All samples, once returned to the laboratory for processing, are prepared in a clean room to avoid airborne contamination.

Appendix III RWQCB SMWP Methods

http://www.swrcb.ca.gov/swamp/docs/qapp_sectionB2.pdf
From: Surface Water Ambient Monitoring Program Section B2
Quality Assurance Management Plan Revision No. n/a
Date: 12/22/02
Page 89 of 144

Bivalve Deployment and Retrieval Summary (for bagged bivalve bioaccumulation studies) Sample collection - mussels and clams
The mussels to be transplanted (*Mytilus californianus*) are collected from Trinidad Head (Humboldt Bay Intensive Survey), Montana de Oro (Diablo Canyon Intensive Survey), and Bodega head (all other statewide transplants). The freshwater clam (*Corbicula fluminea*) source is Lake Isabella or the Sacramento River. Mussel and clam samples are analyzed for background contaminates prior to transplanting (see State Mussel Watch Program staff for more details). Polyethylene gloves are worn while prying mussels off rocks with stainless steel dive knives. Note: polyethylene gloves should always be worn when handling sample. Mussels of 55mm to 65mm in length are recommended. Fifty mussels are collected for each TM and each SO sample. Collected mussels are carried out of collection site in cleaned nylon daypacks. For the collection of resident samples where only one or two samples are being collected the mussels are placed directly into a labeled Ziploc™ or cleaned aluminum foil (SO) and an additional Ziploc™. Clams (*Corbicula fluminea*) measuring 20 to 30mm are collected by dragging the clam dredge along the bottom of the lake or river. The clams are poured out of the dredge into a 30 gallon plastic bag. 25-50 clams are needed for each TM and each SO sample.

Transplanted sample deployment

With polyethylene gloves, fifty transplant mussels are placed in each 76mm X 13mm polypropylene mesh bag. Each bag represents one TM or one SO sample. A knot is tied at each end of mesh bag and reinforced with a cable tie. On one end another cable tie is placed under the cable tie, which will be used to secure the bag to the line for transplant deployment. The mussels in the mesh bag are divided into three groups of approximately equal size and sectioned with two more cable ties.

Once bagged, the mussels are placed in a 30-gallon plastic bag and stored in a cooler (cooled with ice) for no more than 48 hours. The ice is double bagged in Ziploc™ bags to avoid contamination. If samples are held for longer than 48 hours they are placed in holding tanks with running seawater at the Fish and Game Granite Canyon Lab. Control samples for both SO and TM are also held in the tank.

For freshwater clams: clams (25-50) are placed in 50mm X 7mm polypropylene mesh bags using identical procedures to those used with mussels (section 7.2.1). If clams need to be stored for more than 48 hours, the mesh bags are deployed in Lake San Antonio or another clean source until actual sample deployment. The mussels are attached to an open water transplant system that consists of a buoy system constructed with a heavy weight anchor (about 100lbs) or screw-in earth anchor, 13mm polypropylene line, and a 30cm diameter subsurface buoy. The sample bags are attached with cable ties to the buoy line about 15 feet below the water surface. In some cases the sample is hung on suspended polypropylene lines about 15 feet below the water surface between pier pilings or other surface structures. Creosote-coated wooden piers are avoided because they are a potential source of contamination. In some cases the mussels are hung below a floating dock. In shallow waters a wooden or PVC stake is hammered into the substrate and the mussel bags are attached by cable ties to the stake.

The clams are deployed by attaching with cable ties the mesh bag to wooden or PVC stakes hammered into substrate or screw in earth anchors. The bags containing clams are typically deployed 15cm or more off the bottom. In areas of swift water, polypropylene line is also attached to the staked bags and a permanent object (piling, tree or rock). Transplants are usually deployed for 1-4 months. Ideally mussels are transplanted in early September and retrieved in late December and early January. Clams are usually

transplanted in March or April and retrieved in May or June, although this is variable in some cases. Data is recorded for each site samples are transplanted to or collected from. Data includes, but is not limited to station name, date collected or transplanted, collectors names, water depth, GPS readings, photo, ocean/atmospheric conditions (if appropriate), description of site, and drawing in necessary.

Sample Retrieval

The transplanted or resident and control mussels analyzed for metals are placed into two labeled Ziploc™ polyethylene bags (4mm thickness). All mussels to be analyzed for organics are placed in an aluminum foil bag. The bags are constructed of two layers of “heavy duty” aluminum foil. Prior to use these bags are cleaned by heating to 500°c or by rinsing in petroleum ether or methanol. The sample is first wrapped in a foil bag, hen placed in two labeled polyethylene Ziploc™ bags. Note: samples should only contact the dull side of the foil. The bags containing samples are clearly and uniquely identified using a water-proof marking pen or pre-made label. Information items include ID number, station name, depth (if from a multiple sample buoy), program identification, date of collection, species and type of analysis to be performed. The samples are placed in non-metallic ice chests and frozen using dry ice or regular ice. (Dry ice is used when the collecting trip takes more than two days.) At the lab, samples should be stored at or below -20°c until processed.

Appendix IV RWQCB BPTCP Methods

(see http://www.swrcb.ca.gov/bptcp/docs/reg4report.pdf, p33)
This section describes specific techniques used for collecting and processing samples. Because collection of sediments influences the results of all subsequent laboratory and data analyses, it is important that samples be collected in a consistent and conventionally acceptable manner. Field and laboratory technicians were trained to conduct a wide variety of activities using the accepted procedures of EMAP (Weisberg, 1990), NS&T (NOAA, 1991), and ASTM (1992) to ensure comparability in sample collection among crews and across geographic areas.

Cleaning Procedures
All sampling equipment (i.e., containers, container liners, scoops, water collection bottles) was made from non-contaminating materials and was precleaned and packaged protectively prior to entering the field. Sample collection gear and samples were handled only by personnel wearing non-contaminating polyethylene gloves. All sample collection equipment (excluding the sediment sampler) was cleaned by using the following sequential process: two-day soak and wash in Micro detergent, three tap-water rinses, three deionized water rinses, a three-day soak in 10% HCl, three ASTM Type II Milli-Q water rinses, air dry, three petroleum ether rinses, and air dry. All cleaning after the Micro detergent step was performed in a positive pressure “clean” room to prevent airborne contaminants from contacting sample collection equipment. Air supplied to the clean room was filtered.

The sediment sampler was cleaned prior to entering the field, and between sampling stations, using the following steps: a vigorous Micro detergent wash and scrub, a seawater rinse, a 10% HCl rinse, and a methanol rinse. The sediment sampler was scrubbed with seawater between successive deployments at the same station to remove adhering sediments from contact surfaces possibly originating below the sampled layer. Sample storage containers were cleaned in accordance with the type of analysis to be performed upon its contents. All containers were cleaned in a positive pressure “clean” room with filtered air to prevent airborne contaminants from contacting sample storage containers.
Plastic containers (HDPE or TFE) for trace metal analysis media (sediment, archive sediment, pore water) were cleaned by: a two-day Micro detergent soak, three tap-water rinses, three deionized water rinses, a three-day soak in 10% HCl or HNO, three Type II Milli-Q water rinses, and air dried.

Glass containers for total organic carbon, grain size or synthetic organic analysis media (sediment, archive sediment, pore water, and subsurface water) and additional teflon sheeting cap-liners were cleaned by: a two-day Micro detergent soak, three tap-water rinses, three deionized water rinses, a three-day soak in 10% HCl or HNO, three Type II Milli-Q water rinses, air dry, three petroleum ether rinses, and air dry.

Appendix V RWQCB Bioassessment Program Methods

1. Reaches for benthic invertebrate sampling are selected after an initial reconnaissance of the section or stream. The overall goal is to select homogenous wadable reaches that best typify a riffle or run condition. Avoid walking in the stream when conducting a reconnaissance survey. Each riffle used for biological assessment must be approached from downstream and no portion of the riffle disturbed until all sampling is complete. Habitat assessment should be conducted after macroinvertebrates have been collected.

2. Fill out a field log sheet for each riffle section. Enter watershed name, station name, sample identification number, date, time and names of crewmembers.

3. To select a transect, place the measuring tape along the bank of the entire riffle section. Each meter (3 ft) mark represents a possible transect location. Select the transects from all possible meter marks along the measuring tape using the provided table of random numbers. If only one transect is to be sampled, then select one meter mark in the top one third of the riffle. Record the meter mark in the field log for each transect.

4. Once transects have been selected, benthic macro-invertebrates are collected from several locations along the transect and combine them into one sample. If possible, choose three locations; the two side margins and the center of the stream. If the riffle is not ideal, then make adjustments to accommodate prevailing conditions. When making adjustments, such as increasing or reducing the number of locations for collecting organisms or sampling substrate that is not gravel/cobble, try to sample similar conditions at each reach. Record the number of locations per transect in the field log.

5. Starting from the transect furthest downstream, collect macro-invertebrates with a sampling device appropriate for stream conditions. Appropriate devices for wadable reaches include the D-shaped kick-net, Needham-type kick-screen, Surber bottom samplers, and the Hess bottom sampler. Appropriate devices for non-wadable reaches include Eckman and Ponar dredges, and drift nets. Combine the three collections. Measure and record stream temperature.

6. For wadable reaches, place the combined contents from the transect in a standard size 30 or 35 (0.6 or 0.5 mm, respectively) testing sieve. Large organic material is removed by hand while carefully inspecting for clinging organisms. All remaining material is placed with forceps in a 95% ethanol filled jar. If there is considerable debris in the net, inspect the sample in a white enameled pan and rinse material from the pan through the sieve before placing it in the jar.

7. Using a pencil, record the following information for each sample on a piece of waterproof paper and place in the jar:

- sample identification number followed by -01, -02 (to identify each transect)
- collection date and time
- sampler type
- sample area
- habitat type
- collectors name
- comments

If the sample collection requirements above are not met, the sample will be re-collected, if it is possible to do so without compromising sample quality. The procedures for collecting biological samples of benthic invertebrates from non-wadable streams generally follow Methods For Collecting Benthic Invertebrate Samples As Part Of The National Water Quality Assessment Program (USGS 1993a). Specific procedures and any modifications are documented in Appendix G.

Appendix VI SAMO (NPS) Water Quality Monitoring Methods

Determine 3 riffle habitats for BMI sampling.
Using dice or a random numbers chart, choose three riffle habitats to be sampled for BMI.

In the stream:

Measure each habitat (pool, riffle, run, or dry).
Measure the length of each habitat and the width and depth of the deepest point in meters.
Assess each habitat for amphibians.
Note population size, age, sex and behavior for each species. See "Species Observation" form.
If possible, photo document the stream reach.
Photograph the stream reach. Use a wide-angle lens, if possible. Photograph the substrate prior to BMI sampling

For designated riffles (R1-R5), identify BMI and water quality sampling transects.

In each of the three randomly designated riffles choose a site in each that has fast water flow over a cobble substrate. These are the most ideal places for sampling for benthic macro-invertebrates. Place invertebrates into jars, each with individual identification labels, and add 100% alcohol. This kills and preserves specimens in the field.
The area to be sampled will be one width of the kick net and 2x's the width for the length.
Clean off rocks and turn up approximately 4"-6" depth of substrate for 1 to 3 minutes at each sample point.
Repeat BMI sampling at the other two riffle habitats

Physical/Habitat Quality Sampling (to be done after BMI sampling)
Estimate canopy cover in each riffle where BMI is sampled.
Measure surface shade by vegetation using a densiometer.
If a densiometer is unavailable, visually estimate the percentage of shade.

Measure stream flow at all 5 riffles.
Width
Measure the width of the transect.
If necessary, use the average of 2-3 measured widths along the transect (averages can be calculated in the office).
Depth
For every transect width, measure the depth of the riffle at every half meter along the width using a stadia rod.
Calculate the average depth of the transect (averages can be calculated in the office).
Velocity
Measure stream velocity using a flow meter.
If a flow meter is unavailable, time the length it takes for an object (e.g. orange peel) to float down the entire riffle. Do this several times. Calculate the average for the velocity (averages can be calculated in the office).

Calculate stream flow with the following formula (can be done in the office):
(average width) x (average depth) x (average velocity) = stream flow

After completing the stream assessment: This will be done at the end of the season by the stream survey coordinator.

Assess the physical/habitat quality.
See Physical/Habitat Quality handout.

Values will be added up to give an overall score of stream quality.

In the office/lab:
To prevent deterioration of BMI, run samples through a No. 35, 500 μm sieve and transfer specimens to 70% alcohol solution