SANTA MONICA BAY: *State of the Watershed*

First Edition - June 16, 1997

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INTRODUCTION

The purpose of this report is to summarize available information on water quality and water quality improvement efforts in the Santa Monica Bay watershed, including both inland water bodies and the Bay itself. We envision that as the regulatory community works in partnership with other stakeholders to implement a "watershed approach" for managing water quality, this information will be used as a basis for assessing impacts to beneficial uses of waters in the watershed and to provide guidance for future implementation of water quality improvement activities.

This report is a working document. It is built upon the 1993 Santa Monica Bay *State of the Bay* report with an emphasis on available information that is related to the Santa Monica Bay *watershed* as opposed to the Bay alone. This report will be updated periodically (possibly corresponding with the watershed permitting cycle or more frequently if needed) to reflect new water quality and impact assessment data and findings and to incorporate new experiences gained in watershed management.

THE WATERSHED MANAGEMENT APPROACH

Watershed management is an integrated strategy for managing resources. As characteristics and resources vary widely from watershed to watershed, this strategy customizes efforts to manage resources and address problems unique to each watershed and offers stakeholders the opportunity to implement the most cost-effective solutions to problems within their watersheds.

Watershed management represents a shift from the traditional approach focusing on regulation of point sources to a more geographically regional approach which acknowledges the inputs from other sources. Over the last 25 years, point source control has achieved significant reductions in pollutants discharged to California waters. In part because of these successes, the remaining water quality degradation problems come mostly from very diffuse and diverse sources called nonpoint source pollution. Future success in addressing the range of problems must go beyond the control and monitoring of point sources and incorporate nonpoint source solutions into overall water quality management. A watershed management approach will enable us to assess cumulative impacts of point sources with nonpoint sources, to develop watershed-specific solutions that deal with the unique setting in each area and associated beneficial uses, and to balance the environmental and economic impacts of actions taken.

THE REGIONAL BOARD AND THE WATERSHED MANAGEMENT APPROACH

Watershed management can be applied on many different levels -- from an overall system for managing resources, restoring and protecting aquatic ecosystems and protecting human health, to a more focused effort that addresses a single resource such as water. The Regional Board's efforts are focused on watershed management for the protection of water quality and beneficial uses. In many watersheds, the Regional Board's efforts may be included in more comprehensive efforts to manage all resources.

The State Water Resources Control Board and nine Regional Water Quality Control Boards are responsible for protecting water quality in the State of California. Regulatory authority set forth in the Porter-Cologne Water Quality Control Act authorizes these agencies to establish policies, set water quality standards, and implement programs that will protect and, where necessary, remediate water quality.

The California Regional Water Quality Control Board, Los Angeles Region (hereinafter referred to as the Regional Board) has jurisdiction over all coastal drainages flowing to the Pacific Ocean between Rincon Point (on the coast in western Ventura County) and the eastern Los Angeles County line, as well as the drainages of five coastal islands (Anacapa, San Nicolas, Santa Barbara, Santa Catalina, and San Clemente) (Figure 1). The Regional Board's jurisdiction also includes all coastal waters within three miles of the continental and island coastlines.

Up until recently, the Regional Board's regulatory efforts to protect water quality have relied heavily upon the issuance of individual permits for wastewaters discharged from point sources, such as publicly-owned wastewater treatment plants and industrial facilities, in a manner often not well coordinated. These permitting programs alone, however, are not effectively protecting water quality from other pollutant sources, such as nonpoint sources. By definition, nonpoint source pollution is diffuse, hard to locate, and difficult to remedy. Consequently and after consultation with the USEPA, the Regional Board initiated the watershed management approach in the fall of 1994.

Under the new watershed management approach, the Regional Board has reorganized permitting units at the agency by major watersheds to better coordinate activities necessary to protect and enhance the water quality within a watershed. Further, under a framework developed for the Regional Board's watershed management initiative, the Los Angeles Region is divided into eleven major watershed management areas (Figure 2). Watershed management is being implemented sequentially in each of these watersheds, and will be fully implemented by 2002 (Figure 3). For each of the watershed management areas, the watershed approach will be completed and repeated in a seven-year cycle, structured around the seven-year term of the NPDES permits[1].

During the initial 18 months of the seven-year watershed cycle, efforts in each watershed will start with compilations and assessments of available data on both point and nonpoint pollutant sources. The results of these activities will form the core of a State of the Watershed Report for each watershed. With the input of stakeholders, major point source issues will be identified. The Regional Board will then revise permits for major point source discharges and design cost-effective watershed-wide monitoring programs which incorporate evaluating inputs from nonpoint sources. Working with leaders and interested members of the public, the Regional Board will then use this information to develop a strategy which is customized for the watershed to better manage point and nonpoint source discharges. In some watersheds, special studies may also be undertaken that will better quantify problems and provide data that will help develop solutions to watershed-specific problems.

[1] The term of the Los Angeles County Municipal Storm Water NPDES Permit remains five years.

California Regional Water Quality Control Board

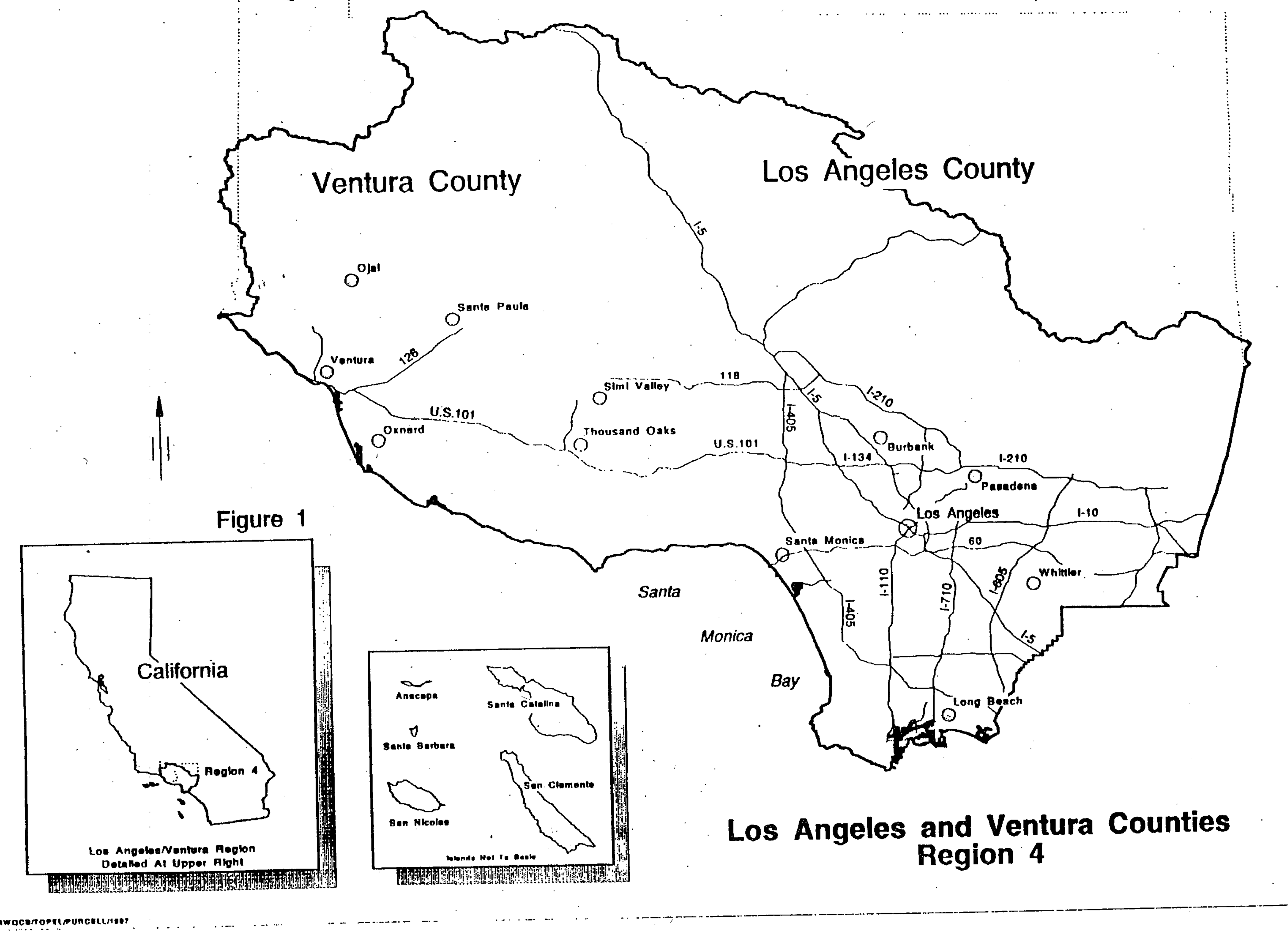
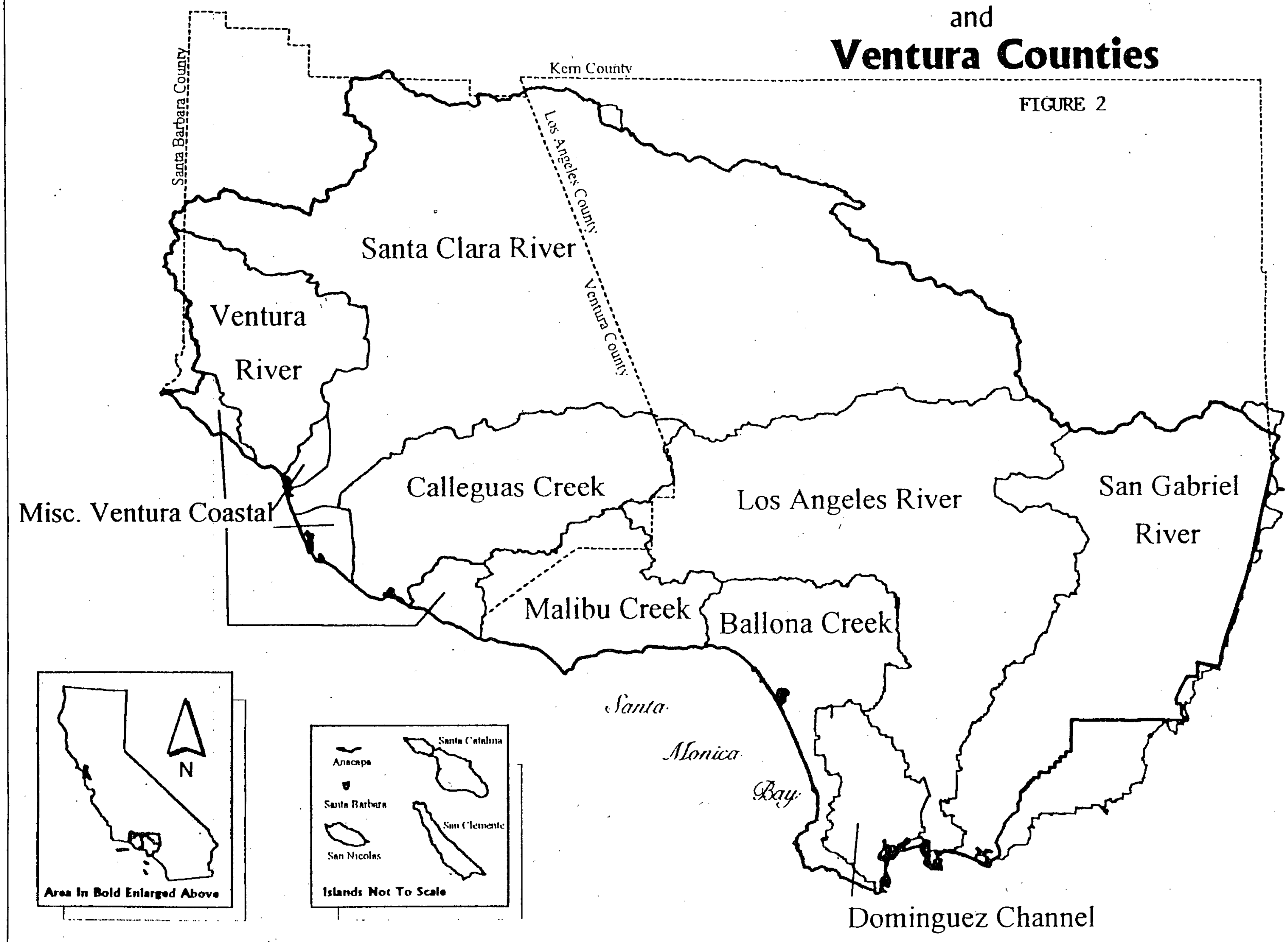


Figure 1

Los Angeles and Ventura Counties
Region 4

Watersheds In Los Angeles and Ventura Counties

FIGURE 2



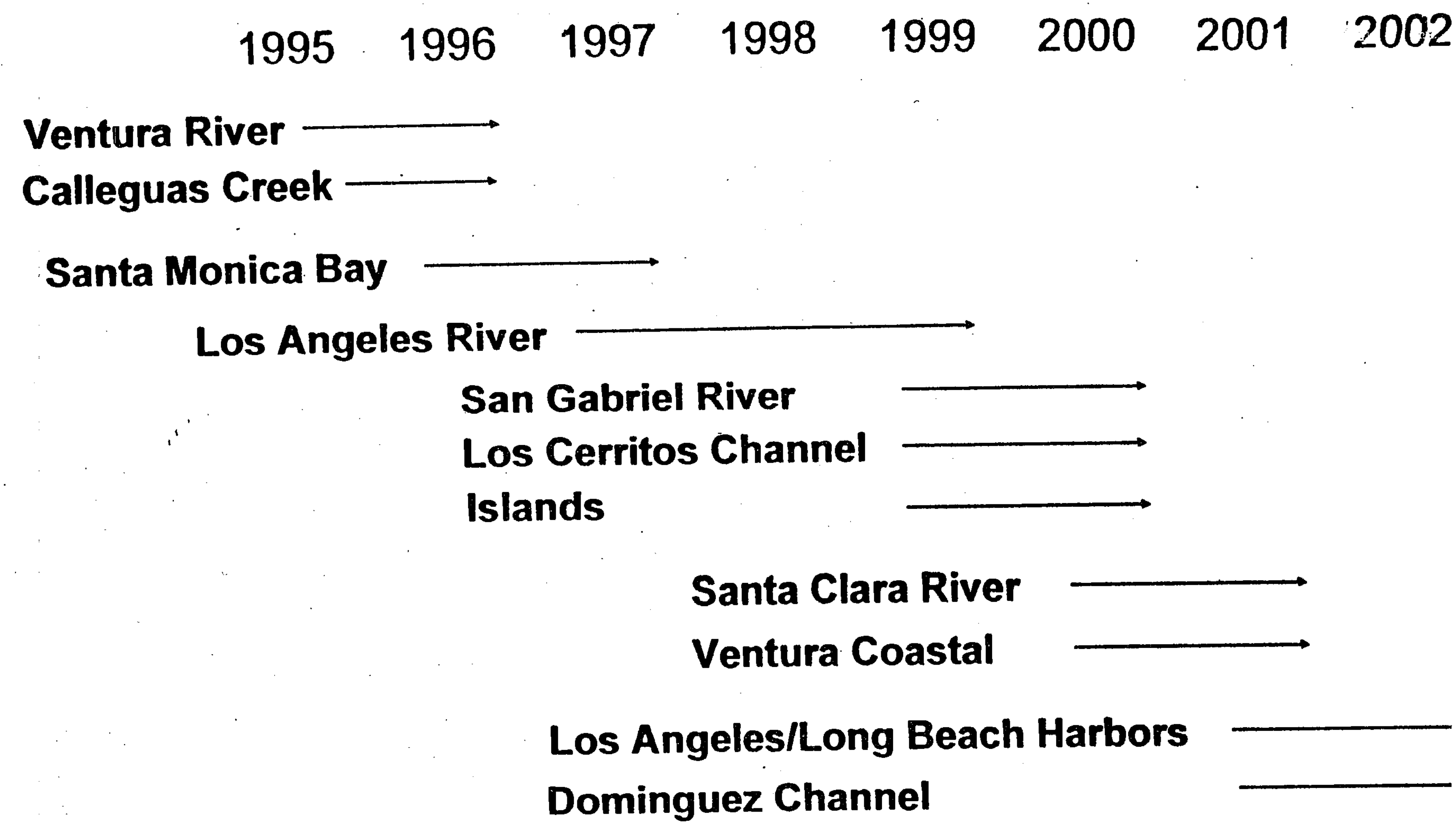


Figure 3: Timeline for Watershed Management Initiative.

It is important to recognize that at this time, the Regional Board may not be able to fully assess cumulative impacts to beneficial uses from all pollutant sources and, in particular, from nonpoint sources. Accordingly, the Regional Board will initially focus efforts on discharges from point sources through coordinated permit renewals in order to assess cumulative impacts from point source dischargers. Utilizing the results of water quality assessments and discharger monitoring data, the Regional Board will develop requirements for all the permits within a watershed. These permits will also contain monitoring requirements. The intention is to develop regional watershed-wide monitoring programs with specific sampling sites assigned to the appropriate point source discharger, and to ultimately secure involvement by nonpoint source contributors in the sampling of other identified monitoring sites. These monitoring programs will serve to fill data gaps and help to identify relative loadings from the watershed's pollutant sources. The monitoring will also assess water quality improvements resulting from the implementation of pollution control strategies within the watershed. These permits will be proposed for adoption following one or more public meetings held by the Regional Board.

Some decisions on discharges from nonpoint sources will also be made on the basis ofq information currently available. During the remainder of the seven-year cycle, the Regional Board will continue to gather information from on-going monitoring and special studies, and to work with stakeholders to develop strategies and projects for addressing pollutants from nonpoint sources. Watershed management is an iterative and long-term process. The strategies for point and nonpoint pollutant control will continue to evolve as the watershed management approach evolves.

THE SANTA MONICA BAY RESTORATION PROJECT AND THE WATERSHED MANAGEMENT APPROACH

The Santa Monica Bay Restoration Project (SMBRP) was formed in 1988 under the National Estuary Program in response to the critical problems of the Bay. The SMBRP was charged with the responsibility of assessing the Bay's problems, developing solutions and putting them into action. Under the five-year development process outlined in the Clean Water Act, both a comprehensive characterization of the Bay's environmental condition and a plan of action were structured with the involvement of a diverse group of stakeholders organized into the SMBRP's Management Conference (Management Committee, Technical Advisory Committee and Public Advisory Committee).

The scientific characterization of the Bay is described in the SMBRP's "State of the Bay, 1993" report and other technical investigations. This report, along with the Project's recommendations for action, comprises the Bay Restoration Plan (BRP), which was approved by Governor Wilson in December 1994 and USEPA Administrator Carol Browner in March 1995. With over 200 recommended actions (74 identified as priorities), the BRP addresses the need for pollution prevention, public health protection, habitat restoration and comprehensive resource management. The Regional Board plays a leading role in implementation of many of these priority actions.

The SMBRP is one of the pioneers of the watershed management approach in the region. With stakeholder involvement throughout, the SMBRP successfully facilitated the shift of management focus from major point sources with direct discharges to the ocean, to nonpoint sources that are associated with various types of land uses in a watershed. Guided by a watershed perspective, the BRP recommended many watershed/ subwatershed-based pollutant management strategies and actions and thus became the first watershed management plan developed in this region.

The SMBRP's experiences serve as a model for the approach that the Regional Board has adopted for the entire region. The organization and membership of the Bay Watershed Council has expanded from the pre-BRP SMBRP Management Conference and is representative of the key stakeholders for this watershed.

THE SANTA MONICA BAY WATERSHED

The Santa Monica Bay watershed includes the Santa Monica Bay and the land area that drains naturally into the Bay. The boundary of the Santa Monica Bay, as defined for the National Estuary Program, extends from the Los Angeles/Ventura County Line to Point Fermin at the southern end of the Palos Verdes Peninsula. The 414-square-mile land area that drains into the Bay follows the crest of the Santa Monica Mountains on the north to Griffith Park. From there it extends south and west across the Los Angeles plain to include the area east of Ballona Creek and north of the Baldwin Hills. South of Ballona Creek the natural drainage is a narrow coastal strip between Playa del Rey and Palos Verdes (Figure 4).

The Santa Monica Bay watershed drains a portion of the southern slopes of the Santa Monica Mountains and a western strip of the Los Angeles Coastal Plain. The Bay itself is part of the Southern California Bight, extending from Point Conception in central California to Cape Colnett in Baja California, with the California Current as its seaward boundary. The mountainous land forming the watershed's northern boundary is largely the result of the slow grind of the Pacific tectonic plate against the North American tectonic plate with the San Andreas fault marking the point of friction between the two. Sediments eroding from surrounding ranges formed the Los Angeles Coastal Plain. The climate is Mediterranean, characterized by warm, dry summers and mild, wet winters. The average annual rainfall on the Coastal Plain is 12 to 13 inches but ranges from four to 25 inches. Rainfall also varies with elevation, with foothill areas receiving as much as 40 inches.

Surface water flows into the Bay from nine subwatershed areas which were delineated, for the purposes of this report, based on their geographic characteristics (Figure 5). The two largest subwatershed areas are drained by Malibu Creek (draining approximately 20% of the total watershed) and Ballona Creek (draining approximately 30%). The North Coast subwatershed area, which includes ten coastal streams, drains the next largest area at about 13% of the total watershed. The other six subwatershed areas (Topanga, Santa Monica Canyon, Pico-Kenter and adjacent, El Segundo/LAX area, South Bay, and Palos Verdes Peninsula) drain between two and four percent of the total watershed.

Most land areas of the watershed are in Los Angeles County, except for a small portion of eastern Ventura County. The cities of Los Angeles and Santa Monica, along with sixteen other cities, are located either completed or partially within the watershed. There are also land areas under the jurisdiction of Los Angeles County, as well as State and Federal jurisdictions (primarily park lands in the Santa Monica Mountain areas).

SANTA MONICA BAY WATERSHED

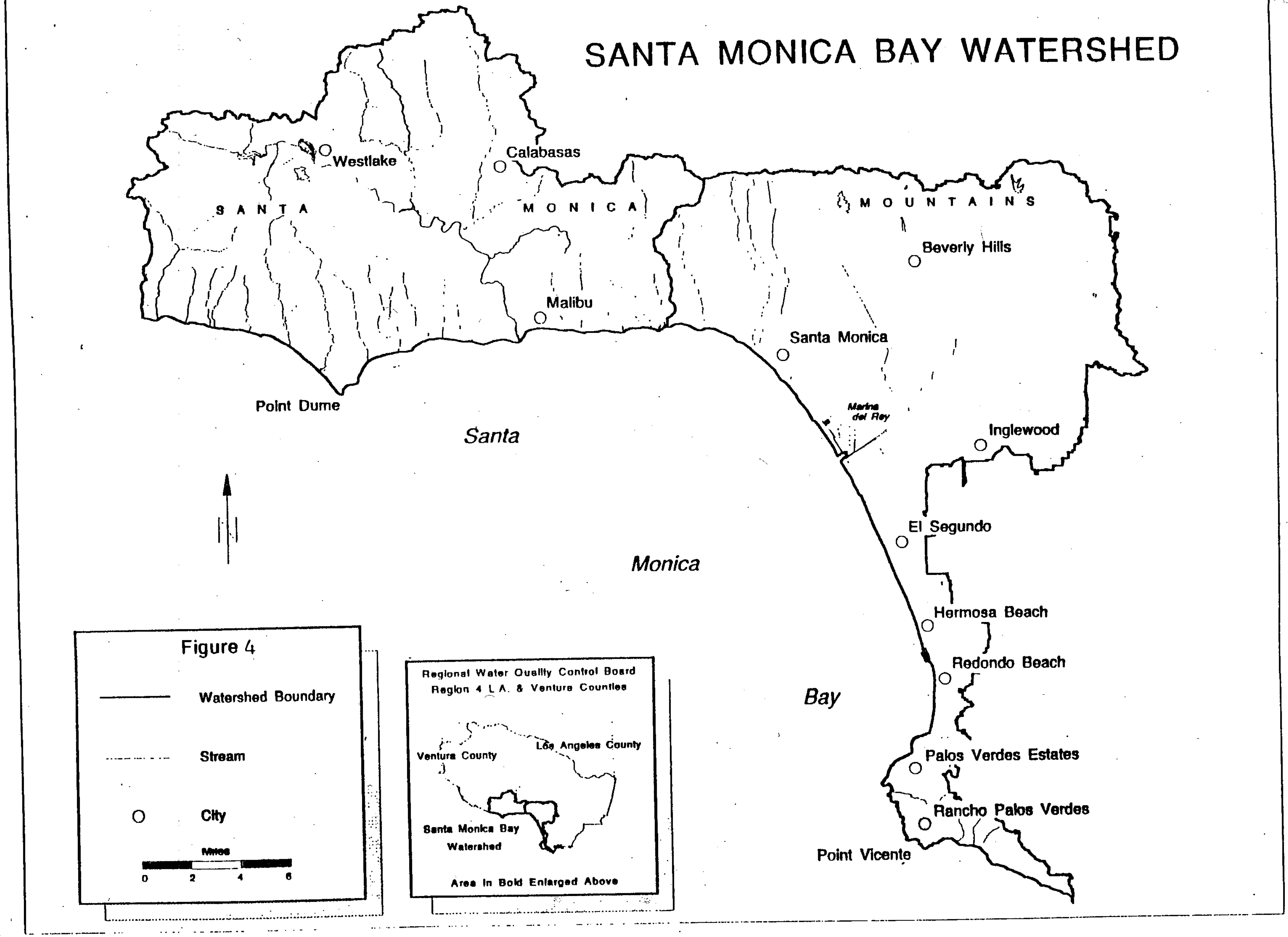
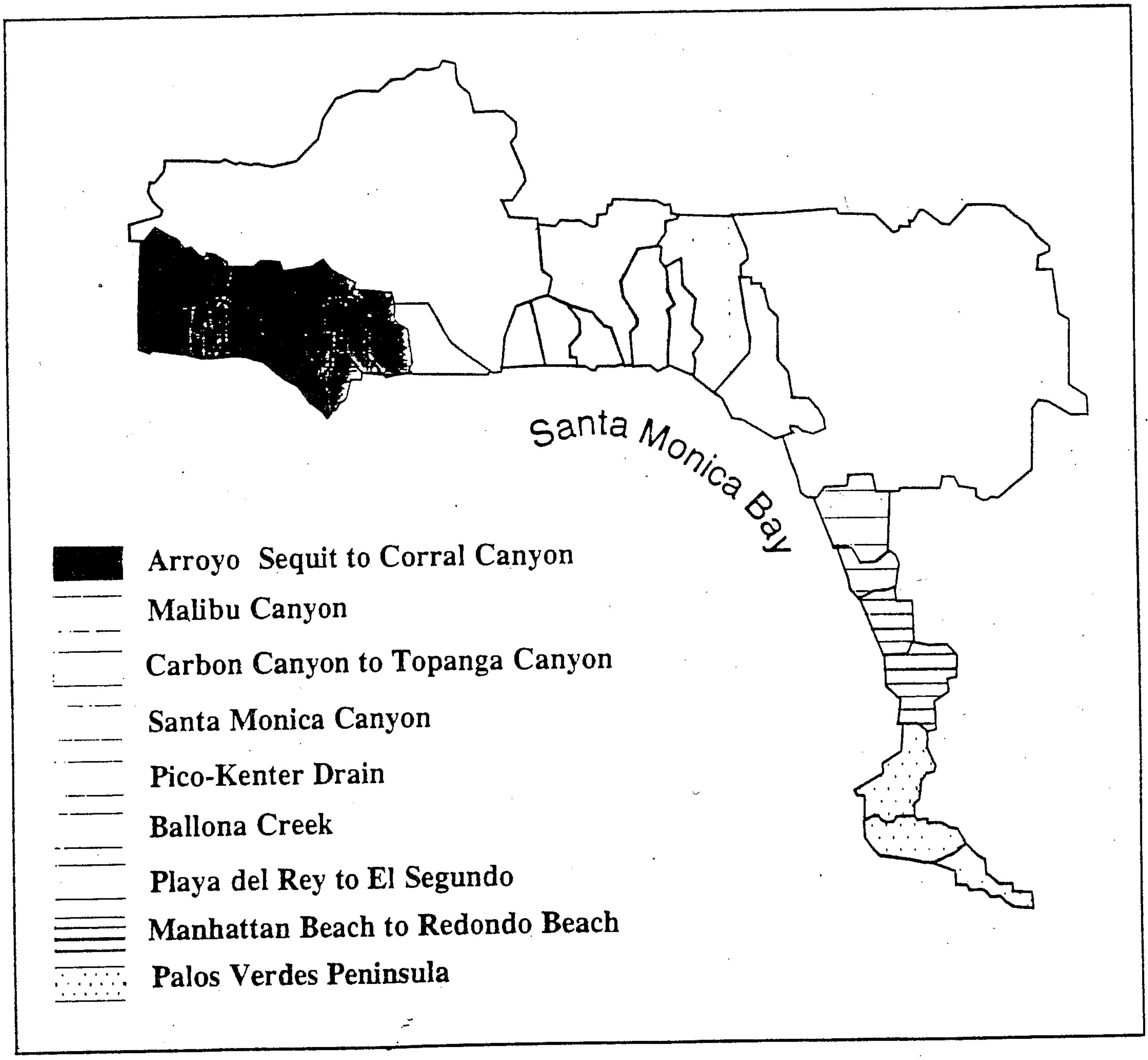


FIGURE 5


Santa Monica Bay
Arroyo Sequit to Corral Canyon
Malibu Canyon
Carbon Canyon to Topanga Canyon
Santa Monica Canyon
Pico-Kenter Drain
Ballona Creek
Playa del Rey to El Segundo
Manhattan Beach to Redondo Beach
Palos Verdes Peninsula

OVERVIEW OF THE WATERSHED

Natural Environment

Santa Monica Bay is the submerged portion of the Los Angeles basin. It has a gently sloping, (about 0.5°), wide continental shelf which extends seaward to the shelf break about 265 feet underwater, then drops more steeply to the floor of the Santa Monica Basin, at about 2,630 feet.

The shelf ranges in width from a few hundred yards to about 12 miles. It is broadest off El Segundo, narrowest off Redondo Beach, and is transected by three submarine canyons: Dume Submarine Canyon off Point Dume; Santa Monica Submarine Canyon seven miles offshore of Ballona Creek; and Redondo Submarine Canyon, a few hundred yards off King Harbor (Figure 6, SMBRP, 1994a).

Marine Habitats

The Bay provides a variety of habitats for a highly diverse group of plants and animals representing at least 5,000 species. The dominant *benthic habitat* in Santa Monica Bay is soft bottom which consists of fine to moderately coarse sediments (Figure 7). Few attached plants live in this habitat but invertebrates are abundant and diverse. Resident animals include crabs and shrimp, snails, worms, echinoderms, and bottom-dwelling fish. Hard bottom areas consist of seafloor covered with bedrock, gravel, and phosphorite. Kelp beds will often be found in these hard bottom areas at depths of 20 to 70 feet in the subtidal regions west of Malibu and around the Palos Verdes Peninsula. The giant kelp attaches itself to the bottom and grows in luxurious forests toward the sunlight above. Although far less in acreage than soft bottom, kelp beds in the Bay provide cover and protection, and thus habitat for more than 800 species of fishes and invertebrates, some of which are uniquely adapted for life in the beds. Consequently, kelp beds are important for sport fishing, commercial harvesting of abalone and sea urchins, and recreational diving.

The *pelagic, or open-ocean habitat* is the primary home to fish such as Pacific sardine, northern anchovy, Pacific mackerel, and Pacific bonito, as well as marine mammals such as seals and sea lions. Many species of whales and dolphins are also observed in Bay waters during the winter/spring migration. The thin uppermost layer of the water column (microlayer) is also home to the eggs and larvae of many invertebrates and fish. One of the unique habitats is the *shallow nearshore* protected areas of the Bay (e.g., Torrance Beach, Redondo Beach), which serve as important nurseries for local marine fishes (e.g., juvenile California halibut, juvenile white seabass). Phytoplankton are the dominant plant life in the pelagic environment. Red tides (which are typically dominated by dinoflagellates) sometimes develop in nearshore areas when warm temperatures, high light levels, abundant nutrients, and a shallow pycnocline (density gradient) occur together. Localized red tides occur almost every year; extensive ones occur less frequently.

Intertidal zones include mud flats, tide pools, sandy beaches, and wave-swept rocks. They provide important habitat and breeding grounds for a variety of plants such as marine algae,

Figure 6

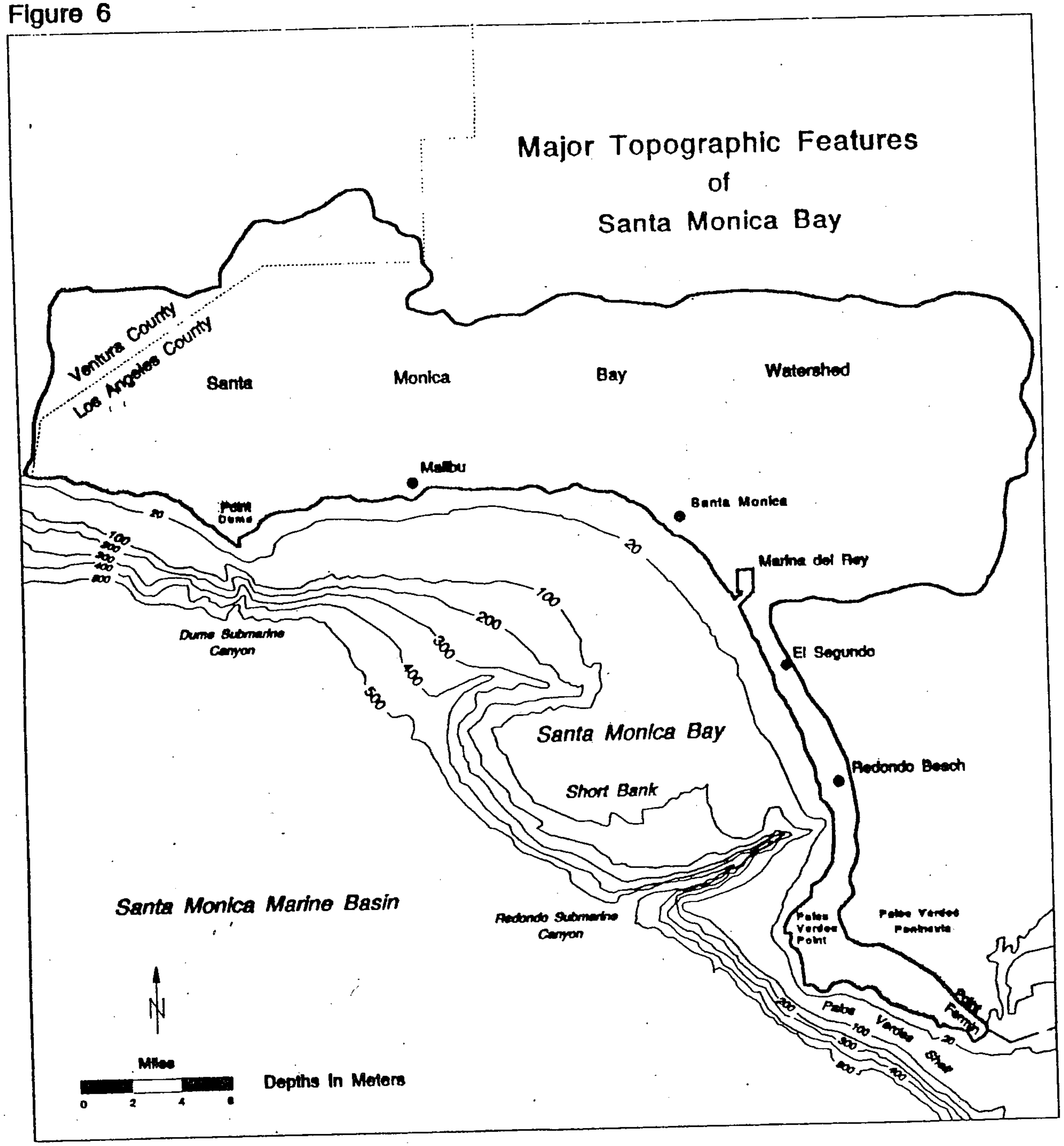
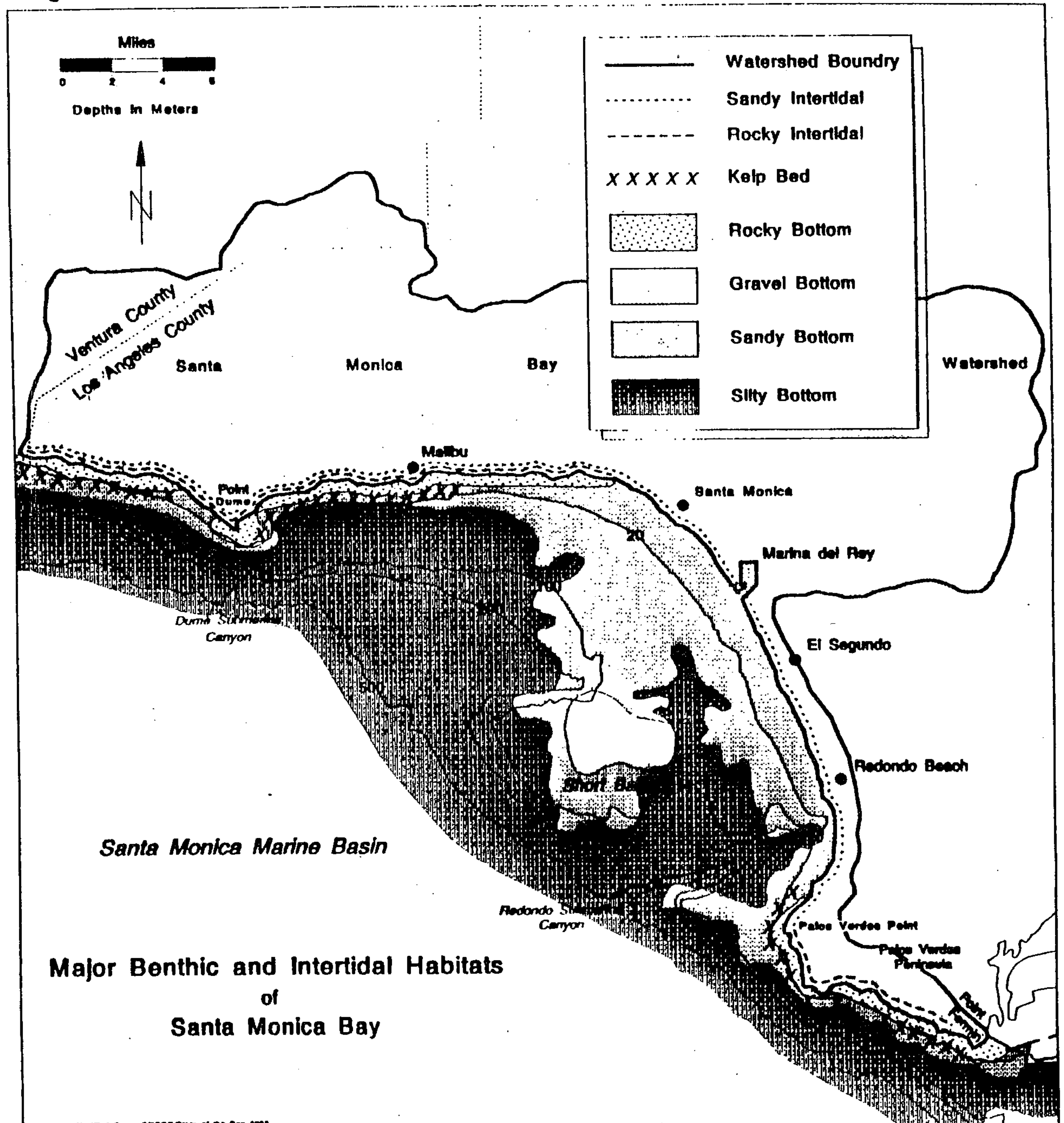

Major Topographic Features
of
Santa Monica Bay
Ventura County
Los Angeles County
Santa
Monica
Bay
Watershed
Malibu
Point Dume
Santa Monica
Marina del Rey
El Segundo
Redondo Beach
Palos Verdes Point
Palos Verdes Peninsula
Point Fermin
Dume Submarine Canyon
Santa Monica Bay
Short Bank
Redondo Submarine Canyon
Palos Verdes Shelf
Santa Monica Marine Basin
N
Miles
0 2 4 6
Depths In Meters
20
100
200
300
400
500

Figure 7



Major Benthic and Intertidal Habitats
of
Santa Monica Bay

fish such as grunion, and many invertebrates. Both beaches and other intertidal zones of Santa Monica Bay are important nesting and feeding grounds for migratory waterfowl and shore birds such as egrets, herons, gulls, terns, sanderlings, and plovers.

Because of the existence of kelp beds, tidepools, and significant ecological diversity, the nearshore area between the Ventura County Line and Latigo Point was designated by the State Water Resources Control Board (SWRCB) as an "Area of Special Biological Significance (ASBS)." An ASBS is afforded special protection for marine life through prohibition of waste discharges within such areas (SWRCB, 1976). The same area and the nearshore area between Palos Verdes Point and Flat Rock Point were each also designated a "significant ecological area" by the County of Los Angeles.

Estuaries and Enclosed Coastal Waterbodies (Shallow Water Habitats)

Enclosed shallow water habitats are important features of the Santa Monica Bay coastline. These waterbodies are protected from rough seas and winter storms and provide a certain amount of stability in the physical environment (less so at the mouths of rivers) and availability of food. The relative complexity of the physical environment (piers, mudflats, sandy bottom, etc.) tends to allow for considerable diversity in the flora and fauna living there.

The Santa Monica Bay Watershed contains five major estuaries/lagoons (Dume Lagoon, Malibu Lagoon, Topanga Lagoon, Ballona Lagoon and Del Rey Lagoon, and Ballona Wetlands)(Figure 8). Lagoons may form at the mouths of rivers (the estuary) periodically when sand bars build up and close off the area. Considerable fluctuations in salinity often result. Coastal wetlands not part of a river system are often a mix of tidal influx and freshwater water inputs (usually from urban runoff) which may result in fluctuations in salinity. Many of the species living in estuaries are either adapted to changing salinity (such as some species of pickleweed) or relocate to stay within the appropriate salinity range (such as tidewater goby). Some estuarine fauna have adapted by producing large amounts of offspring with the likelihood that only some will survive. Lagoons are popular overwintering sites for migrating birds and are utilized by species nesting locally (such as the California least tern) during foraging. Many of the species found in estuaries are unique to that habitat and consequently are very sensitive to estuarine habitat loss.

The enclosed waters of Marina del Rey and King Harbors also function to a large extent as shallow water habitats but in a somewhat different manner. Here salinity is relatively constant and reflective of the nearby ocean waters. Many species of fish use these enclosed waters as nurseries. The mix of hard and soft bottoms yields a large array of organisms; many organisms which might normally attach to rocks will also attach to piers in great abundance (mussels, tunicates). Organisms living in these waters are in constant contact with any pollutants found there.

Inland Riparian Habitats

Riparian habitat exists along each natural watercourse flowing to the ocean and around the lakes of the watershed. Riparian corridors include those found throughout the Malibu Creek watershed, in other Santa Monica Mountain watersheds such as Arroyo Sequit and Big

Major Wetlands of the Santa Monica Bay Watershed

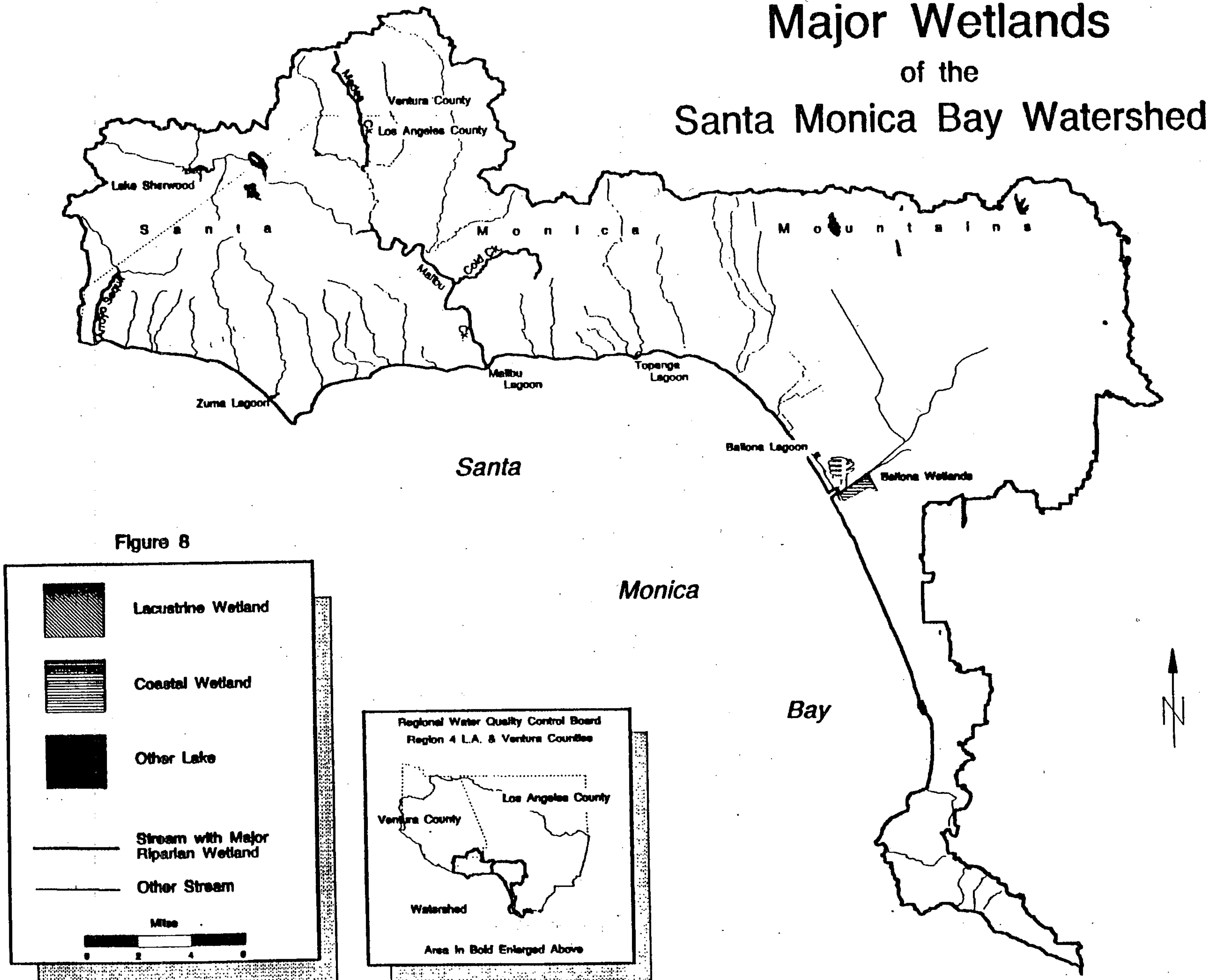


Figure 8

Sycamore Creek, and adjacent to lakes such as Westlake Lake, Lake Sherwood, and Malibou Lake. Riparian habitat generally consists of plants that need to be in close proximity to water at least for part of the year. Typical riparian vegetation includes sycamore trees, willows, mulefat, and cattails (near lakes). The generally large sycamore trees are used by birds for nesting and are particularly important to birds of prey since they give the height needed for these birds to hunt by sight. Shrubs will supply food and nesting habitat to a large variety of birds and rodents. Larger mammals such as coyote, gray fox, and the occasional bobcat are the common predators. Overhanging vegetation tends to minimize the water's temperature which can be very important to fish such as steelhead trout which migrate upstream to spawn like salmon (Malibu Creek is considered the southernmost boundary of their range in the state). Continuous habitat along streams leads to the watercourse functioning as a wildlife corridor which allows movement of wildlife from one part of the watershed to another and opens up the amount of habitat available to them to use. Loss of this continuity, as occurs during development next to watercourses and when large roads cross them, can lead to excessive segmentation of the habitat and loss of overall species abundance and diversity.

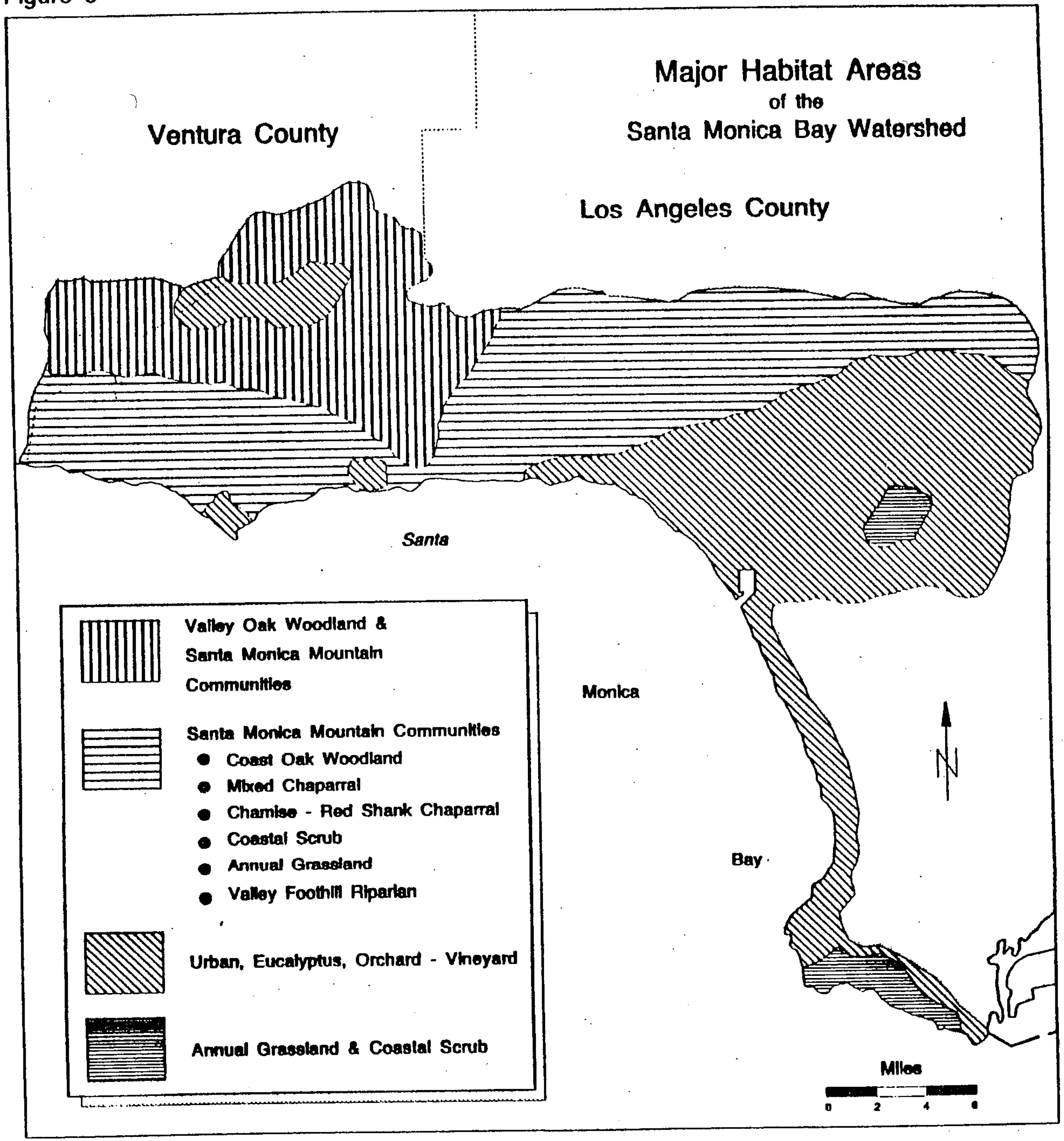
Upland Habitats

Further inland the landscapes are primarily of two types: the Los Angeles coastal plain to the south and the Santa Monica Mountains to the north. Less than 300 years ago, much of the plain was vast rolling grassland scattered with oak trees. In low-lying areas between hills and bluffs, a major river and dozens of lesser streams meandered through broad valleys and wetlands to the sea. Two higher points of land were the peaks of the Baldwin and Palos Verdes hills where coastal scrubs grew, with chaparral vegetation covering the north-facing slopes and oak savannah blanketing the drier south-facing slopes.

However, the grassland today has been replaced by human dwelling structures to become one of the most urbanized areas in the world. Only some coastal scrub habitat remains at the two higher points. Almost all natural waterways were channelized and/or converted to underground culverts. The largest drainage in the coastal plain is Ballona Creek; the Pico-Kenter drainage is second largest. Most others are small storm drains near the coast that extend only a short distance inland and receive no natural flow during summer months.

The Santa Monica Mountains to the north are very different in that most lands in this area are "open," with much of the land area remaining in its natural state. Besides coastal riparian, wetlands, grassland and scrub habitats, there are four habitats that are specific to the Santa Monica Mountains (Figure 9). The valley oak woodland occurs exclusively in the western part of the Santa Monica Mountains, particularly in the upper Malibu Creek drainage. It is dominated by valley oak, a deciduous oak 50-110 feet tall. The habitat usually merges with grassland or riparian vegetation near streams. Coastal oak woodland also occurs in the Santa Monica Mountains. This habitat is dominated by coast oak and California walnut. The mixed chaparral generally occurs above the coastal scrub habitat predominantly on moist coastal or north- and east-facing slopes while the chamise-redshank chaparral predominates on drier, south- and west-facing slopes. The former is dominated by shrubs with stiff evergreen leaves such as scrub oak, ceanothus, and manzanita. The latter is almost exclusively dominated by chamise with some redshank occurring at higher elevations. Both habitat types are fire-adapted (SMBRP, 1994a). These habitats are heavily used by small

Figure 9



Major Habitat Areas
of the
Santa Monica Bay Watershed
Ventura County
Los Angeles County
Santa
Monica
Bay
N
Valley Oak Woodland &
Santa Monica Mountain
Communities
Santa Monica Mountain Communities
Coast Oak Woodland
Mixed Chaparral
Chamise - Red Shank Chaparral
Coastal Scrub
Annual Grassland
Valley Foothill Riparian
Urban, Eucalyptus, Orchard - Vineyard
Annual Grassland & Coastal Scrub
Miles
0 2 4 6

herbivores such as rodents and seed/insect-eating birds, as well as by large ones such as deer. Predators include owls, hawks, coyotes, and foxes.

Endangered Species

Santa Monica Bay habitats (marine, aquatic, and terrestrial) are home to a number of rare, threatened or endangered species. Birds include California brown pelican, California least tern, western snowy plover, Belding's savannah sparrow, American peregrine falcon, and California gnatcatcher. Butterflies include the El Segundo blue, Palos Verdes blue, and wandering skipper. Endangered plants include Santa Monica Mountains dudleya, Lyon's pentachaeta, Conejo buckwheat, and Santa Susanna tarweed (SMBRP, 1994a).

POPULATION, LAND USES, AND ECONOMY

Population

Of the 9.5 million people living in Los Angeles County (1995 PEPS[2] estimate), it is estimated that approximately 2.5 million live within the 414-square-mile Santa Monica Bay watershed. In addition, approximately 8.8 million live within the so-called "wasteshed," the area that is served by the large wastewater treatment plants that discharge into the Bay. The population of Los Angeles County is projected to grow by 19% to 11.3 million in 2005 (PEPS estimate).

Land Uses

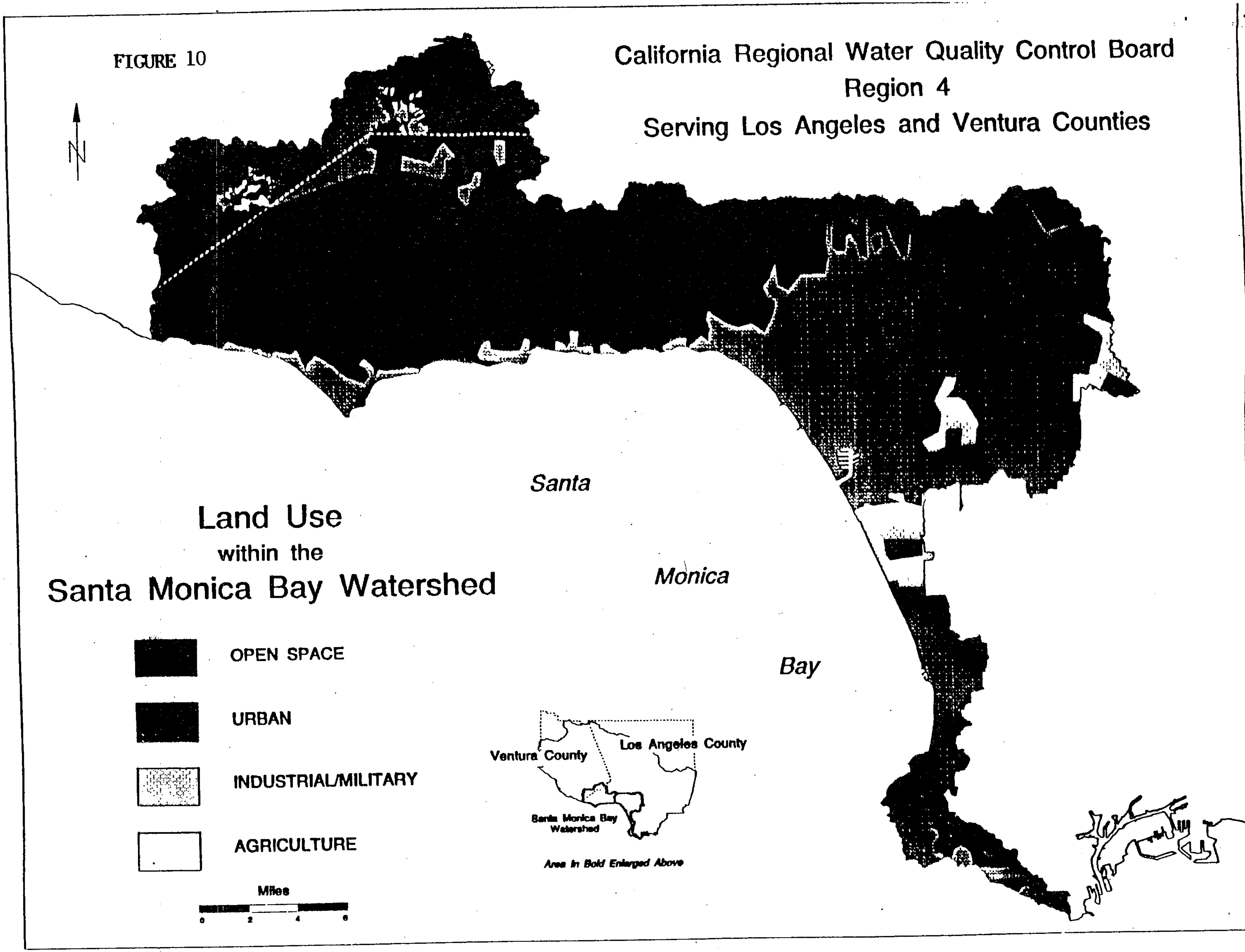
Besides natural open spaces (57% of the area), the predominant human land use in the watershed is residential (Figure 10), of which most are single family homes (26% of the area). Multi-unit family dwellings comprise 7% of the area (SMBRP, 1993).

Though a small percentage of the land area (10%), commercial and industrial land uses are found in all but a handful of the subwatersheds. Large industrial centers in El Segundo, Manhattan Beach, Redondo Beach, and Torrance are the Region's strong base for aerospace and other high-tech manufacturing. Other concentrated commercial/industrial areas in the watershed include Westchester-LAX-Playa del Rey (commercial), Santa Monica-West Los Angeles-Century City (commercial and light industry), Culver City (entertainment industry), Los Angeles Civic Center, and the Hwy. 101 corridor in Thousand Oaks-Westlake Village (light industry and commercial).

Several large industrial facilities are located near the coast, between Marina del Rey and Redondo Beach. These facilities include the Chevron Products Company's El Segundo Refinery, the City of Los Angeles' Hyperion Treatment Plant, and three power generating stations (the Los Angeles Department of Water and Power's Scattergood Generation Station; Southern California Edison's El Segundo and Redondo Generation Stations).

[2]Los Angeles County Population Estimation and Projection System

FIGURE 10


California Regional Water Quality Control Board
Region 4
Serving Los Angeles and Ventura Counties
N
Santa
Monica
Bay
Land Use
within the
Santa Monica Bay Watershed
OPEN SPACE
URBAN
INDUSTRIAL/MILITARY
AGRICULTURE
Miles
0
2
4
6
Ventura County
Los Angeles County
Santa Monica Bay Watershed
Area In Bold Enlarged Above

The southern coastal plain portion of the watershed is at or near build-out, with the exception of the Playa Vista land holding, which is being planned for mixed-use development. Therefore, future coastal development in this area will be restricted to scattered infill development, recycling and redevelopment activities. The future population and economic expansion in the area is likely to result in a more dense pattern of human activities and development.

The narrow strip of coastal land in the northern Santa Monica Mountains portion of the watershed is also at or near build-out. Scattered and block new developments take place by encroaching on canyon slopes. New development and business expansion also takes place in the upper watershed, spreading from the Hwy. 101 corridor to the nearby foothills and even hilltop areas.

Economic Activities

Economic activities in the watershed are similar to those of Southern California as a whole. Major land-based economic activities include the aerospace and electronics industries, tourism, the entertainment industry, trade, and transportation.

The rich biological and aesthetic resources of the Bay provide many economic benefits to the residents of the watershed. The abundant recreational facilities (including 22 public beaches, a 22-mile-long beach bike path, 6 piers, small craft harbors with 6,000+ slips, and 9 artificial reefs) make the area attractive for a wide range of water-dependent activities. Over 45 million people visit Santa Monica Bay beaches each year to engage in sightseeing, sunbathing, swimming, surfing, and biking. Millions of fishing trips were made to the Bay and on fishing piers each year. The region, especially coastal jurisdictions, depend on tourism associated with these activities to generate jobs and revenues.

WATER RESOURCES

As is the case for the rest of Southern California, the Santa Monica Bay watershed is known as "water-poor" because of the limited amount of precipitation the region receives on average each year. However, heavy storms do occur and cause catastrophic flooding on occasion. During wet years, the annual total of rainfall can be as great as 38 inches. Annual rainfall totals vary a great deal depending on local topography (Table 1, annual rainfall between 1949 and 1989). In addition, the region is rich in groundwater resources with several groundwater basins of large storage capacity. Finally, water imports from the eastern and northern parts of the state have fundamentally changed the water resources' balance equation and, in a sense, have dramatically expanded the boundary of the watershed.

Surface Water

Until storms shifted its course in 1825, the Los Angeles River was the largest river system entering Santa Monica Bay. It once meandered through extensive swamp forests, marshes and lakes between the Baldwin and Beverly Hills. Today, there is no one major river system in the watershed but rather smaller perennial or seasonal streams; Ballona Creek in the Los

Table 1 Wet Season Rainfall (a)
(All values in inches)

Water Year	Station 4867	Station 0619	Station 5115	Station 5114
1949	12.32	9.14	7.12	7.04
1950	18.40	13.58	9.50	8.95
1951	10.74	8.38	6.97	5.91
1952	10.54	21.25	25.14	18.42
1953	—	—	8.81	8.04
1954	20.33	17.49	11.54	11.70
1955	15.99	13.33	10.34	9.07
1956	10.26	17.96	15.12	12.66
1957	12.95	12.28	8.41	8.31
1958	25.08	25.20	19.11	16.81
1959	7.76	9.14	4.95	4.95
1960	13.59	10.69	7.74	8.74
1961	7.76	6.44	4.54	4.17
1962	30.30	26.47	18.49	17.48
1963	12.64	8.85	7.75	8.63
1964	8.96	7.33	6.40	5.18
1965	12.67	13.06	12.97	9.57
1966	26.41	18.97	17.99	12.06
1967	17.23	22.84	21.38	12.85
1968	14.98	15.61	15.11	13.58
1969	37.73	24.38	26.26	15.45
1970	15.14	9.38	7.39	5.28
1971	17.93	4.15	12.04	9.43
1972	10.30	8.43	6.94	5.95
1973	25.70	22.85	20.39	15.25
1974	20.80	—	14.33	10.50
1975	11.90	5.80 (b)	12.93	10.36
1976	6.30	4.90	6.52	3.36
1977	8.90	7.90	6.04	6.22
1978	41.00	42.70	30.63	25.74
1979	23.10	14.90	18.91	13.98
1980	32.00	10.40	25.53	20.05
1981	13.70	—	8.66	8.20
1982	11.40	—	9.78	12.44
1983	43.20	—	29.33	24.03
1984	10.40	—	6.62	6.38
1985	8.90	—	11.39	8.28
1986	27.60	—	16.97	17.85
1987	7.70	—	4.58	4.05
1988	14.70	—	8.62	6.40
1989	11.60	—	7.76	6.27
1949-1989 Statistics				
Number of Years with Data	40	29	41	41
Minimum (inches)	6.30	4.15	4.54	3.36
Maximum (inches)	43.20	42.70	30.63	25.74
Average (inches)	17.22	14.76	12.95	10.72
Standard Deviation (inches)	9.45	8.38	7.16	5.42
Coefficient of Variation	0.55	0.57	0.55	0.51

(a) For storms with more than 0.10 inches and inter-event time of 6 hours during November through April.
(b) Value not used in statistics due to missing data.
"—" indicates no data.

Angeles Basin and Malibu Creek in the Santa Monica Mountains have the largest drainage areas.

Today, Ballona Creek and its tributaries, which drain a watershed of about 127 square miles, are concrete-lined channels or covered culverts. Besides Ballona Creek, numerous flood control reservoirs and channels, and debris basins have been constructed to control flooding and speed surface flows directly to the ocean.

By contrast, Malibu Creek and its tributaries, which drain an area of 110 square miles, are for the most part not channelized. Seven upper watershed reservoirs and lakes, however, have been created by dams for recreational and water supply uses. There are about 18 other smaller perennial or seasonal streams which flow through deep and narrow canyons to Santa Monica Bay. Most of these streams remain in their natural condition except for some fills and streambank stabilization due to road and house construction.

Despite little or no rain throughout most of the year, about two dozen streams or storm drains (including Ballona and Malibu Creeks) have flow in the summer months. Several sources contribute to this phenomenom. Springs and seeps historically were common along the base of the Beverly Hills, Baldwin Hills, and throughout the Santa Monica Mountains. Many of these natural springs and seeps still exist today. Various point and nonpoint source discharges are also contributors to the summer low flow. The former are mostly from groundwater pumped from dewatering projects and from cooling tower discharges. The latter are from over-irrigation, or domestic/industrial illicit connections. Regardless of the sources, these are considered excessive flow because they result at least partly from water imported from outside the watershed.

Groundwater

Water in the ground (groundwater) is present at varying depths below land surfaces everywhere. Aquifers, which are permeable units of soil and rock, store ground water that can be easily transmitted and pumped to provide water for uses such as drinking, irrigation and industrial processing. In the Santa Monica Bay watershed (as well as throughout all of southern California), ground water accounts for most of the local (non-imported) supplies of fresh water.

Part of the coastal plain of Los Angeles County is within the Santa Monica Bay watershed. Of the four groundwater basins within the coastal plain, the Santa Monica Basin and parts of the West Coast, Hollywood, and Central Basins lie within the watershed (Department of Water Resources, 1961). Additionally, limited groundwater resources exist in Malibu and Russell Valleys in the Malibu hydrologic area (RWQCB-LA, 1994).

The West Coast Basin Barrier Project recharges aquifers in the West Coast Basin by direct injection into 153 wells of a blend of advanced-treated reclaimed water and potable water imported from other Regions. The barrier recharges aquifers and prevents seawater intrusion into the West Coast Basin.

Water Imports

Water has been imported into the Los Angeles Region from other areas since 1913 when the Los Angeles Aqueduct began delivering water from the Owens Valley. Since that time, southern California has developed a complex system of aqueducts to import water to a rapidly growing population and economy. Water imported to the Region presently meets approximately half of the demand for potable water (RWQCB-LA, 1994).

The principal systems for importing water are the Los Angeles Aqueduct which diverts water from the Mono and Owens Rivers Basins, the California Aqueduct (State Water Project) which transports water from northern California, and the Colorado River Aqueduct which carries water from Lake Havasu on the Colorado River. Importing these waters brings several problems as well as the obvious benefits. Water from the Owens Valley is usually treated for turbidity. Water from the Colorado River generally has a higher mineral content than either local waters or other imported waters. This hardness is the result of dissolved material from soil and rocks in that river's watershed. Water from northern California accumulates organic materials as it flows through the Sacramento-San Joaquin Delta. These organic materials when combined with the chlorine used during typical disinfection treatment processes can result in by-products called trihalomethanes (THMs). These substances have been linked to cancer. A 100 parts per billion standard has been established to mitigate the occurrence of THMs in drinking water, while still allowing for adequate disinfection with chlorine (RWQCB-LA, 1994).

Chloride is one component of hardness in water and, during drought periods, water supplies from northern California often have higher than normal concentrations of chlorides. Excessive chlorides can impair the use of water for human consumption and application on crops. Currently, surface waters within the Santa Monica Bay watershed are not experiencing excessive chloride concentrations due to imported water (RWQCB-LA, 1994).

KEY WATER QUALITY ISSUES IN THE WATERSHED

Though relatively small in size compared with watersheds for major rivers, lakes, or estuaries in other parts of the country, the Santa Monica Bay watershed includes a remarkably high diversity of geological and hydrological characteristics, habitat features, and human activities. Every beneficial use defined in the Basin Plan is identified in water bodies somewhere in the watershed (see Monitoring and Water Quality Assessment Section below). Yet beneficial uses such as body contact recreation and marine habitat have been impaired for years. A complete list of beneficial uses identified for each subwatershed area can be found in each Subwatershed chapter.

Impairment problems with existing and potential beneficial uses in the watershed fall into two categories: human health risk, and natural habitat (wildlife) degradation. The former includes issues primarily associated with recreational uses of Santa Monica Bay. The latter includes 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. Encroachment by human development is another major cause for disappearance or degradation of natural habitats.

Adverse Human Health Impacts

Santa Monica Bay is heavily used by the public for fishing, swimming, surfing, and diving activities; these types of activities are classified as beneficial use water contact recreation (REC-1). However, the ability of people to enjoy these activities has been lost to a certain degree because of the real or perceived risk to human health.. While the perception of risk may sometimes be exaggerated, it is based on real problems quantified in a number of studies. The best documented problems are the acute health risks associated with swimming in runoff-contaminated surfzone waters, and the chronic (cancer) risk associated with consumption of certain sport fish species in areas impacted by DDT and PCB contamination.

Swimming

Reports from the public, environmental organizations, political leaders, the news media and other sources indicate that swimmers increasingly complain about ear, eye, wound and intestinal infections, skin rashes and other illnesses that allegedly occur as a result of contact with Bay waters. In investigating sources of contaminants that could be responsible for possible adverse health effects, researchers have found evidence that points to pathogens (enteric viruses and possibly pathogenic bacteria) that may be carried by urban runoff through storm drains into the Bay. Review of shoreline monitoring data showed higher indicator bacteria (total coliform, fecal coliform, and enterococcus) in waters surrounding storm drain outlets. These are called "indicator" bacteria since their presence suggests pathogenic bacteria and viruses may be present. These indicator bacteria do not themselves cause disease (SMBRP, 1990).

Stronger evidence was found In SMBRP studies completed between 1989 and 1991, when enteric viruses were found in the storm drain effluent at three widely-dispersed locations during dry-weather periods. These outlets collect flow from scattered locations and varied land uses around the watershed (SMBRP, 1992, 1991, & 1990).

In summer 1995, the SMBRP conducted a landmark epidemiological study of possible adverse health effects of swimming in Santa Monica Bay. The study found solid evidence that (1) there is an increased risk of illness associated with swimming near flowing storm drain outlets in Santa Monica Bay; (2) there is an increased risk of illness associated with swimming in areas with high densities of bacterial indicators; (3) illnesses were reported more often on days when the samples were positive for enteric viruses; and (4) high densities of bacterial indicators were measured on a significant number of survey days, particularly in front of drains. The study also showed that the total coliform to fecal coliform ratio is one of the better indicators for predicting health risks, a significant finding that may prompt changes to current monitoring programs (SMBRP, 1996).

Because the health impacts seemed restricted to areas immediately adjacent to storm drain outlets and generally did not extend beyond 400 yards from each side of the drain, the affected beach area is an estimated two miles of the 55-mile shoreline of Santa Monica Bay. The "hot spots" are areas near a dozen storm drains that have low-flow in the summer swimming season (Table 2). Since release of the epidemiological study results, new warning

Table 2. Major storm drains with low-flows to Santa Monica Bay during summer swimming season.

Name	Location	Discharge Point
Malibu Creek	Malibu	Malibu State (Surfrider) beach
Topanga Canyon Creek	Malibu	Topanga State Beach
Bay Club Dr.	Pacific Palisades	Will Rogers State Beach
Palisades Park	Pacific Palisades	Will Rogers State Beach
Montana Ave.	Santa Monica	Santa Monica State Beach
Wilshire Blvd.	Santa Monica	Santa Monica State Beach
Santa Monica Pier	Santa Monica	Santa Monica State Beach
Pico-Kenter	Santa Monica	Santa Monica State Beach
Ashland Ave.	Santa Monica	Santa Monica State Beach
Thornton Ave.	Los Angeles	Venice City Beach
Brooks Ave.	Los Angeles	Venice City Beach
Pershing Dr.	Los Angeles	Dockweiler State Beach
Ballona Creek	Los Angeles	Dockweiler State Beach
Imperial Hwy.	Los Angeles	Dockweiler State Beach
Herondo Ave.	Hermosa Beach/Redondo Beach	Hermosa Beach
Avenue I	Redondo Beach	Redondo State Beach

signs have been posted at all flowing storm drains that inform people of the risks and advise them not to swim in these areas.

Seafood Consumption

The general public has been concerned about potential health risks associated with the consumption of contaminated seafood from Santa Monica Bay for a number of years. Eating contaminated seafood is the primary pathway through which humans are exposed to toxic chemicals found in the marine environment. While recent studies have shown that health risks are limited to consumption of certain seafood species from certain locations, the public perception remains that all seafood in the Bay is contaminated (OEHHA, 1991).

The most extensively studied contaminants in Santa Monica Bay are dichlorodiphenyl-trichloroethane (DDT), polychlorinated biphenyls (PCBs), heavy metals, and their by-products. PCB and DDT (and its derivatives DDD and DDE) present the greatest risk to individuals who consume seafood from Santa Monica Bay. Over the past 25 years, several species from contaminated areas have exhibited very high levels of PCBs and DDTs. After the discharge of these chemicals was stopped in the early 1970s, contaminant levels in fish tissues declined steeply, but additional decreases have been slower since about 1992. However, both PCBs and DDT degrade naturally at a very slow rate and the earlier sharp decline may have been reflective of the cessation of discharges and reduced bioavailability, while continued evidence of contamination today is a reflection of the slow degradation rate (SMBRP 1994a).

A series of studies have been conducted by the State Office of Environmental Health Hazard Assessment (OEHHA) and SMBRP to assess the potential risk to humans associated with consumption of seafood species taken from the Bay. The current consumption recommendations are based on the risk assessment conducted by OEHHA in 1991 (Table 3). According to OEHHA's risk assessment, white croaker is generally considered to be the most contaminated fish in the Bay, especially individuals from areas such as the Palos Verdes Shelf (white croaker have naturally high lipid levels in which the organic pollutants accumulate). Other species found to be relatively contaminated at certain locations are California corbina, queenfish, surfperches and California scorpionfish.

The 1991 OEHHA study is being supplemented and updated by more recent SMBRP studies. These studies have collected data on the concentrations of contaminants in various Santa Monica Bay fish and shellfish species, and on the seafood consumption patterns of local anglers. Utilizing the results of these studies, the exposure scenarios and risk levels are being calculated by environmental scientists at the University of California, Davis. The results will be made available to OEHHA in the Spring of 1997 for development of a new risk assessment and consumption recommendations.

Habitat Degradation and Wildlife Impacts

Human activities such as farming, urbanization, and commercial and industrial development, have significantly changed or degraded the watershed's habitats since the era of Spanish missions and ranchos. The natural habitats have either disappeared or been reduced to a great degree to make space for man-made structures, and/or the flora and fauna have been

TABLE 3

LOCATION	DO NOT CONSUME	NO MORE THAN ONE MEAL A MONTH	NO MORE THAN ONE MEAL EVERY TWO WEEKS	NO RESTRICTIONS
Point Dume	White Croaker			
Malibu Pier		Queenfish		
Malibu (offshore)	White Croaker			
Santa Monica/ Venice Piers				All Species
Venice Beach				All Species
Marina Del Rey				All Species
Short Bank			White Croaker	
Redondo Piers			Corbina	
Redondo Beach				All Species
Palos Verdes (Northwest Side)	White Croaker			
Point Vicente	White Croaker		Sculpin Rockfishes Kelp Bass*	
Cabrillo Pier	White Croaker		Queenfish Black Croaker Surfperches*	
Pier J (Queen Mary)			Surfperches	
Los Angeles/ Long Beach Harbor Breakwater		White Croaker Queenfish Surfperches Black Croaker*		
Belmont Pier			Surfperches	
Horseshoe Kelp		Sculpin White Croaker*		

* For all species combined

Note: One meal is about six ounces (170g).

degraded or altered by pollution or overharvesting. Water temperature changes brought on by El Nino events as well as by releases of pollutants following earthquakes and fires have also contributed to changes in the watershed's ecological community.

Wetlands

Wetlands in southern California include freshwater, saltwater and brackish water marshes, swamps and mud flats. Wetlands help mitigate flooding, filter and recharge groundwater, and provide feeding and breeding habitat for fish and waterfowl. 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 90% of the historic wetlands of the Santa Monica Bay watershed have been destroyed, with the remaining wetlands significantly degraded (SMBRP, 1994c).

A number of brackish wetlands occur along the edge of Santa Monica Bay; the largest are the Ballona Wetlands Complex (Ballona Wetlands, Ballona Lagoon, Del Rey Lagoon, Oxford Flood Control Basin, and Venice Canals) and Malibu Lagoon. At one time, the Ballona Complex was 2,100 acres of coastal estuary and wetlands. But due to the development of Marina del Rey, the Venice canals, and other residential and commercial properties, as well as the drainage of wetlands for agricultural use and to control insects, and finally, channelization of Ballona Creek, the Ballona Complex has been reduced to approximately 430 acres. The 260-acre Ballona Wetland is the largest remaining wetland within its complex. The site is a mixture of habitats dominated by coastal salt marsh. The 16-acre Ballona Lagoon is an artificially confined tidal channel that connects the Venice canals to the Pacific Ocean. The 40-acre Malibu Lagoon, at the mouth of Malibu Creek, is also a remnant of a large system (SMBRP, 1994).

The shrinking local wetlands support less biological diversity and are less productive because of their degraded condition. Restricted water flow, which results in poor water quality (high levels of nutrients and/or contaminants), and the actual loss of wetlands are major concerns at most sites. Additional adverse impacts include the lack of shallow water habitat, disruption of upstream flow, introduction of non-native plants and animals, debris and bacteria from urban runoff, and recreational over-use.

Beach and Intertidal Habitats

Prior to development, the coast between Santa Monica and the Palos Verdes Peninsula consisted primarily of sand dunes and sandy beaches which shifted due to the action of air and water currents. The process of urban development over the years has greatly reduced the size of these dunes and beaches at many locations due to jetties and other man-made structures which increase beach erosion and interfere with sediment transport.

Certain species are of particular concern specifically because of the loss or degradation of southern California beach habitat. These include the endangered California least tern, El Segundo blue butterfly and Western snowy plover. Oil spills are also a potential threat to beaches and intertidal habitats, especially to such species as the California grunion, which lays its eggs on sandy beaches.

With intense and increasing human use of the beaches and waters of Santa Monica Bay, both trash and the need for beach clean-up have increased. In addition, beaches and rocky intertidal habitats are vulnerable to the contaminants often contained in urban runoff. Filter-feeding intertidal organisms have a particularly high potential for bioaccumulating toxic organic compounds or trace metals. This is demonstrated by the fact that high concentrations of trace metals such as lead and chromium have been found in the tissues of California mussels near Marina del Rey.

Marine Habitats

One of the impacts most evident in marine habitats is sediment contamination, which also biologically affects the food web. Contaminant release may occur through natural sediment dynamics, or through disturbance of the sediment, e.g., following vigorous winter storms. Organic compounds such as DDT, PCBs, polycyclic aromatic hydrocarbons (PAHs), 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 and/or eggshells of these organisms. DDT in these organisms are implicated in fin erosion and other diseases in fish as well as eggshell thinning and subsequent species decline in the California brown pelican.

In addition to tissue damage to individuals caused by contaminated sediment, the health of benthic communities has been affected by discharge of solids and contaminants by wastewater treatment plants. The assemblages of benthic fauna found in areas impacted by historical discharges (pre-1987) near the outfalls have relatively lower diversity compared with other areas in the Bay, and are dominated by several opportunistic species (City of Los Angeles-EMD, 1991).

While areas with high levels of contamination from DDT, PCBs, and lead still remain, the top layer of sediment over most of the Bay is now much cleaner than it was in the 1970s. Banning the use of the most toxic chemicals (DDT and PCBs in the 1970s), initiation of wastewater pretreatment programs (in the 1970s), and improved treatment technology have all contributed to this improvement. Since the early 1980s, contaminant concentrations both in sediment and in the tissues of organisms continue to decrease, though at a much slower rate (SMBRP, 1994a).

MONITORING AND WATER QUALITY ASSESSMENT

As described in the previous section, the watershed's identified problems can be categorized in general as those caused by excessive pollutant loads and those caused by loss of sensitive habitats. Monitoring and special studies conducted over the years by the SMBRP, the

Regional Board and its dischargers have mostly been geared toward evaluating problems associated with pollutants and contaminants. This section concentrates on that aspect of the watershed's problems (in order to simplify the discussion, the term *pollutant* should be assumed to also mean *contaminant*; the latter term is defined specifically in the California Water Code as a substance which creates a human health problem).

Pollutants of Concern

Pollutant loading is the generation and dispersal of pollutants into the environment; a by-product of the millions of people who reside or undertake activities in the Santa Monica Bay watershed. Pollutant loads have contributed to the impairment of beneficial uses of the Bay watershed. The SMBRP has spent eight years participating in a multi-agency/stakeholder process which led to identifying the watershed's priority problems and the 19 constituents that are identified as "pollutants of concern," as well as how these pollutants affect the beneficial uses described in the previous section. The 19 pollutants of concern were identified because they present the greatest problems to the Bay. Specifically, these pollutants meet one of the following three criteria:

- Current loadings or historic deposits of the pollutant are impacting the beneficial uses in the watershed.

- Elevated levels of the pollutant are found in sediments of waterbodies in the watershed, or the pollutants have the potential to bioaccumulate.

- The detectable inputs of the pollutant are at a level high enough to be considered potentially toxic to humans and aquatic/marine life.

The 19 pollutants of concern are: DDT, PCBs, polycyclic aromatic hydrocarbons (PAHs), chlordane, tributyltin (TBT), cadmium, chromium, copper, lead, nickel, silver, zinc, bacteria/viruses, total suspended solids, nutrients, trash, chlorine, oxygen demand, and oil & grease. It is important to recognize that not all pollutants of concern are applicable throughout the Bay and its watershed. In many cases, the sources and the receiving water areas impacted by pollutant loading are restricted to a specific area of the region, as discussed in subsequent sections.

Of these pollutants of concern, the organic pollutants DDT, PCBs, PAHs, and chlordane have the highest potential to bioaccumulate in living tissue and accumulate in sediments. The attributes of these chemicals are such that they are hydrophobic (do not mix well in water) and will adsorb onto particles that settle to the bottom or are incorporated into the fatty tissues of organisms living in the water or sediment. People will generally only be at risk should they consistently consume organisms such as fish which may have already bioaccumulated large amounts of these pollutants. DDT, chlordane, and PCBs are manmade chemicals; the first two are banned pesticides while PCBs are a class of chemicals formerly used in hydraulic fluids, paints, and transformers. PAHs are naturally occurring substances found in petroleum hydrocarbons and released through anthropogenic activities such as oil dripping from cars or spills during transport. Storm drains ultimately carry the material to sensitive coastal estuaries or to the ocean. Excessive concentrations of these chemicals in living tissue can lead to problems such as impaired reproduction and pre-cancerous lesions in marine organisms, and may raise the cancer risk in humans who consume these organisms.

The metals cadmium, chromium, copper, lead, nickel, silver, and zinc can bioaccumulate in living tissue and accumulate in the sediment, but not to the degree of organic pollutant accumulation. On the other hand, metals can dissolve in the water column to some extent and occur at high enough concentrations to be toxic to aquatic organisms. Thus organisms may be impacted through both bioaccumulation and direct exposure in the sediment and water column. For example, copper is a component of anti-fouling paints applied to boats because it is very toxic to the fouling organisms which would normally attach to any available surface exposed under water. These metals are generally not a human health problem since metals concentrations in fish tissue are generally not high enough to impact humans and the amount of water a person may swallow while swimming is not enough to pose a risk.

Tributyltin (TBT) is an organo-metal previously used extensively in anti-fouling paints. It is highly toxic to aquatic organisms and can be acutely toxic to humans applying the paint without proper safety equipment. It dissolves fairly easily in water but also degrades quickly. It can bioaccumulate in organisms to high concentrations and has been implicated in growth abnormalities in shellfish. Its high toxicity led to a ban in 1987 on its use except on boats of over 82 feet in length or on those with aluminum hulls. The rationale for the length restriction was that most boats moored in the water on a semi-continuous basis were smaller ones and the toxic components of paint leach out during that time.

The impacts associated with bacteria and viruses primarily center on human health concerns.

Suspended solids can convey organic pollutants to other locations. These solids also create turbidity in the water column and may impact plants such as kelp since light penetration may be reduced. Suspended solids are contributed by urban runoff and discharges from POTWs.

Nutrients such as ammonia, nitrates, and phosphates can pose a variety of problems. In the Santa Monica Bay watershed, a major concern is their contribution to excessive growth of algae in streams and enclosed coastal lagoons. Nutrients are both naturally-occurring and produced by anthropogenic activities. Degradation of plant material will contribute nutrients but runoff from over-fertilized lawns and effluent resulting from the treatment of human waste will also contribute. While some algae should be expected, excessive amounts of nutrients added to shallow waters warmed during a summer day can result in a large explosion in algal growth. This growth can be considered a nuisance but may also be harmful if, during algal die-off, oxygen levels drop dramatically and kill fish.

Trash is usually considered an aesthetics problem but may pose an aquatic life hazard through consumption or entanglement.

Chlorine is a chemical used for disinfection purposes at POTWs and is also used to kill off algae and slime growths in pipes at generating stations and elsewhere. Chlorine can be acutely toxic to aquatic organisms at excessive concentrations.

Oxygen demand refers to a situation rather than a specific pollutant. Consumption of oxygen occurs with degradation of organic material such as dead leaves and algae. When this occurs in a water body with little circulation, an excessive demand is put on the available oxygen and fish kills can result. Although not likely to be a problem throughout the Bay, localized problems can occur near large discharge sites and in smaller enclosed receiving waters.

Oil & grease is the physical manifestation of PAHs contamination. Usually multi-colored sheens of oil will appear on the water surface. In most cases, the ultimate fate of the PAHs is of more concern than the sheen, however, if thick enough, oil may coat aquatic life and cause direct injury.

Regional Board Monitoring and Water Quality Assessment

The approach taken by the Regional Board in evaluating the quality of waters is described in Appendix A. It should be pointed out that all existing beneficial uses in each waterbody may not have been evaluated due to lack of data. The Regional Board is required to assess the quality of its waters every two years and the results become part of that year's Water Quality Assessment produced by the State Water Resources Control Board.

Surface Waters

The most recent Water Quality Assessment Report (SWRCB, 1996) indicates nearshore water quality around the offshore islands is good and that the islands' beneficial uses are being fully supported. On the other hand, 30 square miles (out of 226 total square miles) of the Santa Monica Bay nearshore and offshore zones is considered impaired due to impacts on aquatic life, fish consumption, and shellfish harvesting. Various beaches are assessed as partially or as not supporting body contact recreation. Water quality in some streams within the Malibu subwatershed is impaired by excessive nutrients, bacteria, and in some instances, metals. While natural sources contribute to the problem, nonpoint pollution from human activities is strongly implicated. The quality of the waterways draining more urbanized areas, such as Ballona Creek and the Pico Kenter Drain, is impaired due to a much longer list of pollutants including many metals and organic substances such as DDT and PCBs. Enclosed coastal waterbodies such as Malibu Lagoon are not fully supporting aquatic life, contact recreation, fish consumption, or shellfish harvesting beneficial uses, while many of the watershed's lakes are not supporting contact recreation, aquatic life, or fish consumption beneficial uses. The full report should be consulted for more detailed information.

Groundwater

Groundwater accounts for only a limited portion of the Santa Monica Bay watershed's supply of fresh water; however, the general quality of groundwater in the watershed has degraded from background levels. Much of degradation reflects land uses.

In this watershed area, fertilizers and pesticides, typically used on agricultural lands, contribute to degrade groundwater. In areas that are unsewered, such as Malibu, nitrogen and pathogenic bacteria from overloaded or improperly sited septic tanks can seep into ground water and result in health risks to those who rely on groundwater for domestic water supplies. In areas with aboveground and underground storage tanks, toxics have leaked or are leaking, which can result in volatile organic compounds or petroleum compounds pollution in groundwater. An example of this is the current methyl tertiary butyl ether (MTBE) contamination in Santa Monica which has affected a number of wells in the Santa Monica Basin. Compared to surface water pollution, investigations and remediation of polluted groundwater are often difficult, costly, and extremely slow (RWQCB-LA, 1994 and SWRCB, 1996).

Seawater intrusion created by overpumping also has been a problem in West Coast groundwater basins within this watershed. However, it is under control in most areas now through an artificial recharge system consisting of spreading basins and injection wells that form fresh a water barrier along the coast. Other replenishment programs are underway using storm runoff, imported water and reclaimed water to accomplish eventual reversal of intrusion (RWQCB-LA, 1994).

Results of Three Statewide Monitoring Programs

A considerable number of short-term as well as more long-lived monitoring programs have been implemented in the Santa Monica Bay watershed, particularly over the last 20 years. Sampling efforts tend to center around assessing urban runoff effects in general along the coastline, and in reservoirs of sediments contaminated by PCBs and DDT in the area of the Palos Verdes Shelf. Three statewide monitoring programs -- State Mussel Watch, Toxic Substances Monitoring, and Bay Protection and Toxic Cleanup -- focus on biological measurements.

The State Mussel Watch Program (SMWP) utilizes either mussels native to an area of interest or those that are transplanted from "clean" areas in order to measure bioaccumulation of various substances. There are a number of semi-permanent stations located along the open coastline which serve to identify general trends in contamination, while other stations are located in enclosed waters to identify possible "hot spots" of contamination.

The Toxic Substances Monitoring Program (TSMP) samples fish to analyze for tissue pollutant levels and to provide a quick and cost-effective way to identify problem waterbodies and pollutants.

The Bay Protection and Toxic Cleanup Program (BPTCP) was initiated in 1989 by amendment of the California Water Code. The goals of the program include identification of sediment "hot spots" in the bays and estuaries of the state's coastal waters, prevention of toxic hot spots, and remediation of existing ones. Sediment quality is assessed through collection of "triad" data which include measuring sediment toxicity, sediment pollutant levels, and the number and variety of organisms living in the sediment.

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. Marina del Rey Harbor and the mouth of Ballona Creek are by far the most heavily impacted areas of the Santa Monica Bay watershed. Pollutants of particular concern are chlordane, DDT, copper, and zinc. An extensive review of the data generated by these programs is available in Appendix B.

Volunteer Monitoring

Volunteer monitoring is an important new activity in the Region and the Regional Board views it as integral to watershed management. Volunteer monitoring programs provide an excellent opportunity for citizens and government staff to work together to monitor and assess regional water quality and habitats, including riparian corridors. Many of California's rivers and streams have yet to be assessed or are assessed infrequently. It is estimated that only 2% of California's rivers have been assessed to date.

Regional Board staff have been working with the State Water Resources Control Board staff as well as local environmental and resource groups to start several volunteer monitoring efforts in our region, many of which are focused around Santa Monica Bay. In the spring of 1995, the Regional Board sent out a survey letter to environmental and resource agencies to determine the amount and types of volunteer monitoring in the Region. The responders were then invited to join a volunteer monitoring steering committee that was established in the fall of 1995 to coordinate efforts in the Los Angeles, Ventura and Orange County areas.

The steering committee, with support from the United States Environmental Protection Agency, the State Water Resources Control Board, and this Regional Board, sponsored a series of three Southern California Volunteer Monitoring Training sessions, "Training the Trainers," in August and September, 1996. These training sessions were designed to give hands-on certification for a variety of water quality monitoring techniques that could be used by citizen volunteer groups including school groups to evaluate water quality in the Region. Topics such as how to design a volunteer monitoring program, how volunteer monitoring fits into the "big picture" of resource protection, proper sample collection and preservation techniques, and quality assurance were covered. Over 50 individuals participated in the training sessions. In addition, a standardized field observation sheet was developed. A southern California volunteer monitoring handbook is being developed.

The Malibu Creek Watershed Advisory Council has identified volunteer monitoring as an important activity to help educate the public and provide data to help protect water quality at Malibu Lagoon and Surfrider Beach. A Volunteer Monitoring Subcommittee of the Malibu Creek Watershed Advisory Council was initiated in the fall of 1996 to direct activities within that watershed.

Ongoing volunteer monitoring efforts within the Santa Monica Bay include:

> Santa Monica BayKeeper: Storm event sampling at over 30 Santa Monica Bay stormdrains.
>
> Heal the Bay: Gutter Patrol Monitoring in inland neighborhoods and the Malibu Creek Watershed Citizen Monitoring Program (water quality, biology, and vegetation) for Malibu Lagoon and the lower watershed.
>
> Resource Conservation District of the Santa Monica Mountains: Water quality and biological monitoring and surveys of Malibu Lagoon.

City of Calabasas: Volunteer monitoring of the upper Malibu Creek watershed.

Surfrider-Malibu Chapter: Coliform bacteria monitoring of the surfzone in the Malibu area.

Los Angeles County Storm Water Monitoring and Assessment

The most recent Los Angeles County Municipal Storm Water NPDES Permit was adopted by the Regional Board during a public hearing held on July 15, 1996. Discharger self-monitoring is a major component of this, as well as other, NPDES permits. A key monitoring objective is to evaluate the effectiveness of Best Management Practices (BMPs) such as street sweeping and other potentially beneficial activities, which may be implemented to control levels of pollutants in storm and urban runoff. A variety of monitoring/investigative approaches are to be used to evaluate BMP effectiveness including: land use monitoring, mass emissions monitoring, identification of illicit connections, characterization of critical sources, and receiving water studies. Also, chlorpyrifos and diazinon analyses have been added to the analysis list. These two chemicals are commonly used for ant and flea control around homes and businesses and may also be used in agriculture. Urban and storm runoff carries them to surface waters. They are highly toxic to some aquatic organisms.

Data from receiving water studies were presented at a recent conference (California and World Ocean '97) and submitted to the Regional Board in the form of a progress report by the contractors to the Los Angeles County Department of Public Works (SCCWRP, et al., 1996). These studies seek to further quantify the influence of storm runoff on the marine environment. One study investigated the dispersion of runoff from the major contributors -- Ballona and Malibu Creeks -- once it reaches the Bay. The investigators found a freshwater patch off of Ballona Creek drifting north as long as two days after a storm event. The freshwater plume was found to spread 2- 5 kilometers (km) offshore as well as descending to greater than 10 meters in depth from an initial depth of less than 5 meters.

Another study investigated the toxicity of the runoff, again with an emphasis on the ocean off of Ballona and Malibu Creeks. At the highest concentrations of storm water there was a strong reduction in sea urchin fertilization but the study overall found low toxicity. Toxicity was not found to be associated with suspended solids; rather, since the water was filtered prior to testing, toxicity was associated with one or more dissolved pollutants. No toxicity was found off of Malibu Creek following a small storm while after the same storm, toxicity was found in waters within a few kilometers of Ballona Creek. Samples collected after a second larger storm exhibited toxicity in waters off of Ballona Creek. The effect was found up to 4 km offshore which correlated with the freshwater plume. Toxicity Identification Evaluations (TIEs) were conducted on samples off of Ballona Creek exhibiting toxicity, and zinc was potentially implicated in the toxicity.

A third study looked for impacts in the benthic community of the nearshore zone. A large amount of fine-grain material found at a depth of 25 meters off of Ballona Creek was a signal for a depositional area where impacts may be occurring. There were more fine sediments off of Malibu Creek and significantly higher levels of naturally-occurring metals such as chromium and nickel compared to Ballona Creek. There was also a large peak of PCBs and lead off of

Ballona but not off of Malibu Creek. There were significantly less benthic organisms found off of Ballona than off of Malibu and also fewer species. Diversity and evenness were similar, however, and overall there were no striking community effects indicating degradation at either site.

Development of a Comprehensive Monitoring Program for Santa Monica Bay

The efforts to develop a Santa Monica Bay comprehensive monitoring program began in early 1990 and are ongoing. The development was initiated by the SMBRP soon after its formation in an effort to address several fundamental problems that have hampered monitoring in the past. These problems include:

- overlaps and duplication of effort among separate programs;
- information gaps;
- a lack of focus on management information needs;
- insufficient standardization across separate programs;
- a lack of flexibility and adaptability;
- an over-emphasis on large point sources; and
- an inability to combine data from separate programs.

Development of the comprehensive monitoring program is being carried out in three phases. All three phases are being facilitated by Eco-Analysis and Southern California Coastal Water Research Project (SCCWRP) as contractor to the SMBRP. In the first phase, the contractor conducted an assessment of monitoring and data management needs in Santa Monica Bay, and built consensus among stakeholders (both political and technical) on the overall objectives of monitoring in Santa Monica Bay. The overall objectives were depicted as four fundamental questions that motivate monitoring in the Bay:

- How safe is it to swim in the Bay?
- How safe is it to eat the local seafood?
- Are marine resources adequately protected?
- Is the health of the ecosystem being safeguarded?

In the second phase, the contractor developed a comprehensive monitoring framework that defines the information needed to respond to the four fundamental questions. The information needs were translated in the framework as 54 data elements in the natural stressor, human stressor and human and biotic response indicator categories. The framework also illustrated linkages of these data elements to various components of a proposed comprehensive monitoring program and management goals. The framework therefore ensures that necessary information is available and that information gaps and overlaps are eliminated in the proposed comprehensive monitoring program.

In the third and ongoing phase, detailed designs of key components of the comprehensive monitoring program have been or are being developed. The development builds directly on the goals, objectives, and regional information linkages defined in the comprehensive framework. Each component incorporates information linkages with other agencies in the Bay that monitor the same data types with other data types that provide critical background and/or context for interpretation, and with regulators and managers who use the monitoring data. Due to time and budget constraints, only nine key components out of the original 16 are targeted for completion by the end of this project (see Figure 11).

Workgroups were formed to provide technical input, guidance and review for the monitoring designs as they are written up by the SMBRP contractor. Design for each component will provide design rationales and detailed description of issues such as measurement endpoints, indicators, location and frequency of indicator measurements, statistical basis and analysis approaches. The workgroups also make efforts to ensure that these design details are within the existing capability or ability to change by the designated monitoring agencies so that they can be readily implemented by these agencies once the design is completed.

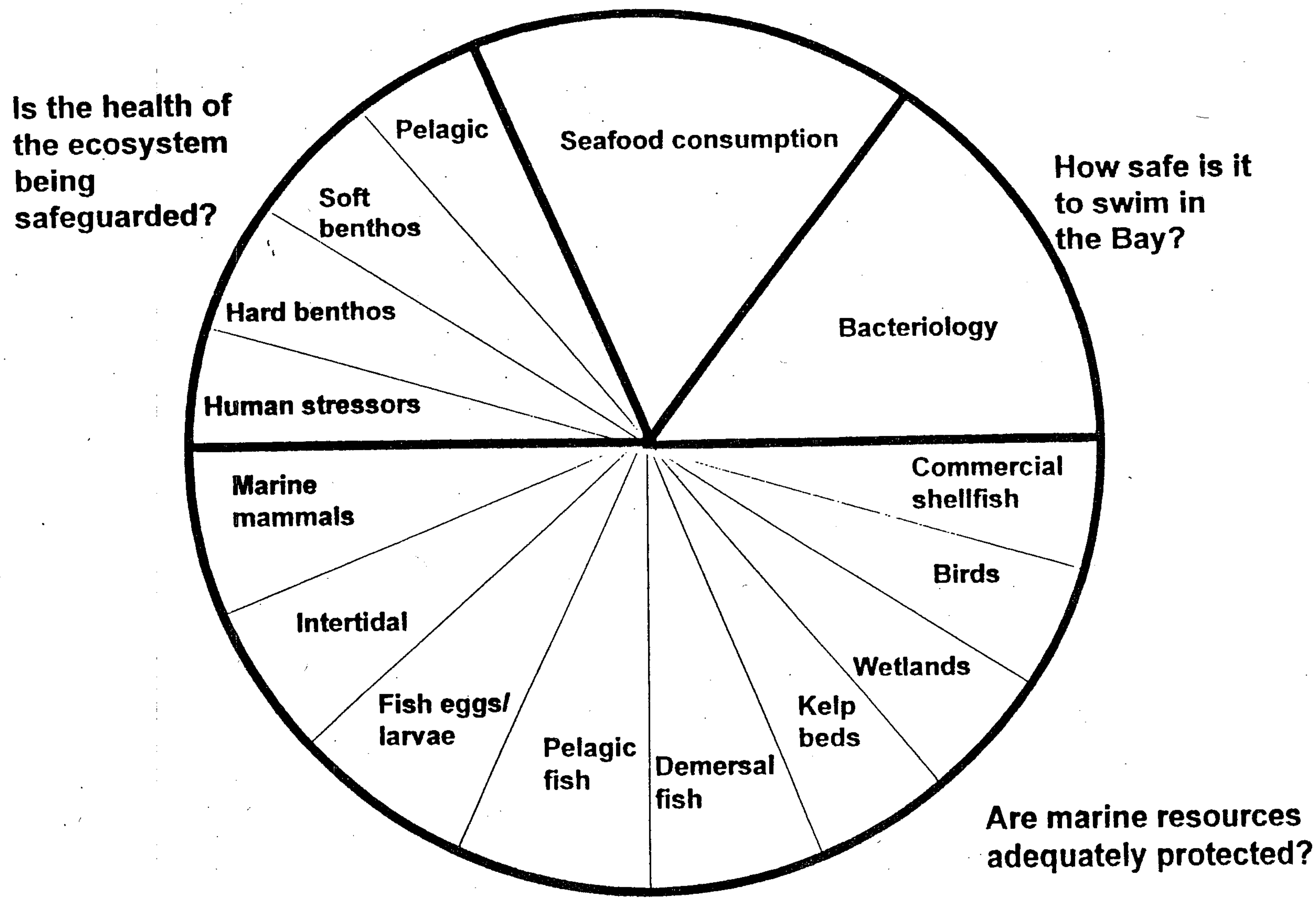
To date, four monitoring designs (bacteriology, seafood consumption, wetlands, and pelagic ecosystem) are near completion. The preliminary design for the benthic ecosystem was completed in 1993 and was tested under the Southern California Bight Pilot Project (SCBPP, see below). The bacteriological design has been in use by local monitoring agencies since January 1995. It is hoped that relevant changes recommended in other components will also be implemented in the Bay in the next few years.

Most progress to date made under the SMBRP monitoring program has been in the design of monitoring of the Bay's conditions. Parallel with this effort, the SMBRP has also looked at the monitoring needs of the land area of the watershed. In 1992, the SMBRP completed a storm water/urban runoff monitoring program design. The objectives of this monitoring program are to provide accurate data for assessing the pollutant loading to the Bay from storm drains; to identify areas with potential water quality problems; to provide information that allows the determination of the need for and the prioritization of BMPs, and to assess long-term trends in the quality of storm drain discharges to Santa Monica Bay. This program design later became the basis for the storm water monitoring program currently implemented under the Los Angeles County Municipal Storm Water NPDES Permit.

In 1994, the SMBRP and Regional Board staff completed a review of monitoring and response protocols for the Malibu Creek watershed. This review is the first-ever attempt to examine how monitoring efforts from various parties can be coordinated on a watershed basis, and how monitoring can be used to link upstream and downstream problems. Many good ideas to achieve coordinated monitoring watershed-wide were included in the findings and recommendations of this study.

Currently, the SMBRP is working on developing a comprehensive source and loading monitoring program. As the last component to be developed under the SCCWRP-EcoAnalysis contract, this project will produce a monitoring design that should provide accurate data on pollutant loading from various sources in the entire watershed. More importantly, it will refocus the current monitoring program on loadings of pollutants that have the largest impacts, and on the largest contributors of pollutant loadings in the watershed.

Figure 1


How safe is it to eat the local seafood?
Is the health of the ecosystem being safeguarded?
How safe is it to swim in the Bay?
Are marine resources adequately protected?
Pelagic
Seafood consumption
Soft benthos
Hard benthos
Human stressors
Bacteriology
Marine mammals
Commercial shellfish
Birds
Intertidal
Wetlands
Fish eggs/ larvae
Kelp beds
Pelagic fish
Demersal fish

The Southern California Bight Pilot Project (SCBPP)

Millions of taxpayers' dollars are spent each year monitoring water quality in the coastal marine environment off southern California. Most coastal monitoring is required to comply with NPDES waste discharge requirements. As a result, the emphasis of most programs is on meeting standards, not on assessing the overall health of the ocean and the condition of aquatic habitats and resources. Although protection of the environment is the goal, most compliance monitoring programs lack clearly formulated management and scientific objectives.

Compliance monitoring programs do not evaluate the cumulative effects of all discharges in the area. The NPDES permits set limits for individual point discharges, but they do not address pollutants discharged from other nearby sources. The boundaries of existing compliance monitoring programs do not match the spatial and temporal boundaries of the important physical and biological processes in the ocean. The area covered by monitoring programs is less than 1% of the total area of the Southern California Bight (SCB) (78,600 km2), of which Santa monica Bay is a part, and less than 10% of the nearshore zone. Compliance monitoring programs emphasize small-scale, discrete questions, not Bight-wide processes in a region where large natural environmental fluctuations like El Nino have a significant effect on the ecology of the ocean. Compliance monitoring programs do not provide enough information to distinguish the effects of human activities from the effects of natural environmental variability.

Despite two decades of large annual expenditures on marine monitoring in southern California, environmental managers do not have the scientific information they need to make informed decisions about use of the coastal environment. Better technical information is needed about the status and trends of the marine environment to guide management and regulatory decisions, to verify the effectiveness of existing programs, and to shape policy on marine environmental protection.

To address these concerns, the Southern California Coastal Water Research Project (SCCWRP) began planning for a regional monitoring program in 1993 and coordinated implementation of the project, known as the Southern California Bight Pilot Project (SCBPP) in 1994. The SCBPP was intended to develop and demonstrate an integrated, coordinated regional environmental monitoring program based on existing compliance monitoring programs. When completed, the SCBPP will provide synoptic information about the ecological condition of the mainland shelf in the Southern California Bight, and will evaluate new assessment approaches and alternative designs for compliance monitoring programs. The SCBPP also encouraged participating agencies to adopt common sampling designs and methods to facilitate comparisons among the programs in the Region for years into the future.

The SCBPP is a cooperative sampling effort by 12 agencies, including four major POTWs and three Regional Water Quality Control Boards in Southern California, the State Water Resources Control Board, US EPA Region IX and Office of R&D, SCCWRP, and SMBRP. One task of the SCBPP was to evaluate the sampling design used by EPA's Environmental Monitoring and Assessment Program (EMAP). EMAP sampling is based on randomly-placed points within hexagonal grids covering the contiguous United States and associated coastal waters. The interpoint distance for the EMAP grid is approximately 27 km; however, the grid spacing can be adjusted as needed for a particular sampling design. Use of the hexagonal grid ensures that sample points are well-distributed over the study area. Moreover, the explicit spatial basis of the design ensures that each sampling point represents a known area, so that it is possible to estimate the amount of area with a particular characteristic (e.g., the area with DDT concentrations greater than 1 part per million). Random placement of the grid and random selection of sampling points provides the randomness needed for statistical inference.

Water quality, benthic invertebrate and fish assemblages, fish pathology and bioaccumulation, sediment characteristics (including toxicity), and marine debris were measured in three geographic zones (north, central and south); three depth zones (shallow, middle and deep, 10 - 200 meter depth); and in municipal wastewater and storm water discharge areas.

Under the SCBPP design, Santa Monica Bay and the area around the Hyperion outfall were selected as special subpopulations of interest. As a result, a greater proportion of sampling stations were placed in these areas. Sampling and analysis under the SCBPP are expected to generate results that enable assessments of both impacts of anthropogenic activities (e.g., an outfall), and comparison of the Bay's condition with the rest of the Bight and/or background conditions.

Sampling was completed in the summer of 1994. SCCWRP is preparing reports summarizing the results and evaluating the success of the pilot project design in fulfilling the objectives of the program. Draft reports have been completed for the water quality and sediment toxicity components of the pilot project. The remaining reports should be available within the next few months.

The pilot project was intended to set the stage for a recurring regional monitoring program. The current goal is to conduct a second round of regional monitoring during the summer of 1998. Over the next twelve months, discussions will focus on how to design the second sampling program to take advantage of the experience and information gained from the first effort. Consideration will be given to changing or refining the objectives, expanding the range of subpopulations to be investigated, increasing the number of indicator measurements, improving sampling and analytical techniques, and broadening the funding base by adding new participants to the program.

The planning process for the 1998 sampling program has already begun. In June, 1997, EPA will sponsor a workshop to invite new participants to join the project and present results from the pilot project. In July, SCCWRP will sponsor a workshop to identify the primary objectives to be addressed in the next survey. By September, to goal is to finalize the selection of new participants and approve the objectives. From October through December, the details of the sampling design, logistics and analytical protocols will be developed. By February, 1998, the sampling plan and supporting documentation should be finalized and approved. The 1998 survey is scheduled to be conducted in July, 1998.

DISCHARGES/SOURCES

Pollutants reach surface waters in the watershed through a number of pathways. Major pathways include treated wastewater carried by the region's sewage system; storm water/urban runoff carried through the region's storm drain system; treated industrial wastewater directly discharged into the waterbodies; oil and hazardous wastes spilled directly into the waterbodies; air-borne pollutants deposited directly into the waterbodies, boating wastes, and re-suspension of contaminated sediments. Many pollutants can also reach groundwater by leaching through soil and, at times, recharging directly. Occasionally, contaminated groundwaters are pumped out, treated, and discharged into surface waterbodies and thus become another (usually minor) source of pollutant loading.

Major POTWs

City of Los Angeles - Hyperion Treatment Plant

The City of Los Angeles operates the Hyperion Treatment System, which consists of the Hyperion Treatment Plant on the coast near El Segundo and two upstream plants - the Donald C. Tillman Water Reclamation Plant and the Los Angeles-Glendale Water Reclamation Plant. The system serves about 4 million people, over 100,000 businesses and industries in a 600-square-mile area, and 29 agencies and contract cities. Among the cities with contract for sewer services are San Fernando, Burbank, Glendale, West Hollywood, Beverly Hills, Santa Monica, Culver City and El Segundo.

The Hyperion plant has a design capacity of 420 millions of gallons per day (mgd) of wastewater, most of which comes from the central Los Angeles area and includes excess flow from the San Fernando Valley. During the period from August 1995 through September 1996, Hyperion discharged an average of 360 mgd of treated wastewater into Santa Monica Bay through the five-mile outfall. The effluent was a combination of about 50 percent advanced primary and 50 percent secondary effluent but is moving toward full secondary treatment of all the effluent by 1998 as required under a consent decree. Additional information on the treatment plant is located in Appendix C.

County Sanitation Districts of Los Angeles County -Joint Water Pollution Control Plant

The County Sanitation Districts of Los Angeles County (CSDLAC) operates the Joint Water Pollution Control Plant (JWPCP), a regional wastewater treatment facility, at 24501 South Figueroa Street in Carson, California, which serves approximately five million people. The plant is part of a Joint Outfall System (JOS) and treats municipal and industrial wastewater (approximately 85% and 15%, respectively), as well as sludge from six of the CSDLAC's upstream water reclamation plants (Whittier Narrows, San Jose Creek, Pomona, Los Coyotes and Long Beach).

The JWPCP advanced primary treatment facility has a dry weather average flow design capacity of 400 mgd with an National Pollution Discharge Elimination System (NPDES) permitted capacity of 385 mgd and a peak design capacity of 540 mgd.

The final effluent, which is a blend of advanced primary and secondary effluents, travels 6.5 miles through tunnels to Whites Point where it is discharged through two outfalls off of Whites Point, San Pedro. A third, shorter ocean outfall is used only during heavy rains for hydraulic relief, when necessary, and a fourth (shortest) ocean outfall serves as a standby. A federal consent decree requires the facility be upgraded to full secondary treatment by the end of 2002. Additional information on the facility is available in Appendix C.

Las Virgenes Municipal Water District /Triunfo County Sanitation District - Tapia Water Reclamation Facility

The Las Virgenes Municipal Water District (the District) operates the Tapia Water Reclamation Facility (Tapia), the Rancho Las Virgenes Farm (the Farm), and the Rancho Las Virgenes Composting Facility (Rancho). Tapia is located at 731 Malibu Canyon Road in Calabasas and is jointly owned by the District and the Triunfo County Sanitation District (TCSD). In 1994, the construction for Tapia's treatment capacity expansion from 10 mgd to 16.1 mgd was completed. Tapia can utilize both solids and liquid treatments, although the solids have mostly been relegated to Rancho. The treatment processes start with preliminary treatment and primary treatment. Then the flow stream separates into two routes, one for solids and the other for liquid. The solids handling includes aerobic digestion and sludge dewatering, while the liquid handling consists of secondary treatment, tertiary treatment, chlorination, and de-chlorination.

Primary sludge is sent to the Rancho for anaerobic digestion and is eventually composted for use in plant nurseries, sod farms, landscaping, and related activities. The digested sludge can also be pumped to the Farm (located at 3242 Las Virgenes Road) for subsurface sludge injection or to a new state-of-the-art compost facility.

Treated effluent is either reclaimed for irrigation and industrial uses or discharged to Malibu Creek. Incoming flow has averaged 8.46 mgd over the past five years, while the average effluent discharge has been 3.02 mgd, and the average reclaimed water flow has been 4.48 mgd. Tapia currently serves a total population of 80,000. The municipalities served are Triunfo Sanitation District (25,000), Calabasas - Hidden Hills (22,000), Upper Old Topanga (500), and Agoura Hills - Westlake Village (32,500).

Tapia provides reclaimed water for irrigation throughout the Malibu watershed. Any water that cannot be sold for recycling purposes, is discharged either directly into Malibu Creek near the facility, through percolation ponds at Tapia park, or on rare occasions, to the Creek as overflow across from the District's Headquarters reservoir. Additional information on this facility is available in Appendix C.

Direct Industrial Discharges

Four major industrial facilities discharge treated wastewaters directly into the Bay. They include three electric power generating stations and Chevron's El Segundo Refinery. The power generating stations (the City of Los Angeles Department of Water and Power's Scattergood Plant, and Southern California Edison's El Segundo and Redondo Beach Plants) use seawater from Santa Monica Bay to cool steam condensers. Cool seawater is pumped into the station, circulated through noncontact heat exchangers, and discharged at a temperature above the intake temperature. In addition to elevated temperatures, the once-through cooling water may include treated wastewater which has been determined to be non-hazardous as defined by state and federal regulations. Chlorine is also injected periodically to control biological growth.

The Chevron Refinery manufactures various petroleum products. It discharges treated wastewater (equivalent to secondary treatment) through an outfall 2/3 mile offshore of the beach south of Grand Avenue. The refinery discharges approximately eight mgd of treated water during dry weather and up to 20 mgd during wet conditions. Additional information on these facilities is available in Appendix C.

Non-Industrial Discharges

Of the approximately 220 NPDES permit discharges into the watershed, the majority are either treated contaminated groundwater or those classified as miscellaneous (treated wastes from dewatering, recreational lake overflow, swimming pool discharges, water ride wastewater, and groundwater seepage). The majority of these discharges are less than 0.1 mgd and most go into Ballona Creek. These discharges would not be expected to contain significant levels of any pollutants of concern.

Storm Water/Urban Runoff

Urban and storm water runoff are carried to waterbodies through the Region's massive storm drain system. In some areas of the watershed, the drainage system consists of natural streams, riparian corridors and wetlands, and therefore are waterbodies with considerable ecological value as previously described. The rest is part of the 5,000 mile concrete-lined storm drain network within Los Angeles County that was built to move flood waters quickly to the ocean. The storm drain system is completely separate from the sewer system.

Storm water and urban runoff are discharged to Santa Monica Bay through more than 200 outlets; some are as large as a 370 feet-wide concrete channel connected to other channels many miles inland, while others are so small that they are hard to detect and only drain one or two blocks near the coast. About a dozen of these outlets have flows during dry-weather, discharging 10 to 25 gallons of water/second. On a rainy day, however, 10 billion gallons can flow through the system. Each year an average of 30 billion gallons of storm water and urban runoff are discharged into Santa Monica Bay (SMBRP, 1994c).

Urban and storm water runoff is made up of greatly varying types of material. Land use strongly influences the types and concentrations of materials found in runoff. Runoff quantity and velocity increases when roads, buildings or pavement (impervious surfaces) cover land that once absorbed and filtered rainfall. Human activities that occur within each type of land use contribute various types of pollutants, as illustrated by Table 4.

The quality, and to some extent, the quantity of storm water runoff is controlled primarily through the use of source control programs known as best management practices (BMPs). This approach is embodied in the municipal storm water NPDES permit which was reissued in

TABLE 4.

POTENTIAL SOURCES OF URBAN RUNOFF POLLUTANTS BY LAND USE

Pollutant of Concern	Industrial/ commercial	Transportation	Residential	Construction	Public	Other
PAHs	Oil leaks, spills	Fuel and oil combustion, spills	Motor oil dumping	Fuel and oil combustion, leaks		Natural oil seeps; brush fires
Chlordane	Stored product discharge		Stored product discharge			
Cadmium	Metal plating	Fuel combustion; tire wear	Batteries; paint	Paint		Water supply
Copper	Metal plating; antifouling paints; manufacturing	Fuel leaks, combustion; auto part wear	Insecticides; fungicides		Insecticides; fungicides	Water supply
Lead	Lead metal; chemicals; paint	Leaded fuel combustion; coolant leaks	Paint; batteries	Paint		Water supply
Nickel	Metal plating; industrial applications	Fuel combustion; auto part wear				
Zinc	Galvanizing; pigments	Fuel, oil and coolant leaks; tire wear.	Paint	Paint		Water supply
Pathogens			Septic tank or sewer leaks, illegal connections; pets		Sewer leaks; dumping or illegal connections; human waste	Wildlife
Total Suspended Solids	Dust and dirt	Pavement wear	Erosion	Erosion from land grading	Soil runoff	Natural erosion
Nutrients	Detergents; facility cleaning	Fertilizers	Fertilizers; detergents		Fertilizers; livestock manure	Natural erosion
Debris	Trash dumping	Litter	Yard waste, litter	Trash dumping	Litter	Natural vegetation
Oil and Grease	Waste oil dumping; oil leaks	Oil leaks, spills	Waste oil dumping	Oil leaks	Oil leaks	Natural oil seep

July 1996 to Los Angeles County (as principal permittee) and 85 cities (as co-permittees) by the Regional Board. Activities such as increased street sweeping decrease the amounts of suspended solids in the receiving waters as well as pollutants which normally adhere to the solids. Public education programs strive to inform people of the impacts of activities such as pouring antifreeze or used motor oil down storm drains or overfertilizing lawns, and can offer alternatives to negative behaviors.

General storm water discharge permits for industrial facilities and construction sites were issued by the State Board in the summer of 1992. Currently, approximately 150 general industrial and 90 construction activity permits exist within the watershed.

Highway Stormwater Pollution

Land-use analyses indicate that 0.4864 square miles (mi^2) in Malibu Creek / other Rural watersheds and 6.2075 mi^2 in Ballona Creek / Urban Watersheds are made up of roadways, highways and freeways (Los Angeles County Department of Public Works, 1996).

Transportation and related activity on roadways, freeways and highways generate a number of pollutants of concern which arise from several sources. For example, hydrocarbons are present in fuels, motor-oil and other lubricating oils; suspended solids are generated during construction; pesticides wash-off from landscape overuse; nitrogen and phosphorous are present as additives in lubricants and in fertilizers; and heavy metals occur in fuel, lubricants, brakepads, vehicle tires, and as by-products of vehicle wear-and-tear.

The Federal Highway Administration (FHWA) characterized pollutants and their concentrations in storm water from highways in a nationwide study analyzing 993 storm events at 31 sites distributed among eleven states (FHWA, 1989). One monitoring site (I-405 2 mi south of LAX) in the FHWA study lies within the Ballona Creek / other Urban watersheds and was sampled in 1981 for seven storm events. The Average Daily Traffic (ADT) at this site was 200,000. The FHWA survey is the earliest known report of highway runoff characterization in Santa Monica Bay watersheds (FHWA 1989).

The California Department of Transportation (Caltrans) monitored four storm events at three sites in Los Angeles County during the 1995-1996 wet season, under the municipal storm water NPDES program. One of the three sites is located in the Ballona Creek watershed (I-405 at Santa Monica Blvd.). The Ballona Creek site has an ADT of 315,000. Highway storm water was analyzed for conventional pollutants, coliform bacteria, heavy metals, semi-volatile organics, VOCs, pesticides and PCBs (California Department of Transportation, 1997). In addition, high fecal coliform (1,500 - 90,000 MPN/0.1L) were observed in storm water from the first storm event sampled by Caltrans at the three study sites. Further characterization of the bacteria indicated that fecal contamination of highway runoff may have occurred at two of the three sites, including the site in the Ballona Creek watershed (Memo to Dammel from Loge and Darby, UC Davis, 1996).

Table 5. summarizes data for pollutants that exceeded USEPA storm water benchmark criteria in the Caltrans study. Results of highway pollutant concentration changes between 1981 and 1996 are compared graphically in Figure 12.

Table 5. Pollutants in highway storm water runoff that exceed USEPA benchmark criteria. Discharges from four storm events between December 1995 and March 1996 were sampled at I-405 at Santa Monica Boulevard (Ballona Creek watershed) for general parameters, conventional pollutants, metals, VOCs, semi-volatile organic compounds, PCBs and pesticides. Samples from one event were discarded because slow accumulation and sample collection error. Values reported are for the first four hour composited samples. (California Department of Transportation, 1997).

POLLUTANT	USEPA BENCHMARK	BENCHMARK CRITERION	OBSERVED VALUES AT OR ABOVE BENCHMARK (n = 3)
General Parameters Oil and Grease	15 mg/L	Median concentration of Storm Water Effluent Limitation guideline	19.5; 15
Chemical oxygen demand	120 mg/L	Factor of 4 x BOD⁵ concentration	270
Total suspended solids	100 mg/L	NURP Median concentration	140; 112
Nitrate + Nitrite N	0.68 mg/L	NURP Median concentration	1.74; 1.72;
pH	6 - 9	Secondary treatment regulations	5.9;
Metals Copper	64 ug/L	Minimum level (MDL x 3.8)	90; 70;
Lead	82 ug/L	Ambient Water Quality Criteria for Acute Aquatic Life Freshwater	100;
Zinc	117 ug/L	Ambient Water Quality Criteria for Acute Aquatic Life Freshwater	430; 210; 250
Iron	1 mg/L	Ambient Water Quality Criteria for Chronic Aquatic Life Freshwater	5.4; 1.7; 4.1

The relative importance of roadways, highways and freeways as sources of pollutants to storm water are also compared in Figure 13 using the Source Disproportionality Ration (SDR) for four pollutant classes: total suspended solids (sediment); chemical oxygen demand (organics); copper (heavy metals); and phosphorous (nutrients) . The SDR is the ratio of percent pollutant load to percent landuse area. The higher the SDR, the greater is a landuse's relative contribution to pollutant load in relation to its size.

Caltrans will continue monitoring at the Ballona Creek / other Urban watersheds site in future years under its NPDES monitoring program. The pollutant parameters monitored will be similar to those in the Los Angeles County's municipal storm water monitoring program.

Figure 12. Pollutant Concentration Changes in Highway Storm Water Runoff in Los Angeles County (1981 - 1996). Mean concentrations of selected pollutants for the Ballona Creek watershed site only (96B) and all three Los Angeles County watershed sites (1996) are compared with the FHWA Ballona Creek / Urban watersheds site (1981). Broken lines indicate USEPA storm water benchmarks. The benchmark for total-P at 2 mg/L is off-scale. ADT is the average daily vehicular traffic. The error bars indicate + 1SEM. The SEM for TSS (1981) is off scale. No error bars are indicated for the Ballona creek site which is included within Los Angeles County sites. Lead has declined significantly since 1981because of improved emissions controls and phase-out of lead-tetraethyl as a gasoline additive. Oil and grease has increased significantly because of the increase in vehicular traffic. Improved emissions controls has been offset by the increase in vehicular traffic for other parmeters which may explain the lack of statistically significant change from 1981. The high variability in TSS at the Ballona site in 1981 may have been associated with construction activity.

	1981	96B	1996	CHANGE	P
	Ballona	Ballona	All LA	1996 cf. 1981	
	Mean conc.	Mean conc.	Mean conc.	Percent	
TSS	345	114	108	-79	>0.05
COD	291	133	220	-24	>0.05
Oil & Grease	8.4	15	17	+102	≤0.05
PO4	0.63	0.6	0.53	-16	>0.05
Pb	1233	60	47	-96	≤0.01
Zn	935	297	759	-9	>0.05
ADT	200,000	315,000	273,000		
n (events)	7	3	3		
N (sites)	1	1	3		

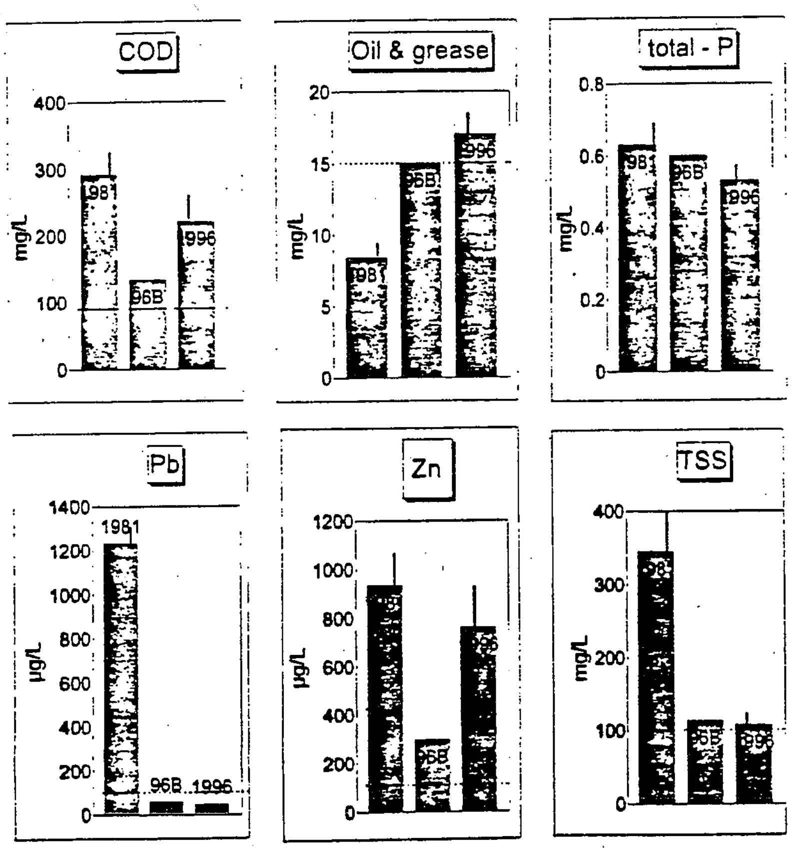
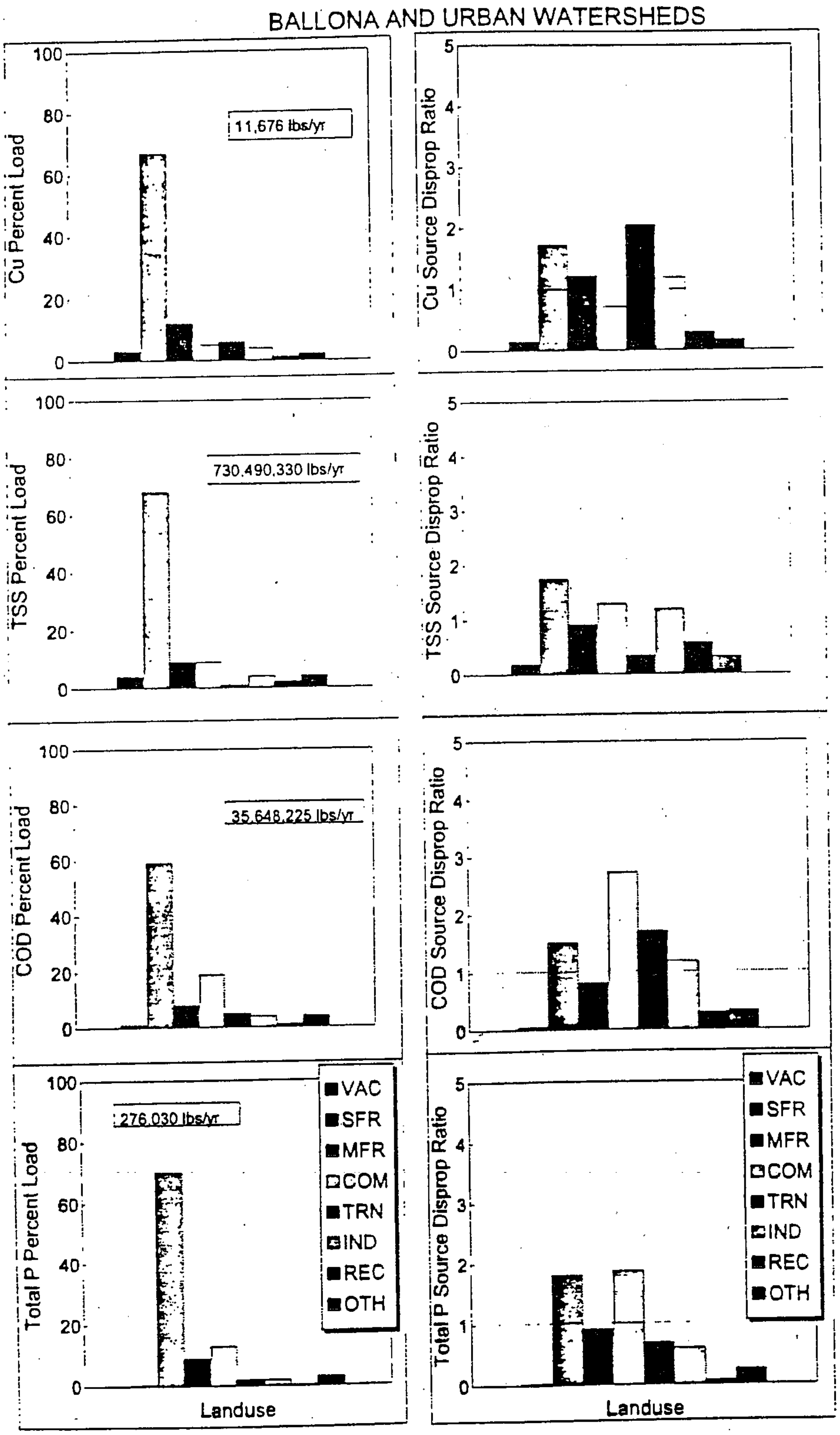
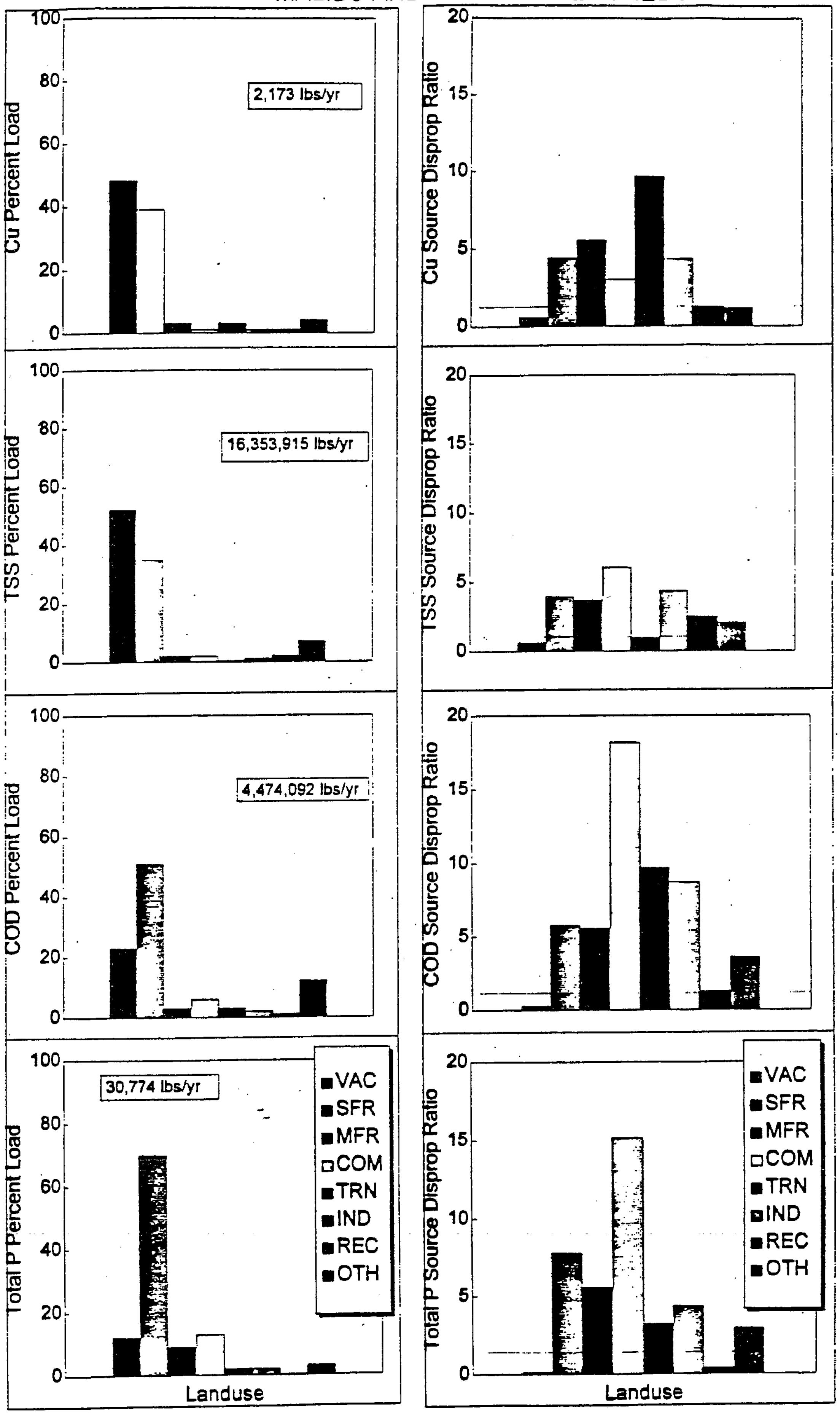


Figure 13. Comparison of mass emissions by landuse for Ballona Creek and Malibu Creek Watershed for Cu (heavy metal), COD (organic conventional pollutant), TSS (sediment) and total-P (nutrient). VAC = Vacant; SFR = Single family residential; MFR = Multi family residential; COM = Commercial; TRN= Transportation; IND = Industrial; REC = Recreational; and OTH = Other Landuses
Mass emissions affect bioconcentration and sediment contamination
Source Disproportionality (SDR) for a pollutant is expressed as the ratio of percent load divided by percent landuse. If emissions from all landuses are in proportion to their respective area, DSR would b indicated by the 'dotted line. The ratio may range from 0.01 to 99 in theory. A higher SDR indicates that the landuse contributes high pollutant concentrations. The SDR may be used as an indicator for c based effects such as acute and chronic toxicity.



MALIBU AND RURAL WATERSHEDS



Atmospheric Deposition

Deposition of airborne pollutants is recognized as a potentially significant source of contamination to waterbodies in the watershed. The Santa Monica Bay watershed is situated within the South Coast Air Basin, which experiences the nation's worst air quality. Contaminants that are found to originate from atmospheric deposition include, but are not limited to, chlorinated organic compounds, metals, PAHs, and oxides of nitrogen. The most plausible sources of these pollutants (except chlorinated organic compounds) are deposition of vehicle fuel exhaust and wear of auto parts. However, few studies have been conducted to date to definitively identify the sources and quantify the loading of these pollutants.

It is estimated that most airborne pollutants are carried eventually to waterbodies by storm water runoff, both wet deposition as intercepted by rain drops, and dry deposition as scoured by surface flows. Atmospheric deposition directly to the Bay can be significant when wind direction changes and pushes air from inland to the sea. Other notable sources of direct deposition include air traffic and wildfires.

Contaminated Soil and Groundwater Cleanup Sites

Chevron - El Segundo

The contaminants of concern at this site include total petroleum hydrocarbon (TPH) and aromatic volatile organic compounds. The estimated size of the free product upon the ground water is about 6,000 feet by 8,000 feet and the dissolved hydrocarbon plume attenuates quickly in the lateral direction.

The facility is operating a free product recovery system consisting of free product extraction and treatment through the unsegregated or segregated drainage system (see Appendix A). About 1.5 mgd of treated ground water are discharged along with up to 20.75 mgd of storm water into a 3,500 feet long outfall into the Santa Monica Bay, in accordance with NPDES permit No. CA0000337, Order No. 95-054. The facility is required to monitor the effluent from the treatment system on a weekly basis. Effluent monitoring results indicate compliance with all discharge limits.

LAX FUEL

The contaminant of concern at this site is jet fuel. Contaminated site soils were excavated and land treated in accordance with this Regional Board's General Waste Discharge Requirements Order No. 90-148. The estimated volume of free product upon the ground water is about 600,000 gallons. A dissolved hydrocarbon plume has thus far not been seen.

The facility is operating a free product recovery system consisting of free product extraction, oil water separation, and water filtration by granular activated carbon. The treated water is discharged into the Argo storm drain, which flows into Santa Monica Bay, in accordance with General NPDES permit No. CAG834001, Order No. 92-091. The facility is required to monitor the effluent from the treatment system on a weekly basis to prevent untreated groundwater from being discharged into the storm drain. Since they started in July, 1996, weekly sampling results have indicated that all discharge limits were met.

Continental Airlines

The contaminants of concern at this site include total petroleum hydrocarbon (TPH) and volatile organic compounds (VOCs). Although the extent of ground water contamination has not been fully defined at this site, it appears that the contamination is contained within the site boundaries. Free product is recovered using a skimmer system; any water that is recovered is disposed with the recovered product. This facility does not have any discharges into the storm drain.

Bradmore Investment Company/Cornell-Dublilier Superfund Site

The contaminants of concern at these sites are halogenated volatile organic compounds (VOXs) of which the extent is undefined. Tetrachloroethylene up to 22,000 mg/L has been identified beneath the Bradmore Investment Company site adjacent to the Superfund site. No ground water remediation is occurring at the present time. The Department of Toxic Substances Control is reviewing a proposal to only contain the contaminants at the Superfund site.

Facilities Not Considered to be a Large Influence Upon the Santa Monica Bay

These facilities do not discharge into the storm drains that lead to the Santa Monica Bay, and therefore are not considered a large influence to the Bay. The contaminants of concern are primarily halogenated volatile organic compounds with a few petroleum hydrocarbon plumes.

Unisys Corporation The contaminants of concern at this site were volatile organic compounds (VOCs). A dissolved plume of up to 2.9 mg/L trichloroethene, 1.5 mg/L 1,1-dichloroethylene, and 1.5 mg/L freon remains in the source area at the site. Site contaminants are primarily contained on-site, with some minor off-site migration, for a total area of about 400 feet by 600 feet within the method detection limits concentration values. The pump and treat system at the site was operated for eight years prior to its shut down in November 1996. Performance criteria indicated that further remediation was not effective for this shallow bedrock site.

Allied Signal - El Segundo This site is located on the landward side of the seawater intrusion barrier and thus is not considered a major impact to the Santa Monica Bay. The contaminants of concern at this site are volatile organic compounds (VOCs), primarily trichloroethene, tetrachloroethylene, freon, and carbon tetrachloride. A dissolved plume of up to 500 mg/L total halogenated VOCs has been identified at the site. The lateral and vertical extent of the ground water plume is undefined.

Allied Signal - LA This facility does not have any discharges into the storm drain, and therefore is not considered a large influence to the Santa Monica Bay. The contaminants of concern at this site include total petroleum hydrocarbon (TPH) and halogenated volatile organic compounds (VOXs). There is no significant groundwater contamination at this site and no remediation is occurring.

Rockwell - NAAD This facility does not have any discharges into the storm drain, and therefore is not considered a large influence to the Santa Monica Bay. The contaminants of concern at this site are primarily halogenated volatile organic compounds (VOXs) which are located in the perched ground water within the site boundaries. A Health Risk Assessment is currently under review by the Department of Toxic Substances Control for closure.

Hughes Aircraft - El Segundo This is a UGST site that has been closed.

H. Kramer & Company The contaminants of concern at this site are primarily arsenic and lead. A cap has been placed over the contaminated soils at the site. Site metals have been identified in the ground water which are monitored to assure that they are contained within the site boundaries.

Contaminated Sediments

Contaminated sediment problem areas in the Bay include DDT- and PCB-contaminated sediments around the JWPCP outfall on the Palos Verdes Shelf and Slope, and around the Hyperion Plant outfall in the Santa Monica submarine canyon.

Over the last 10 years, there has been a substantial increase in our knowledge about the characteristics of sediments and sediment contamination on the Palos Verdes Shelf. Most of the information comes from the natural resource damage assessment conducted by trustees of a National Oceanic and Atmospheric Administration (NOAA) lawsuit and studies conducted by the SMBRP (see also the previous section on Statewide Monitoring Programs). Yet, information obtained under the NOAA damage assessment was not available for many years until it was revealed to the general public in October 1994. The information includes not only updated assessments on physical, geotechnical, and chemical properties of the sediments, and transport, fate, and effects of the contaminants in the sediments, but also evaluation of potential remediation and restoration alternatives (SMBRP, 1997).

Based on the NOAA assessments and other existing information, the U.S. EPA in July 1996 began a Superfund investigation of the contaminated sediments on the Palos Verdes Shelf. Under this investigation, EPA will soon complete a site characterization investigation and feasibility analysis which considers capping and other alternatives for remediation of the contaminated sites (SMBRP, 1997).

Water Supply

The water supply can become a source of pollutant loading if the concentration of certain pollutants in either imported water or pumped ground water exceeds the "background" level of existing surface waters. It can be a concern when the water supply is considered the only or the major source of the pollutant.

Other Sources

Other sources of pollutant loading include beach littering, boating wastes, oil and hazardous material spills, dredging and dredge material disposal, sediment resuspension, and advection.

Besides trash and debris generated in the watershed and carried to the ocean via storm flows, beach littering and boating wastes are two other important sources of marine debris. Although the high number of beachgoers and recreational boats utilizing the Bay suggests that the scale of the problem could be large, there is little information regarding the contribution of marine debris from these sources compared with stormwater/urban runoff.

In addition to marine debris, boating activities (and in particular boat maintenance) have been known to be the major source of TBT found in marinas and harbors. Boating activities are also potential sources of pathogens, oil and debris, and the heavy metals copper and zinc (the former from anti-fouling paint and the latter from zinc anodes).

If not contained, a major oil or hazardous materials spill can cause considerable ecological damage and contribute to the total pollutant loading of polycyclic aromatic hydrocarbons in the watershed. In March 1991, a transport vessel's anchor snagged the offshore mooring complex at the Chevron El Segundo Refinery, resulting in a spill of 9,240 gallons of a diesel oil/naphthalene mixture. The floating oil eventually contacted the shore at Malibu, causing beaches be closed to swimmers for several days. However, large scale spills like the 1991 incident are generally rare in Santa Monica Bay. Most reported vessel spills involve few to several hundred gallons. The U.S. Coast Guard listed 82 vessel spills in Santa Monica Bay between 1973 and 1987, with an average of six spills per year totaling just 2,000 gallons during this period.

The risk of future spills may grow with an increase in ship traffic to and from San Pedro Bay coincident with port expansion. On the other hand, new state and federal laws in response to the Exxon Valdez spill are expected to increase safeguards against future spills.

Currently, disposal of dredged material is not a significant source of pollutant loading in Santa Monica Bay. Marina del Rey Harbor is one area of concern for sediment buildup and where periodic maintenance dredging is carried out. Dredged material from these sites is disposed of directly on the beach if it is deemed "clean" and is otherwise compatible (coarse-grained). No permanent solution has been reached for disposal of contaminated sediment. Ocean disposal within Santa Monica Bay is unlikely since there is no permitted ocean dumpsite located in the Bay at this time (see Marina del Task Force for more information).

Sediment resuspension has been and will continue to be the major loading source for historically deposited toxic chemicals, most notably, DDT and PCBs on the Palos Verdes Shelf. Under the ongoing EPA superfund investigation, capping and other alternatives are being considered to remediate the contaminated sites. However, because of the large size of the contaminated area, any solution will only reduce, but not eliminate the input from this source.

Advection is the transport of material by ocean currents. In general, surface currents flow south off the Palos Verdes Peninsula, while below 290 feet, water enters the Bay from the south. Therefore, contaminants from the Los Angeles-Long Beach Harbor may enter the Bay from the south, via the subsurface current which flows north along the Palos Verdes Shelf, while contaminants from the Shelf may enter the outer harbor area.

Pollutant Loading

Source-Specific

Combined, the three major POTWs (particularly the two larger ones) in the watershed still contribute the majority of loadings for heavy metals, oil and grease, and TSS. Despite this, significant reductions in emissions of all pollutants of concern have occurred over the last 20 years. This trend is expected to continue, though at a much slower pace, as Hyperion and JWPCP complete their upgrade to full secondary treatment. In some cases, loading of certain pollutants of concern may stabilize or slightly increase, as the Region's population continues to grow and the volume of wastewater discharge increases.

Currently, approximately one fourth of the total pollutant loading entering waterbodies in the watershed can be attributed to pollution from storm water and urban runoff. As total loadings from POTWs decrease, storm water and urban runoff contribute an increasingly greater proportion of the total pollutant loads discharged into waterbodies in the watershed. Figure 14 compares the relative loadings of heavy metals from these two major sources in 1986 and 1995. For example, as indicated in this figure, storm water and urban runoff have replaced POTWs as the predominant source for lead and zinc. In addition, storm water and urban runoff are known to be the primary sources for trash, debris, and pathogens (SMBRP, 1994b).

Pollutant loadings through storm water and urban runoff vary greatly from different land uses. Single-family residential areas contribute the largest loads of heavy metals and nutrients; open areas supply the largest load of total suspended solids (TSS); and the largest quantities of oil and grease are associated with multi-family and commercial areas (SMBRP, 1993). This is also depicted in Figure 13 above.

Direct industrial discharges contribute a small portion of pollutant loads. Currently all major direct industrial discharges receive advanced levels of treatment before entering receiving waters. The relative contribution from minor industrial discharges to total loadings into the storm drain system needs to be estimated.

The relative contribution of atmospheric deposition to total pollutant loading is not well-known at this time. Studies have shown that mass emissions of nitrogen compounds, several trace metals, and PAHs originating from atmospheric deposition may exceed those from specific sources and account for much of the material found in storm water runoff (Kaplan and Lu, 1993; SCCWRP, 1986a and 1986b).

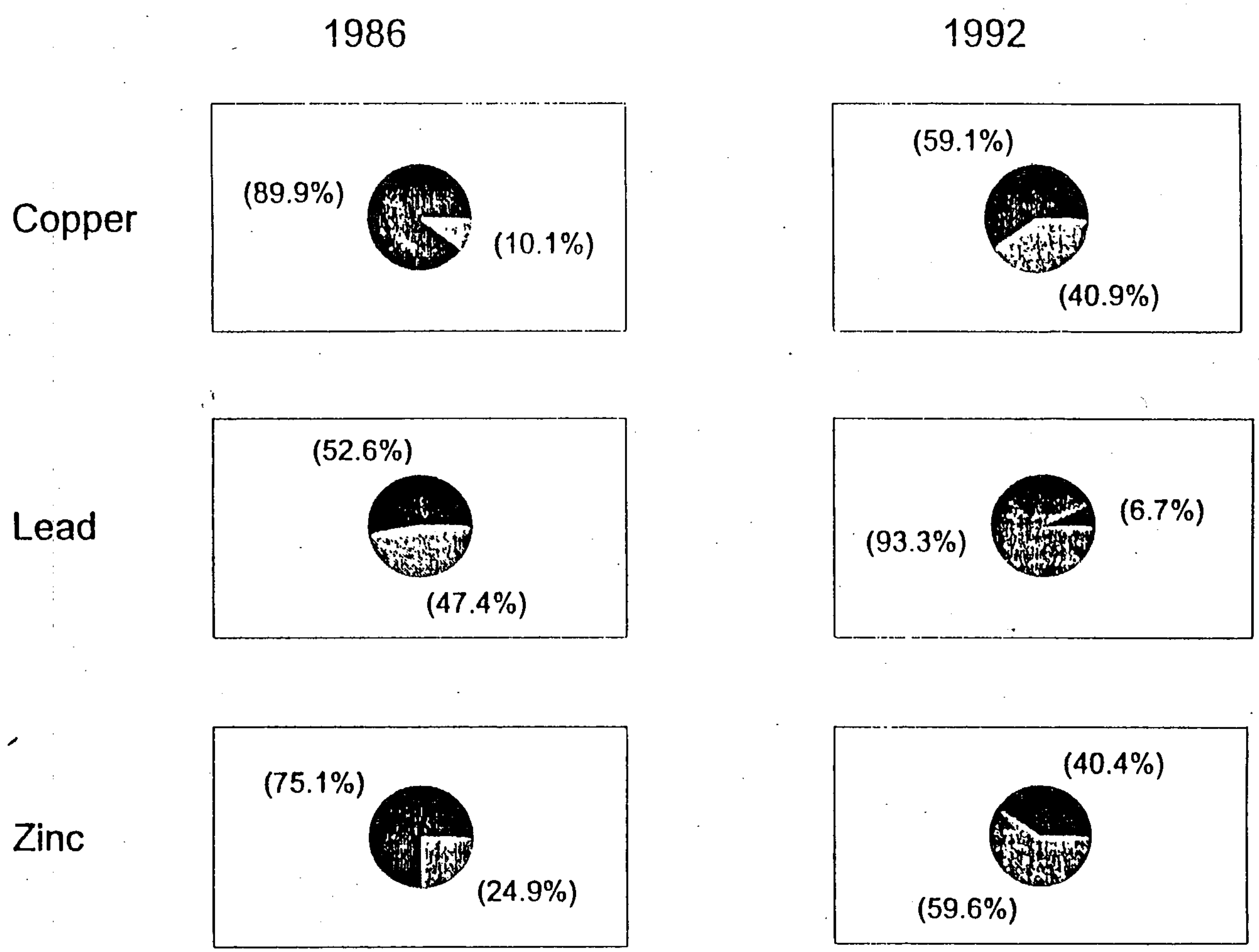


Figure 14. Relative contributions of three heavy metals from POTWs and storm runoff. Black-shaded area represents contribution from POTWs; gray-shaded area represents contribution from runoff.

Region-Specific

Sources of loading for each pollutant of concern may not be distributed evenly within the watershed. Depending on land use characteristics, layout of infrastructure, climatic influence, and historic contamination, certain pollutants are generated more in some areas than in others. On the other hand, depending on the location of sources and routes of transportation, each pollutant of concern may have a specific destination, resulting in a "hot spot".

With regard to total pollutant loading, the Ballona Creek and Malibu Creek subwatersheds are the two largest contributors. With regard to loadings of heavy metals, Ballona Creek is the largest contributor (Figure 15). Hot spots in the receiving water exist at and near the mouth of Ballona Creek. Other hot spots are located near POTW outfalls and clearly result from high historical loadings of these pollutants.

The primary sources of DDT and PCBs are historical deposits in the sediments near the JWPCP Whites Point outfalls on the Palos Verdes Shelf. Sediments adjacent to the Hyperion Treatment Plant outfall also have high concentrations of these pollutants. Though the surface concentration of these contaminants slowly declines with burial or other natural processes, these areas remain existing hot spots and potential generators if sediment resuspension takes place.

All storm drains with dry-weather flow are potential sources of pathogens. However, as indicated by concentrations of bacterial indicators, areas such as Malibu Beach, Will Rogers Beach (north), and Santa Monica Beach apparently receive more pathogen input than other beach areas along the Bay and are thus identified as hot spots.

Results
Annual Pollutant Loadings

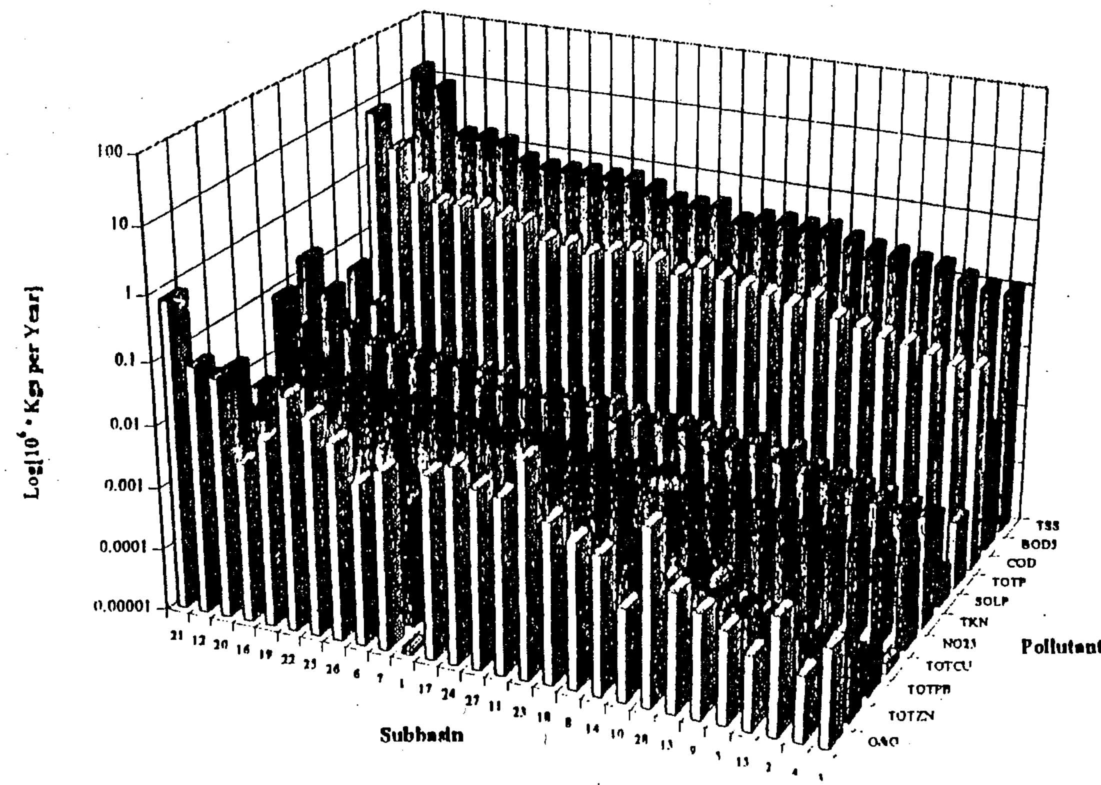


Figure 15. Comparison of annual loadings of 11 pollutant categories among the 21 subbasins in the Santa Monica Bay watershed (Basin 21: Ballona Creek, Basin 12: Malibu Creek; data from SMBRP, 1993).

CURRENT WATERSHED PROTECTION EFFORTS

Bay Restoration Plan Implementation

The Bay Restoration Plan adopted in December 1994 includes a blueprint of 250 separate actions needed to restore and protect the Bay and the estimated time period over which each action would span (fiscal years 1994/95 - 1998/99). Of the 250 actions identified, 74 are considered priorities and have an estimated implementation cost of $64.7 million dollars.

During the five-year implementation phase, the SMBRP is responsible for overseeing the progress made in implementing these priority actions. Among other functions, the SMBRP has conducted two annual implementation progress surveys over the last two years. The surveys not only provide direct, tangible (either empirical or quantitative) information on the status of implementation efforts, but also offer insight into what works, what does not, and how improvements can be made to ensure success. Following each survey, the SMBRP releases a summary report, highlighting the previous year's achievements along with the barriers that need to be overcome in the future. The most recent summary report is available in Appendix D.

As reported by the SMBRP, as of May 1997, significant progress had been made on most priority actions in important areas such as pollution prevention outreach, urban runoff pollution control, upgrading of waste treatment, water reclamation, health risk assessment, wetland restoration, watershed planning, public education, and comprehensive monitoring. There are several high-profile achievement including the successful completion of the epidemiological study and the adoption of the new municipal storm water NPDES permit.

Also, as indicated by the summary report, making progress requires overcoming obstacles. Implementation of some priority actions has been stalled for various reasons. Most notably, funding issues continue to be a major concern among many cities and agencies designated as implementors. In other cases, changes to current regulations and governmental procedures are needed to implement innovative approaches. With regards to future direction of the SMBRP's efforts, a recent survey of the members of the Bay Oversight Committee continued to request that the Project focus on facilitating the implementation of actions related to storm water/urban runoff pollution control.

Los Angeles County Storm Water Program

Los Angeles County Storm Water NPDES Permit

The most recent Los Angeles County Municipal Storm Water NPDES Permit was adopted by the Regional Board during a public hearing held on July 15, 1996. This was a renewal (with considerable revision) of the original 1990 storm water permit.

The area covered by the Permit has approximately 2,500 miles of storm drains, contains 2.3 million parcels, has more than 150,000 licensed businesses, and covers a 3,100 sq. mi. drainage area. As previously described, only a portion of this area drains to Santa Monica Bay; however, many monitoring objectives and requirements are common to the County's six watershed management areas. A separate Watershed Management Area Program will be developed to address pollutants of concern and other water quality issues unique to that watershed management area, with the objective of reducing pollutants in discharges to the maximum extent practicable.

The Permit contains requirements for land use monitoring, mass emissions monitoring, identification of illicit connections, characterization of critical sources, and receiving water studies in order to evaluate the effectiveness of BMPs implemented.

Proposition A Projects

On November 5, 1992, voters in Los Angeles County approved Proposition A, a measure that allocated grant funds to improve safety of recreation areas, help prevent gangs, plant trees, and acquire, restore, and preserve beach, park, wildlife and open space resources. Section 8.a.6 of the Proposition designated $4 million to be awarded for the purpose of restoring and improving the Santa Monica Bay by measurably reducing the toxicity and/or pollutant load in urban runoff to the Bay.

In July 1996, the Los Angeles County Department of Public Works (LAC-DPW), as the agency designated to administer the Prop. A funds, released an application manual and solicited competitive proposals from public agencies within the Santa Monica Bay watershed. Per request of the LAC-DPW, the Bay Watershed Council formed a selection panel. The Panel evaluated 16 submitted proposals and recommended funding or partial funding of 12 projects (Table 6) for approval by the Executive Officer of the LARWQCB. The Regional Board gave its approval of the Panel's recommendation in February 1997.

On November 5, 1996, voters in Los Angeles again approved Proposition A, similar to the one approved in 1992. The new Prop. A designated another $4 million for the same purpose as the previous proposition. Proposal solicitation and selection of the new grant recipients are expected to begin in June 1997.

Grants from these two propositions represent one of the largest single funding sources to date for water quality improvement projects in the watershed. Their expenditure is expected to result in significant improvement in water quality for a large portion of the Bay and its watershed. The eight diversion/treatment projects awarded under the first Proposition A grant, for example, will eliminate runoff during dry weather from most of the problematic drains in the watershed, including two of the three worst ones (Ashland and Malibu) tested during the epidemiological study. The Proposition A grants, especially the $4 million from the new Proposition A, also provide a good opportunity for implementing measures deemed as priorities under the watershed approach.

Table 6. Storm Water Quality Improvement Projects funded under the 1992 Proposition A Grant Funds

Project Title	Award Recipient	Awarded Amount ($$)
Herondo Storm Drain Low-Flow Diversion	Los Angeles County Department of Public Works	188,976
Ashland Ave. Storm Drain Low-Flow Diversion	Los Angeles County Department of Public Works	158,061
Brooks Ave. Storm Drain Low-Flow Diversion	Los Angeles County Department of Public Works	152,613
Pershing Dr. Storm Drain Low-Flow Diversion	Los Angeles County Department of Public Works	167,398
Palisades Park Storm Drain Low-Flow Diversion	City of Los Angeles	117,606
Bay Club Dr. Storm Drain Low-Flow Diversion	City of Los Angeles	138,174
Water Treatment Facility at Pico-Kenter Storm Drain	City of Santa Monica	1,000,000
StormTreat System at City Mantenance Yard	City of Santa Monica	63,750
Las Virgenes Creek Restoration and Sediment Reduction	Santa Monica Mountains Resource Conservation District	125,295
Westchester Road Yard Runoff Enhancement (Stormcepter) Project	Los Angeles County Department of Public Works	48,152
Water Level Management and Disinfection Facility at Malibu Lagoon	City of Malibu	1,275,000 ($150,000 for the design phase. The rest is contingent upon the completion of a feasible design.)
Total		3,435,025

Lower Malibu Creek and Malibu Lagoon Restoration

Malibu Creek watershed stakeholders have been meeting regularly for a number of years to identify and reach resolution on the watershed's problems. A series of facilitated meetings coordinated by the Santa Monica Bay Restoration Project resulted in identification of an original action list of 111 items; these have since been consolidated into 44 items. These recommendations include, among many others, protecting beneficial uses, establishing minimum native species standards, monitoring and reducing pathogens, studying and reducing nutrients, evaluating options for regulating lagoon water levels, and implementing a dye study of area septic systems. This last recommendation will be implemented shortly. Protection of beneficial uses is a broad recommendation that includes as goals the development and use of water quality objectives to prevent point and nonpoint pollutant sources and pathogens from adversely affecting the beneficial uses of the watershed and nearshore areas. This includes defining the suitable range in the lower creek and lagoon for salinity, pH, and dissolved oxygen, and recommending nutrient objectives in order to minimize nuisance algae and episodes of eutrophication. Recommended nutrient objectives may be incorporated into the Regional Board's Basin Plan objectives for the Malibu Creek watershed, and will then be available for use in Total Maximum Daily Load studies, which will lead to allocation of nutrient loads from various point and nonpoint sources in the watershed.

Developing water quality objectives is a complex process and is closely linked with gaining a better understanding of the lagoon's hydrology and establishing the optimal array of native biota needed for this lagoon to regain its functionality and finish the restoration process which was started many years ago. Consequently, the Coastal Conservancy developed a workplan for Lower Malibu Creek and Malibu Lagoon resource enhancement and management. The Coastal Conservancy also put together a funding package with Conservancy, EPA and Santa Monica Bay Foundation funds and working with Malibu Lagoon Task Force has develop a request for proposal to execute the workplan. The information gained from this work will ultimately be used to protect and restore the native biodiversity, wetland and riparian habitats, water quality, and human health and recreational values of the lagoon and lower creek.

Marina del Rey Task Force

The Marina del Rey Task Force was formed in December 1994, in response to the problems and controversy associated with the maintenance dredging operation at Marina del Rey. Because the Marina shares its entrance to the Bay with Ballona Creek, deposition of sediment carried from the large creek watershed has created navigational problems for Marina del Rey, resulting in the need for maintenance dredging once every 2-3 years.

Historically, the dredged material was used for nourishment of nearby beaches. However, the dredging operation has become highly controversial because sediments in the harbor's entrance channel were found to be contaminated and were thus not suitable for beach nourishment. Other options for disposal of the contaminated sediments were prohibited either by law (e.g., open ocean disposal), or by high cost ($5/cubic yard for "clean" dredged materials vs. up to $100/cubic yard for contaminated sediments). As a result, dredging operations were halted and one of the Marina's entrance channels had to be closed due to shoaling.

In response to this problem, the Marina del Rey Task Force was formed in December 1994 to develop a long-term solution that would minimize contamination of sediment and maximize beneficial use of dredged material for purposes such as beach nourishment. The Task Force is led by the U.S. Army Corps of Engineers (USACOE), the Los Angeles County Department of Beaches and Harbors, and the Santa Monica Bay Restoration Project, and joined by other federal and local agencies and environmental groups. The formation of the Task Force for the first time ensured participation of local storm water management agencies in addressing the dredging/disposal issue. Also, for the first time, a watershed management approach was adopted to assess the impacts of sediment and contaminant loads from the upstream watershed.

Under the leadership of the Task Force, several steps are being taken to develop the long-term solution. In September 1995, the USACOE completed a Reconnaissance Study that compiled all existing information and presented a preliminary analysis of various management alternatives for conducting dredging, disposal, and source elimination operations. Currently, members of the Task Force are jointly conducting a feasibility study. The first step of this study involves collection and analysis of storm water samples from various locations, and identification of sources and loading of contaminated sediments within the watershed. The next step is to develop a long-term watershed strategy to reduce loading of contaminated sediment from the watershed, based on data analysis. It is anticipated that future efforts under the watershed strategy will be coordinated with Los Angeles County's municipal NPDES Storm Water Management Program. It is also hoped that this type of coordinated, long-term planning approach will not only reduce the conflict and uncertainty over dredging projects related to Ballona Creek, but will also serve as a model for other community-based efforts to resolve environmental problems.

WATER QUALITY ASSESSMENT AND ISSUES BY SUBWATERSHED AREAS

INTRODUCTION

This section provides summaries of water quality assessment and issues for nine subwatershed areas in the Santa Monica Bay watershed. These nine subwatershed areas are grouped from 28 catchment basins based on their distinctive geographical (topographical and land use) characteristics. Descriptions on each of the nine regions are confined to the land and coastal water areas (areas defined as "waters of the state"). Issues related to ocean waters outside the "waters of the state" are addressed in a separate "Ocean" section.

Each summary of the subwatersheds (including the "Ocean" section) includes a general description of the region, list of identified beneficial uses, evidence of beneficial use impairments, list of pollutants of concern, information on sources and loading, and water quality improvement strategies. Descriptions and discussion emphasize issues that are specific to and/or a priority in a subwatershed area.

NORTH COAST

Overview of the Region

The North Coast region represents one of nine difference sub-watershed groups that drain to Santa Monica Bay. These nine groups span 414 square-miles and collectively are known as the *Santa Monica Bay watershed*. This sub-watershed drains an area of approximately 55 square miles and borders the eastern portion of Ventura County to the west, the Malibu Creek sub-watershed to the north and east, and the Pacific Ocean to the south (see Figure 16). Several minor streams and creeks discharge directly to the Bay, but there are no major point sources discharges in this sub-watershed. The area is largely undeveloped, has similar land use activities and pollutant load characteristics, and the immediate receiving waterbody is generally considered pristine.

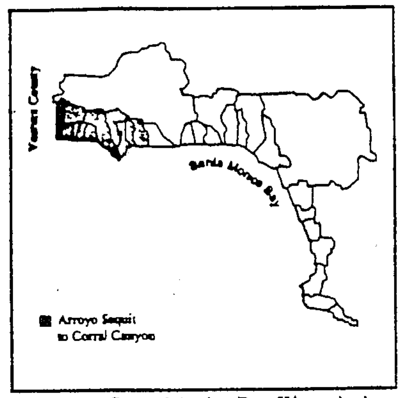


Figure 16, Santa Monica Bay Watershed, North Coast Region

Flows

A number of creeks and streams in the North Coast sub-watershed discharge flows directly into Santa Monica Bay. The largest of these creeks are Arroyo Sequit and Zuma. Together, the flows in this region total approximately 5500 acre feet per year. Table 7 summarizes the average yearly wet weather flows for each creek/stream in this region.

Table 7. North Coast Sub-watershed Flows (SMBRP, 1993)

Waterbody	Discharges		
	Drainage Area (Acres)	Discharge Point	Average Annual Storm Runoff (AFY)
Arroyo Sequit	7203	Lagoon/Ocean	985
San Nicholas Canyon Creek	1428	Ocean	192
Los Alisos Canyon Creek	1108	Ocean	153
Lachusa Canyon Creek	1178	Ocean	149
Encinal Canyon Creek	2014	Ocean	272
Trancas Canyon Creek	6862	Lagoon/Ocean	1158
Dume Creek (Zuma Canyon)	6101	Lagoon/Ocean	1129
Ramirez Canyon Creek	3387	Ocean	642
Escondido Canyon and Latigo Canyon Creeks	2229	Ocean	321
Solstice Canyon Creek	3370	Ocean	518

Land Uses

Although this region is rural, there is still evidence of development in the North Coast sub-watershed. Most of the development is located close to the coastline, near Point Dume and just north of Malibu Creek and Lagoon. Additionally, a few areas in the upper sub-watershed area have been developed, but the percentage is relatively small. Land use activities can be broken down into the following: 92% open space, 7% residential, and less than 1% for commercial/industrial and public (combined).

Wetlands

The North Coast region is home to some of Southern California's last remaining wetlands. They can be found in the drainage areas of Arroyo Sequit Canyon, Trancas Lagoon and Lower Zuma Creek and Lagoon; each varies in both type and function. The Arroyo Sequit Canyon, and Zuma Creek and Lagoon areas are considered riparian (stream-side) freshwater wetlands while Trancas Lagoon represents a more typical saltwater coastal wetland (SMBRP, 1994b). The drainage areas of these creeks and lagoons lie within the Santa Monica Mountains National Recreation Area (SMMNRA), as do several others in this sub-watershed.

Arroyo Sequit Canyon Arroyo Sequit is located approximately 28 miles west of the City of Santa Monica and is one of the best preserved small coastal drainages in the Santa Monica Bay watershed. The drainage area of this canyon is approximately 7203 acres. The riparian wetlands located there begin at the confluence of the East and West Forks of Arroyo Sequit and extend 3.2 miles to the Pacific Ocean, where a small coastal lagoon has formed. The habitat is primarily sycamore alluvial woodland. Stream flow supports a wide variety of native aquatic animals, including resident and migratory populations of rainbow and steelhead trout. However, the lower floodplain has been encroached upon by the camping facility for Leo Carillo State Beach. Restoration of the riparian and lagoon habitats is important for native plant and wildlife species.

Zuma Creek and Lagoon. The Zuma Creek and Lagoon drainage area, of approximately 5,722 acres, is mostly undeveloped national parkland and open space. Lower portions of the creek are channelized in places, and there is a residential area adjacent to the stream just north of the Pacific Coast Highway bridge. The riparian corridor is supported by a small perennial stream, providing the primary source of water for the lagoon (only during heavy storms is ocean water able to enter the lagoon). Freshwater wetland vegetation can also be found there, although it is severely stressed during periodic drought conditions. This area also supports a dune habitat. In dry (low flow) years, there is typically little water present, but with increased runoff from development and recent "wet" years, a larger lagoon has formed (approximately two acres). However, this lagoon has most likely fluctuated in size over time. The area is currently degraded due to past dumping practices and the presence of non-native vegetation.

Trancas Creek and Lagoon Trancas Lagoon is a small coastal lagoon (approximately nine acres) located several miles west of Point Dume in Los Angeles County and is fed by numerous small tributaries. However, some runoff enters the lagoon from hillsides and from adjacent land uses, such as residential, commercial, and local roadways.

Trancas Creek drains a watershed of 6,233 acres. The mouth of the creek is often closed by sand bars which form due to wave action and littoral transport of sand. The berm closes the system to tidal action and causes the creek flow to back up within the lagoon. In the past, the lagoon was mechanically breached periodically in order to allow outflow and to prevent local flooding. A cement and boulder lined debris basin has been built 0.8 miles up Trancas Canyon and ends at a broad basin just east of PCH near Trancas Beach. The mouth of Trancas Creek has been highly constricted by fill. A shopping center and nursery operation border one side of the lagoon and an old, vacant horse riding area borders the other side.

Solstice Canyon Creek Solstice Canyon is home to some of Santa Monica Bay watershed's unique wetlands. Specifically, the Solstice Canyon wetlands are Palustrine, i.e., non-tidal wetlands dominated by vegetation (trees, shrubs, herbs, mosses and lichens). Streams feeding these wetlands are intermittent, flowing only part of the year and the stream corridors are typically steep, narrow and highly erosive. This in turn confines riparian vegetation to the immediate stream channel area.

Beneficial Uses

The North Coast sub-watershed is host to several beneficial uses, including beaches, recreation areas, kelp beds, tide pools and significant biological diversity. Table 8 summarizes the beneficial uses designated for waterbodies in this sub-watershed.

Significant Regions

Sections of the North Coast sub-watershed (from the Ventura County line to Latigo Point) have been designated as *Areas of Special Biological Significance* by the State Water Resources Control Board (SWRCB) and as *Significant Ecological Areas* (SEA) by Los Angeles County. These areas require protection of species or biological communities to the extent that alteration of natural water quality is undesirable, and that the preservation of natural water quality be maintained to the extent practicable. Zuma Canyon, Arroyo Sequit and Point Dume are three such designated areas in this region.

The North Coast is also home to state and federally listed endangered species such as *Pentachaeta lyonii* (an endangered plant) and *Vireo Bellii* pusillus (an endangered bird), and to significant wetlands and lagoons, as previously mentioned. Local wetlands serve several purposes, including providing essential habitats for a diversity of species such as birds, fish, amphibians, reptiles, invertebrates, and mammals. They also act as natural filters which are able to absorb, retain and remove pollutants from the water, recharge groundwater, and they provide flood protection, recreational use, and aesthetic value. The lagoons provide feeding and resting areas for shore birds and migratory waterfowl.

Local Parks and Beaches

Zuma Beach is one of the most heavily used beaches in Los Angeles County. Hundreds of thousands of residents and tourist flock to this area for sunbathing and surfing activities each year. Additionally, educational meetings and field trips are held here for local students and the general public. Currently, efforts are underway to restore Zuma Creek and Lagoon. This restoration effort is led by the National Parks Service, the Santa Monica Bay Restoration Foundation, and L.A. County Beaches and Harbors, with additional funding support provided by the U.S. Environmental Protection Agency. Leo Carillo State Beach is another popular beach in the North Coast sub-watershed. This beach offers many of the same opportunities as Zuma Beach, in addition to providing camping grounds, hiking and biking opportunities and many other outdoor activities.

Table 8. North Coast Sub-Watershed Beneficial Uses (Modified from Basin Plan, LARWQCB, 1994)

Waterbody	Beneficial Uses													
	MUN	GWR	NAV	REC1	REC2	COM	WARM	COLD	EST	WILD	RARE	MIGR	SPWN	WET
Arroyo Sequit	P	I		E	E		E	E		E	E	E	E	E
San Nicholas Canyon Creek	P			I	I		I			E				
Los Alisos Canyon Creek	P			I	I		I			E	E			
Lachusa Canyon Creek	P			I	I		I			E				
Encinal Canyon Creek	P			I	I		I			E	E			
Trancas Canyon Creek	E			E	E		E			E	E			
Dume Lagoon			E	E	E	E			E	E	E	P	P	E
Dume Creek (Zuma Canyon)	E			E	E		E	E		E	E	P	P	
Ramirez Canyon Creek	I			I	I		I			E			P	
Escondido Canyon Creek	I			I	I		I			E	E			
Latigo Canyon Creek	I			I	I		I			E	E			
Solstice Canyon Creek	E			E	E		E			E		P	P	

E: Existing Beneficial Use
P: Potential Beneficial Use
I: Intermittent Beneficial Use

Evidence of Impairment

To date there is no documented evidence of impairment from pollutants of concern in the North Coast sub-watershed, although potential pollution problems exist for areas not in public stewardship.

However, this region is impacted by invasion of non-native plant and animal species, sedimentation and erratic stream flows, trash and debris, septic systems and is frequently used by transients. These impacts limit diversity and density of plants and wildlife, and pose public safety concerns. Trancas Lagoon is one such example of an area degraded due to poor water quality and trash and debris. Furthermore, there is concern about the ability of the underlying substrate in this region to handle septic discharges and leaks.

Pollutants of Concern

There are no associated pollutants of concern for the North Coast sub-watershed due to limited human activity in this area. However, as mentioned above, the threat of trash and debris, oil spills and possibly even excessive sedimentation are potential threats to the North Coast region.

Sources and Loadings

Table 9 links potential sources of pollution with pollutants (as identified above) that may threaten the waterbodies and habitats of this region.

Table 9. Pollutants of Concern and Sources of Loadings

Pollutant of Concern ⇒ / Source of Loadings ⇓	TSS and Fine-grained Sediments	Trash and Debris	Pathogens, Bacterial and Nutrients	Oil and Grease (Oil Spills)
Households	X	X	X	X
Horse and Animal Farms	X		X	
Septic Systems			X	
Land Grading/ Construction Activities	X			
Fires	X	X		
Transportation-related Activities	X			X
Non-point Sources	X (erosion)	X	X	X

Data from the SMBRP Bay Restoration Plan

Trash and Debris

Trash and debris found in the creeks and lagoons most likely comes from improper disposal of waste by beach-goers, visitors, transients and residents. An aesthetic nuisance, it adversely impacts the sensitive habitats of the area.

Oil Spills

The threat of spills to the Bay resulting from oil tankers exists given the continual oil transporting activities that occur along California's coastline. Ocean currents have the potential to transport oil from spills directly to the shoreline, thereby significantly degrading this sub-watershed's special coastal habitats.

TSS and Fine-grained Sediments

Sediments and total suspended solids (which hinder light transmission into waters, smother spawning areas and hard-bottom subtidal habitats, and provide a transport medium for other pollutants such as heavy metals and pesticides) also have several known and suspect sources. Non-stabilized hillsides, development activities where best management practices have not been properly implemented, improper land grading activities, horse and animal farms located too close to waterbodies, and other relevant agricultural activities all contribute sediments and TSS to this watershed's creeks and streams, which ultimately flow to the lagoons and ocean. Furthermore, fire residual may be washed down by storm runoff, thereby contributing excessive sediments and nutrients to the watershed's receiving waters.

Water Quality Improvement Strategies

In accordance with previously identified problems and in order to protect the beneficial uses of waterbodies in this region, the greatest benefits in achieving water quality improvements in the North Coast sub-watershed could be achieved by focusing efforts on the following:

- Restore Lower Zuma Creek and Lagoon.
- Protect and restore remaining wetlands in the North Coast sub-watershed.
- Implement measures to control excessive sedimentation.
- Implement measures to reduce the amount of trash and debris.
- Reduce/eliminate non-native plant species where feasible.
- Examine the use of septic systems in this sub-watershed, particularly near the coastline.

Lower Zuma Creek and Lagoon Restoration

The SMBRP, National Parks Service and the Dept. Beaches and Harbors are currently spearheading efforts to implement a restoration plan for Lower Zuma Creek. This restoration effort includes removing non-native species and revegetating with native species, removing trash and debris from old rubble piles, establishing volunteer monitoring to record these changes associated with the restoration project, and providing educational displays to inform the public of the value of the area.

Wetlands Protection and Restoration

Because the wetlands in this sub-watershed are affected by the land use activities and water quality impacts that occur upstream, as well as invasion of non-native species, any restoration activities taking place should consider these issues. Development of a comprehensive plan should address identified pollutants and sources found in the North Coast sub-watershed and should be based on water quality, salinity, habitat and biodiversity objectives for wetlands restoration. Special focus should be given to the Trancas Lagoon wetlands area. Although federal and state regulations seek to protect wetlands from being filled in unnecessarily and assure mitigation of unavoidable impacts, there needs to be more coordination at the local level to ensure protection of the unique wetlands found in this region. The SMBRP's Bay Restoration Plan identifies specific actions that can be taken to protect and restore Trancas Lagoon, Arroyo Sequit Canyon and other priority wetlands found throughout the Santa Monica

Bay watershed. These actions should be considered in the development of any comprehensive protection/restoration plan.

Excessive Sedimentation Control

Sediments are transported by creeks and streams to lagoons and ultimately the ocean. It is a necessary and natural function that replenishes beaches along the coastline. However, excessive sedimentation can be harmful to downstream habitats (as discussed previously) and efforts must be made to control unnatural sediment loads from reaching the local creeks and streams. These efforts should include promoting proper implementation of runoff controls at construction sites, planting native species that will prevent erosion of hillsides and stabilize topsoils, educate appropriate audiences about the impacts of improper land grading activities, and educate owners of horse/animal farms about how the location of their livestock can contribute to sedimentation of adjacent creeks and streams.

Reduction of Trash and Debris

Although problems resulting from trash and debris are intermittent and do not pose a constant threat to this watershed, appropriate action should be taken where recurrent problems arise. This may include installing additional trash receptacles, educating the local public and visitors, posting informational signs, installing "trash nets" and establishing volunteer programs where people can serve as both watchdogs and support for cleanup activities.

Removal of Non-native Species

Non-native species limit diversity of local, native plants and animals. Location and types of non-native species throughout the North Coast sub-watershed should be identified and mapped. Once this information has been prepared, an assessment should be performed in priority habitats on the feasibility of eliminating non-native species and restoring the area with native, indigenous species. This effort is already underway at Zuma Lagoon, with the restoration design phase almost complete and restoration implementation phase estimated at approximately two year to complete.

Examination of Septic Systems

Septic systems are located throughout the North Coast sub-watershed. Although there is no evidence that septic systems have impaired the beneficial uses or degraded water quality of this region, they have the potential to leak bacteria and nutrients which can then migrate to sensitive habitats and the surf zone. Special attention should be given to them due to these concerns and other associated problems found in adjacent sub-watersheds. Special focus could be given to monitoring water quality in the creeks and lagoons for presence of human pathogens and along the surf zone where potentially problematic septic systems have been identified.

MALIBU CREEK

Overview of the Region

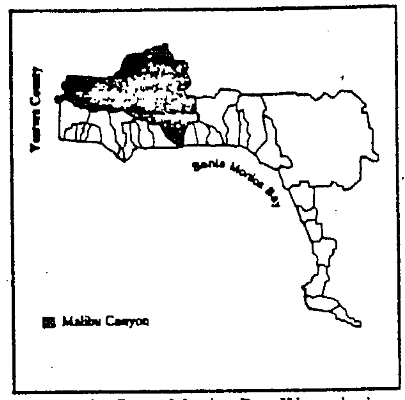


Figure 17, Santa Monica Bay Watershed, Malibu Creek Region

The Malibu Creek region (Figure 17) is one of the largest of the nine sub-watersheds that comprise the entire Santa Monica Bay watershed. With its discharge point to the Bay at the mouth of Malibu Creek and Lagoon, it drains an area of about 109 square miles. Approximately two-thirds of this sub-watershed lies in Los Angeles County and the remaining third in Ventura County. Much of the land is part of the Santa Monica Mountains National Recreation area and is under the purview of the National Parks Service. The region borders the eastern portion of Ventura County to the west and north, the North Coast sub-watershed to the south, and portions of the Topanga Canyon sub-watershed and Los Angeles River watershed to the east. Major tributaries contributing flows to Malibu Creek and Lagoon include Cold Creek, Lindero Creek, Las Virgenes Creek, Medea Creek, and Triunfo Creek. Additionally, five lakes and two reservoirs are located upstream from Malibu Creek; they are Malibou Lake, Lake Sherwood, Westlake Lake, Lake Lindero, Lake Eleanor and the Las Virgenes and Century Reservoirs. Located at the end of and receiving flows from Malibu Creek is the 40-acre area known as Malibu Lagoon. The Lagoon includes coastal salt marshes and wetlands, and is home to many diverse plant, marine and animal species.

Flows

At the Mouth of Malibu Creek, the estimated dry-weather flow is approximately 4-11 cfs (continuous base flow) although peak flows of more than 24,000 cfs[1] have been recorded at the gauging station in Malibu Creek during the rainy season, which is significantly more that minimum dry-weather flows. The broad difference in values between minimum dry-weather and maximum wet-weather flows reflect the dominant influence of storm water runoff, which is typical of stream flow patterns in Southern California. In fact, in the Malibu Creek sub-watershed over 70% of the total annual runoff occurs during the winter months, which results in approximately 13,565 acre-feet of water discharged to the Bay each year (SMBRP, 1993).

Land Uses

Although still relatively rural, this region's population has more than doubled in the past 20 years to 80,000, resulting in significant changes in types of land use activities. Consequently, artificial flows in the Malibu Creek sub-watershed have increased. Today, the region's land uses are 88% open space, 3% commercial/light industry, 9% residential and less than 1% public (SMBRP, 1993). However, approximately 22% this sub-watershed region is either part of the Santa Monica Mountains National Recreation Area or state park land and development

[1] Los Angeles County, Department of Public Works

opportunities are limited.

Wetlands

The Malibu Creek sub-watershed is also home to some of Southern California's last remaining wetlands. Malibu Lagoon, located at the mouth of Malibu Creek, occupies approximately 40 acres and is characterized as a typical coastal saltwater wetland habitat. Prior to commercial and residential development of the adjacent and upstream areas, the total acreage of wetlands was approximately 272 acres (SMBRP, 1994b). Although the area has been severely impacted by urbanization, it supports a variety of species which are discussed in the *Beneficial Uses* section below.

Permitted Discharges

The Malibu Creek sub-watershed includes one permited wastewater treatment facility - Tpia Water Reclamation Facility, located on Malibu Canyon Road near Tapia Park,[2] Tapia serves a population of approximately 60,000 from three cities, the western portion of Los Angeles County and a small portion of Ventura County. It has a treatment capacity of 16 million gallons per day (mgd). Currently (1996) the average flow to the facility is about 9 mgd. During the summer months, the facility's tertiary-treated wastewater is sold through a water reclamation project, resulting in almost no discharge to the creek during most of June, July, August and September. Tapia's reclaimed water is used for such activities as landscape irrigation and fire suppression; the biosolids generated are either pumped to land injection farms or recycled at a state-of-the-art composting facility located nearby, then sold or given away. Furthermore, pollutant loadings such as TSS, BOD and all metals found in Tapia's wastewater discharges are low.

The Malibu Creek sub-watershed also includes three additional permitted discharges. They are two groundwater seepage discharges and one cooling water discharge[3].

Beneficial Uses

The Los Angeles Regional Water Quality Control Board has designated several beneficial uses for the Malibu Creek sub-watershed, including unique habitats that support a variety of marine life and wildlife, waters that are used for municipal and domestic supply and commercial and sport fishing opportunities, recreational areas that provide outdoor opportunities for tourists and residents, parks that provide educational opportunities, groundwater recharge projects, etc. Table 10 summarizes the beneficial uses designated for all waterbodies in this sub-watershed.

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[2] Los Angeles Regional Water Quality Control Board, per com.

[3] Los Angeles Regional Water Quality Control Board, per com.

Significant Regions

Certain sections of the Malibu Creek sub-watershed have been designated as Areas of Special Biological Significance by the State Water Resources Control Board (SWRCB) and as "Significant Ecological Areas" (SEA) by Los Angeles County. These designations require protection of species or biological communities to the extent that 1) alteration of natural water quality is undesirable and that 2) the preservation of natural water quality be maintained to the extent practicable. The Malibu coastline, Malibu Canyon and Lagoon, Las Virgenes, Malibu Creek State Park and Cold Creek are all such designated areas.

Malibu Lagoon Malibu Lagoon, located at the mouth of Malibu Creek, is a brackish waterbody, influenced by intermittent breaching events and inflows from Malibu Creek. The Lagoon serves several purposes such as providing essential habitats for a diversity of species -- birds, fish, reptiles, invertebrates and mammals -- and is an important feeding/nesting area for birds migrating along the Pacific Flyway. The Tidywater Goby was reintroduced here, and subsequently declared an endangered species. The lagoon also acts as natural filter which is able to absorb, retain and remove pollutants from the water. It provides recreational use, educational opportunities, aesthetic value, flood protection and is a source of groundwater recharge. In fact, Malibu Lagoon represents the most significant coastal lagoon in the entire Santa Monica Bay watershed; and Malibu Creek, which feeds the Lagoon, represents the southernmost steelhead trout watercourse and spawning area in California.

Malibu Lagoon just beyond the Walking Bridge.

Local Parks and Beaches There are several parks located in this sub-watershed, most notably Malibu Creek State Park and Malibu Creek State Beach. These grounds provide hiking, picnicking, horseback riding, bicycling and educational opportunities as well as swimming, surfing and sunbathing activities. Thousands of visitors flock to this sub-watersheds parks and beaches each year and take advantage of the opportunities they provide.

Table 10. Malibu Creek Sub-watershed Beneficial Uses (Modified from Basin Plan, LARWQCB, 1994)

Waterbody	Beneficial Uses															
	MUN	IND	PROC	AGR	GWR	NAV	REC1	REC2	WAR	COLD	EST/MAR	WILD	RARE	MIGR	SPWN	WET
Malibu Lagoon						E	E	E			E	E	E	E	E	E
Malibu Creek	P						E	E	E	E		E	E	E	E	E
Cold Creek	P						E	E		P		E	E		P	E
Las Virgenes Creek	P						E	E	E	P		E	E	P	P	E
Century Reservoir	P						E	E	E			E				E
Malibu Lake	P					E	E	E	E			E	E			E
Medea Creek	I				I		E	E	E	P		E	E			E
Lindero Creek	P						I	I	I			E				E
Triunfo Creek	P				I		I	I	I			E	E			
Westlake Lake	P					E	E	E	E			E				
Potrero Valley Creek	P				I		I	I	P			E				
Lake Eleanor Creek	P				I		I	I	I			E				
Lake Eleanor	P				E		E	E	E			E	E			E
Las Virgenes Reservoir	E	E	E	E			P	E	P			E				
Hidden Valley Creek	I				I		I	I	I			E				
Lake Sherwood	P				E	E	E	E	E			E				E

E: Existing Beneficial Use P: Potential Beneficial Use I: Intermittent Beneficial Use

Evidence of Impairment

This region's environmental quality is impaired by three major causes: alterations of natural flow regime, pollutant inputs, and degradation of sensitive habitat.

Alterations of Natural Flow

Due to the population increase in the Malibu Creek sub-watershed, there has been a continued increase of pollutants to Santa Monica Bay from this region. At the terminus of Malibu Creek, Malibu Lagoon receives the natural and artificial runoff from the entire 109 square mile watershed, which reaches as far north as Simi Hills and as far west as Thousand Oaks. Much of the water the creek and lagoon receives is imported, with the State Water Project contributing an estimated 5 to 12 times more water (up to 17,000 acre feet per year) to the natural flow regime than existed prior to importing. This imported water is used by watershed residents for domestic and irrigation purposes, then discharged as wastewater to the treatment plant and as runoff to local storm drains, lakes, creeks and streams.


Rindge Dam

Rindge Dam, which was constructed in the 1924-25, has long since filled up with sediment deposits. The 100 ft dam now poses problems for fish migration and spawning, where available upstream habitats are crucial to their existence. Most notably impacted by this structure are steelhead trout. Malibu Creek represents the southern most steelhead trout run location in California and Rindge Dam impacts their ability to spawn further upstream. Nevertheless, discussions on how best to deal with the removal of Rindge Dam are currently underway, although no feasible alternative has been chosen to date. One major obstacle to moving ahead with a dam removal project seems to be securing financing; the total cost has been estimated somewhere between $5-30 million.

Contamination

As the volume of runoff in the Malibu Creek sub-watershed increases, additional pollutant loads have been identified which impair the region's recreational and biological resources. This is evident in many ways. An SMBRP Epidemiological study conducted during the summer of 1995 confirmed the relationship between high bacteria counts in the sufzone and illnesses observed in people swimming directly in front of flowing storm drains. *No Swimming* warnings have been placed at Malibu Lagoon and the adjacent surfzone. *No Fishing* advisories are posted that warn anglers about eating potentially contaminated white croaker caught in the area as well as advisories discouraging the collection of mussels from the lagoon. Sensitive habitats and native species also found at the Lagoon are threatened by increased flows from imported water which disrupts the salinity regime and natural flow conditions. Critical habitats are smothered by high TSS loading. Suspended sediments also provide a transport medium for heavy metals, pesticides and other pollutants. Increased algae and aquatic vegetation growth is prevalent, especially in the Lagoon and in areas located adjacent to storm drains and horse farms where high levels of nutrients enter the creeks. Indeed, algae is abundant throughout creeks and streams in the Santa Monica Mountains. Potential problems resulting from increased temperatures also exists in this sub-watershed, due to sparse vegetative cover along segments of the creeks. Bacterial counts from water samples taken in the sub-watershed creeks and Malibu Lagoon suggest the presence of harmful pathogens in downstream receiving waterbodies.

Furthermore, multiple non-point sources such as storm drain runoff, street runoff, and development activities contribute sediments, trash and debris, and other contaminants to the waterbodies and wetlands located in the Malibu Creek sub-watershed. Another non-point source of pollution in this region, especially recently, has been what remains after fires burn throughout the area. Unfortunately, fire season comes directly before the rainy season so there is little or no opportunity for hillsides to restabilize naturally. The rain, consequently, washes fire residual directly to the local streams and ultimately to Malibu Creek and Lagoon. The result is an increased TSS, nitrogen compounds, and trash and debris.

Densely populated suburban commercial and residential developments have encroached upon the Malibu Creek sub-watershed and further contribute to the non-point source pollution problems it faces. The presence of livestock and intense grazing activities also degrade water quality by denuding vegetation cover, increasing the erodability of soils and hence the sediment load carried by the streamflow. Septic systems, which are located primarily in the lower watershed and coastal stretches, have the potential to leak pathogens and bacteria to local area waterbodies.

Habitat Degradation

In addition to increased water supplies, major modifications of natural land features such as channelization of tributaries, destruction of riparian zones and wetlands, changes in soil infiltration characteristics and the construction of dams cause additional adverse impacts. The invasion of non-native plant species further upsets the natural condition of wetlands and other riparian zones, which in turn impairs their biological functions. Only 5.3% of the 133 plant species identified at Malibu Lagoon are native estuarine species, and only 29.7% of those 133 are native to California (National Parks Service, 1994).

Non-native aquatic species are found in the creeks, streams and lakes of the Malibu Creek sub-watershed. According to The Ecology of Riparian Habitats of the Southern California Coastal Region: A Community Pofile, over 28 different non-native fish have become established in Southern California streams (National Parks Service, 1994), including large mouth bass, black bullhead, green sunfish, Oriental shrimp and crayfish, just to name a few. These non-native aquatic species may adversely affect indigenous species of the area. Crayfish is one such non-native species likely responsible for the severe decline in salamanders and frogs.[4]

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[4] Lee Katz, Pepperdine University (per Randall Orton, LVMWD).

Malibu Lagoon Malibu Lagoon, which for the past 11 years has been managed by State Parks and Recreation Department, now faces new problems. Previously, under an Interim Water Management Plan, State Parks breached the Lagoon's sand berm barrier when water levels rose above 3.7 feet. However, concern for the impacts on endangered species and habitats, the possible adverse health effects to surfers and swimmers, and abrupt changes in salinity of the Lagoon have changed the breaching protocol. Additionally, the California Coastal Commission requires a Coastal Development Permit before breaching activities continue. Breaching of the Lagoon has been temporarily suspended until further information on hydrology, biology and water quality of the Lagoon can be assessed. These studies, now underway, are needed to determine the true impacts breaching activities have on the Lagoon and on the habitats supported there.

Pollutants of Concern

The pollutants of concern identified for this sub-watershed include nutrients (nitrogen and phosphorus compounds), sediments, pathogens, TSS, trash and debris, and oil and grease. This region has the second highest loading of TSS in the Santa Monica Bay watershed, which may be in part due to natural causes.

Although the Bay Restoration Plan has identified heavy metals as pollutants of concern within the entire Santa Monica Bay, they have not been specifically identified as pollutants of concern in the Malibu Creek sub-watershed. However, heavy metals should continue to be monitored in runoff, especially since models suggest inputs to the Bay from this sub-watershed. Likely sources contributing to heavy metals loadings include runoff contaminated from transportation-related activities, air deposition, etc. More monitoring is warranted before the overall impacts of heavy metals can be understood.

Sources and Loadings

In the Malibu Creek sub-watershed, many point and non-point sources of pollution have been identified. Table 11 links these sources of pollution with the pollutants of concern (identified above) found in the waterbodies of this region.

Permitted Discharges

The Tapia Water Reclamation Facility, this region's major discharger contributes pollutants including nitrates, phosphates and ammonia to Malibu Creek and Lagoon. However, concentrations of all pollutants discharged are within the parameters set by the Los Angeles Regional Water Quality Control Board (in accordance with their Waste Discharge Permit), meet both state and federal standards for recreational contact and are monitored on a regular basis.

Nutrients

Nutrients, which are a major source of pollution to the receiving waterbodies, are found throughout the watershed and have several suspect and known sources. The Tapia Water Reclamation Facility (NO_3), area storm drains, horse and animal farms, land grading activities, agricultural activities and transportation-related activities have all been identified as contributors to the nutrient loads found in the local creeks, streams and the Lagoon.

TSS and Fine-grained Sediments

Sediments and total suspended solids (which hinder light transmission into waters, smother spawning areas and hard-bottom subtidal habitats, and provide a transport medium for other pollutants such as heavy metals and pesticides) also have several known and suspect sources. Non-stabilized hillsides, development activities where best management practices have not been implemented, improper land grading activities, horse and animal farms located to close to creeks and stream and other relevant agricultural activities all contribute sediments and TSS to this watershed's creeks and stream, which ultimately flow to Malibu Creek and Lagoon. Furthermore, fire residual may be washed down by storm runoff and contribute acute excessive sediments and nutrients to the watershed's receiving waters.

Pathogens

Malfunctioning septic systems are suspected of contributing to the pathogen loads found in Malibu Creek and Lagoon. A dye study now underway by the City of Malibu will confirm whether this assumption is correct. Although the Tapia Water Reclamation Facility also discharges to Malibu Creek, they meet the 2 cfus/100 ml limits for indicator coliform bacteria set by the LARWQCB nearly all of the time. Other likely sources of pathogens include recreational inputs and wildlife, households, and storm drain discharges.

Oil Spills

Although not currently an issue, the threat of oil spills to the Bay from tankers exists due to continual oil transporting activities along California's coastline. Ocean currents have the potential to transport oil from spills directly to the shoreline, thereby significantly degrading this sub-watershed's special coastal habitats.

Table 11. Pollutants of Concern and Sources of Loadings (Modified from SMBRP, 1994b)

Pollutant of Concern ⇒ / Source of Loadings ⇓	Nutrients	Pathogens (including coliform bacteria)	TSS and Fine-grained Sediments	Trash and Debris	Oil and Grease (Oil Spills)	Nitrogen/ Phosphorus Compounds	Heavy Metals
Permitted discharges Tapia Groundwater Seepage Cooling Water	X						
Households	X	X	X	X	X		X
Industrial/ Commercial	X (Detergents)		X	X	X		X
Storm Drains	X	X	X	X	X		X
Horse and Animal Farms	X		X				
Land Grading/ Construction Activities	X		X				
Agriculture	X		X			X	
Septic Tanks		X					
Fires			X	X		X	
Transportation-related Activities	X		X		X		X
Air Deposition	X	X					X (lead)
Non-point Sources	X	X	X (erosion)	X	X		X

Water Quality Improvement Strategies

In accordance with previously identified problems and in order to protect the beneficial uses of waterbodies in this region, the greatest benefits in achieving water quality improvements in the Malibu Creek sub-watershed could be achieved by focusing efforts on the following:

- Protect and restore Malibu Lagoon and the remaining wetlands in the Malibu Creek sub-watershed.
- Enhance and protect beach and intertidal habitats for threatened and endangered species.
- Develop specific erosion and control strategies; consider the impacts of hillside developments.
- Develop a Total Maximum Discharge Load (TMDL) strategy for nutrients for the sub-watershed (underway).
- Reduce/eliminate non-native plant species where feasible.
- Examine the use of and impacts from septic systems in this sub-watershed, particularly near the coastline. Develop a management strategy to minimize potental impacts from the septic systems.

- Encourage water conservation, water reclamation, and other steps to reduce the Malibu Creek sub-watershed's dependence on imported water and input of unseasonal freshwater into the Creek.

Malibu Lagoon and Remaining Wetlands

Because Malibu Lagoon and wetlands in this sub-watershed are affected by the land use activities and water quality impacts that occur upstream, any restoration activities taking place should consider these issues. Development of a comprehensive plan should address pollutants of concern for this region and should be based on water quality, salinity, habitat and biodiversity objectives for wetlands restoration. The SMBRP's Bay Restoration Plan identified specific actions to protect and restore Malibu Lagoon, as well as other priority wetlands found throughout the Santa Monica Bay watershed.

Beaches and Intertidal Habitats

Malibu Creek and Lagoon, as well as several other unique habitats in this sub-watershed, are home to a few threatened and endangered species (e.g., tidewater goby, steelhead trout, oak trees). Many non-threatened/non-endangered species also rely on these habitats for their existence and may become threatened if habitat degradation continues. Long-term, protective management strategies should be implemented for their protection and may include acquisition of land, public education about the values of these species/habitats, increased enforcement activities, on-going monitoring, interagency cooperation, etc.

Erosion Control Strategies

Development of a erosion and control strategy must consider several factors, including pre-development sediment transport volumes and the impacts of development on the normal sediment transport process. Although natural erosion and sedimentation transport activities are both necessary and desirable for natural beach replenishment and healthy functioning wetlands, excessive erosion and sediment transport can adversely impact downstream sensitive habitats. Assessing appropriate and necessary transport volumes is key to developing this overall control strategy.

Removal of Non-native Species

Non-native species limit diversity of indigenous plants and animals. Location and types of non-native species throughout the Malibu Creek sub-watershed should be identified and mapped. Once this information has been prepared, an assessment should be performed in priority habitats on the feasibility of eliminating non-native species and restoring the area with native, indigenous species. This effort is already underway at Malibu Lagoon and should be expanded to include other sensitive areas, where feasible.

Septic System Management Strategy

Septic systems are located throughout the lower Malibu Creek sub-watershed. Water quality monitoring results suggest that septic systems might be contributing factors to the impairment of beneficial uses and degrade sensitive habitats in certain areas of this region. These systems have the potential to leak bacteria, pathogens and nutrients which can then migrate through sensitive habitats, and ultimately to the surf zone. Special attention should be given to them due to these concerns and other associated problems inherent to malfunctioning septic systems. Special focus should be given to monitoring water quality in the creeks and lagoons and along the surf zone of this sub-watershed where a greater number of septic systems have been identified.

Water Conservation

Water conservation practices, spearheaded by the Las Virgenes Municipal Water District, are already being encouraged in this sub-watershed. They have a number of existing programs and pilot projects underway to reduce the importation of water into the watershed, including providing residential and commercial water audits, distributing ultra-low flush toilets and irrigation training, just to name a few. Nearly all the programs implemented by LVMWD are co-funded with local, state and federal funds and are administered with the cooperation of local cities, the Municipal Water District of Southern California and other watershed stakeholder groups. Currently, over 20% (5,000 acre-feet) of the watershed's urban water demands are being met by water conservation and wastewater recycling.

TOPANGA AND ADJACENT

Overview of the Region

Located approximately 4.5 miles west of the City of Santa Monica, the Topanga sub-watershed includes Puerco, Corral, Carbon, Las Flores, Piedra, Pena, Tuna, Topanga, Santa Ynez and Mandeville canyons, which covers an area of 18 square miles within the Santa Monica Mountains (Figure 18). This sub-watershed borders the Malibu Creek sub-watershed to the west, the Los Angeles River watershed to the north, the Santa Monica Canyon and Ballona Creek sub-watersheds to the east and the Pacific Ocean to the south. Several minor creeks and streams discharge directly to the Bay (Table 12), but there are no major point source discharges in this sub-watershed.

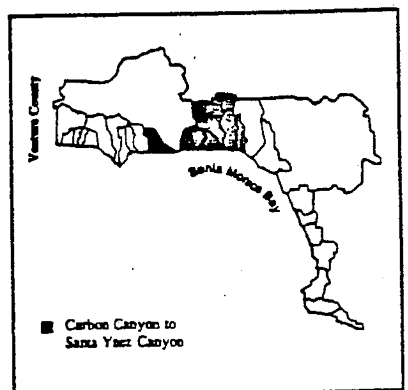


Figure 18, Santa Monica Bay Watershed, Topanga Region

Flows

The creeks in this region flow through towns in the upper reaches and through steep, narrow gorges in the lower reaches, ultimately emptying into the ocean just south of Highway 1. In the lower reaches, the canyons broaden into floodplains with dense riparian vegetation, houses, shacks, and stream crossings. In many places, Topanga Canyon Creek has been lined with boulders and concrete, and banks have been sandbagged to protect from erosion. Abandoned partially-buried vehicles and buildings attest to recurrent flooding experienced in this region.

Land Uses

Though this region is rural, there is still evidence of residential development in the Topanga sub-watershed. Additionally, a few areas in the upper sub-watershed area have been developed, but the percentage is relatively small. Land use activities can be broken down into the following: 92% open space, 7% residential, and less than 1% for commercial/industrial and public (combined).

Topanga Canyon

A small lagoon has formed at the mouth of Topanga creek due to a berm created by littoral drift and wave action. The lagoon is constrained to a narrow, linear basin defined by the high bluffs to either side of the creek. Tidal action occurs, as evidenced by aquatic marine vegetation within this lower part of the creek.

Table 12. Topanga Sub-watershed Flows (SMBRP, 1993)

Waterbody	Major Discharging Creeks		
	Drainage Area (Acres)	Discharge Point	Average Annual Storm Runoff (AFY)
Puerco Canyon and Corral Canyon Creeks	4288	Ocean	755
Carbon Canyon Creek	2246	Ocean	371
Las Flores Canyon Creek	3157	Ocean	571
Piedra Gorda Canyon, Pena Canyon and Tuna Canyon Creeks	2054	Ocean	253
Topanga Canyon Creek	12606	Lagoon/Ocean	2371
Santa Ynez Canyon	4959	Ocean	1043

Beneficial Uses

The Topanga sub-watershed is host to several beneficial uses, including recreational (swimming and surfing), wildlife and marine/aquatic habitat, fish spawning and migration, tidepools, intertidal and beach habitats. Table 13 summarizes the beneficial uses designated for waterbodies in this sub-watershed.

Sections of the Topanga sub-watershed have been designated as areas of *Special Biological Significance* by the State Water Resources Control Board (SWRCB) and as *Significant Ecological Areas* (SEA) by Los Angeles County. These areas require protection of species or biological communities to the extent that alteration of natural water quality is undesirable and that the preservation of natural water quality be maintained to the extent practicable. Tuna Canyon is one such designated area in this region.

Topanga Canyon is home to some of the unique wetlands that can be found throughout the entire Santa Monica Bay watershed. Specifically, the Topanga Canyon wetlands are palustrine, i.e., non-tidal wetlands dominated by vegetation (trees, shrubs, herbs, mosses and lichens). Streams feeding these wetlands are intermittent, flowing only part of the year and the stream corridors are typically steep, narrow and highly erosive. This in turn confines riparian vegetation to the immediate stream channel area.

Local Parks

There are several parks located in this sub-watershed, most notably Topanga Creek State Park, Will Rogers State Park and Will Rogers State Beach. These grounds provide hiking, picnicking, horseback riding and bicycling opportunities as well as swimming, surfing and sunbathing activities. Semi-regular interpretive and educational meetings are also held at these locations. Thousands of visitors flock to these locations each year and take advantage of the opportunities they provide.

Table 14. Pollutants of Concern and Sources of Loadings

Pollutant of Concern ⇒ / Source of Loadings ⇓	Pathogens	TSS and Fine-grained Sediments	Trace Metals
Households	X	X	X
Industrial/ Commercial		X	X
Storm Drains	X	X	X
Horse and Animal Farms		X	
Land Grading/ Construction Activities		X	
Fires		X	
Transportation-related Activities		X	X
Air Deposition	X		X (lead)
Non-point Sources	X	X (erosion)	X

Data from the SMBRP Bay Restoration Plan

Table 13. Topanga Canyon Sub-Watershed (Modified from Basin Plan, LARWQCB, 1994)

Waterbody	Beneficial Uses													
	MUN	GWR	NAV	REC1	REC2	COM	WARM	COLD	EST	WILD	RARE	MIGR	SPWN	WET
Puerco Canyon Creek	I			I	I		I			E				
Corral Canyon Creek	I			I	I		I			E				
Carbon Canyon Creek	P			I	I		I			E				
Las Flores Canyon Creek	P			I	I		I			E				
Piedra Gorda Canyon Creek	P			I	I		I			E				
Pena Canyon Creek	P			I	I		I	E		E				
Tuna Canyon Creek	P			I	I		I			E				
Topanga Lagoon			E	E	E	E			E	E	E	E	E	E
Topanga Canyon Creek	P			I	I		E	E		E		P	I	
Santa Ynez Canyon	P			I	E		I			E	E			
Santa Ynez Lake	P			P	E		E			E				
Mandeville Canyon Creek	P			I	I		I			E				

E: Existing Beneficial Use
P: Potential Beneficial Use
I: Intermittent Beneficial Use

Evidence of Impairment

Loss and degradation of riparian habitat, degradation of coastal wetlands

Limited development in this region but potential pollution problems exist if the percentage of developed lands increases.

The proposed lower Topanga restoration area encompasses almost 204 acres of land including 1.2 miles of Topanga Creek and its surrounding floodplain. Development within the watershed has caused erosion, degraded water quality and habitat values. For example, concrete sacks, rocks, and debris have been used for erosion control, reducing the vegetation along the stream. Stream temperatures are high, and because of the high nutrients discharged to the stream summer algal growth is significant. The area is also affected by debris, trash, uncontrolled discharges and vegetation removal.

Pollutants of Concern

The pollutants of concern identified for this sub-watershed include pathogens, TSS and trace metals (mercury and lead).

Although the Bay Restoration Plan has identified several heavy metals as pollutants of concern within the entire Santa Monica Bay, they have not been specifically identified as pollutants of concern in the Topanga sub-watershed. However, heavy metals should continue to be monitored in runoff. Likely sources contributing to heavy metals loadings include runoff contaminated from transportation-related activities, air deposition, etc. More monitoring is warranted before the overall impacts of heavy metals can be confirmed.

Sources and Loadings

Table 14 links potential sources of pollution with the pollutants of concern (identified above) found to threaten the waterbodies of this region.

TSS and Fine-grained Sediments

Sediments and total suspended solids (which hinder light transmission into waters, smother spawning areas and hard-bottom subtidal habitats, and provide a transport medium for other pollutants such as heavy metals and pesticides) also have several known and suspect sources. Non-stabilized hillsides, development activities where best management practices have not been implemented, improper land grading activities, horse and animal farms located to close to creeks and stream and other relevant agricultural activities all contribute sediments and TSS to this watershed's creeks and stream, which ultimately flow to Santa Monica Bay. Furthermore, fire residual may be washed down by storm runoff and contribute acute excessive sediments to the watershed's receiving waters.

Water Quality Improvement Strategies

In accordance with previously identified problems and in order to protect the beneficial uses of waterbodies in this region, the greatest benefits in achieving water quality improvements in the Topanga sub-watershed could be achieved by focusing efforts on the following:

- Protect and restore remaining wetlands in the Topanga sub-watershed.

Wetlands

Because the wetlands in this sub-watershed are affected by the land use activities and water quality impacts that occur upstream, any restoration activities taking place should consider these issues. Development of a comprehensive plan should address pollutants of concern for this region and should be based on water quality, salinity, habitat and biodiversity objectives for wetlands restoration. Special focus should be given to the Lower Topanga Canyon wetlands area. The SMBRP's Bay Restoration Plan identified specific actions to protect and restore Lower Topanga Canyon as well as other priority wetlands throughout the Santa Monica Bay watershed.

SANTA MONICA CANYON

Overview of the Region

Santa Monica Canyon drains runoff into Santa Monica Bay at the stretch of Will Rogers State Beach near the intersection of Chautauqua Boulevard and Pacific Coast Highway in Pacific Palisades, a community of the City of Los Angeles. The drain receives runoff from an approximately 5,600 acre drainage area, including the Pacific Palisades and the Brentwood/Palisades communities, and a nominal portion of the City of Santa Monica (Figure 19). It also drains runoff from popular attractions such as Will Rogers State Park, Riviera Country Club and portions of Topanga State Park.

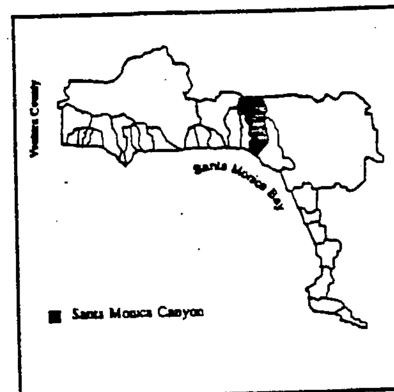


Figure 19. Santa Monica Bay Watershed, Santa Monica Canyon Region

The Santa Monica Canyon storm drain has two major branches, Santa Monica Canyon and Rustic Canyon. Santa Monica Canyon is a concrete-lined, rectangular open channel, except for a stretch where it traverses underground through the Riviera Country Club. It branches off to Mandeville Canyon and Sullivan Canyon storm drains, near the intersection of Sunset Boulevard and Mandeville Canyon Road. Mandeville Canyon is approximately 1.5 miles long. Sullivan Canyon is first intercepted by the Sullivan Canyon Park Debris Basin, then extends towards Mulholland Drive. Including Sullivan Canyon, the Santa Monica Canyon has a total length of approximately eight (8) miles. Rustic Canyon joins Santa Monica Canyon near the intersection of Entrada Way and Short Avenue. It also has a total length of approximately eight (8) miles and is an open, natural creek for most of its length. Its upper reach extends to the Topanga State Park near Mulholland Drive.

The drainage area of Santa Monica Canyon is comprised of mostly low density residential and open spaces, with minimal manufacturing and industrial activities. Table 15 shows the break down of land uses in both Santa Monica Canyon and Rustic Canyon area (in acres).

Table 15. Land uses in Santa Monica Canyon sub-watershed (Source: City of Los Angeles, 1995)

Area	Residential	Open Space	Commercial	Public Street
Santa Monica Canyon*	3,700	1,230	10	280
Rustic Canyon	560	3,910	< 5	165
Total*	4,260	5,140	<15	445

* Area within City of Los Angeles only.

Santa Monica Canyon flows year round with a typical dry flow of approximately 100-300 thousand gallons/day. Like storm drain system in the rest of the watershed, the drain can swells to an estimated hundred million gallons per day during a significant storm in wet season.

Beneficial Uses

Beneficial uses are identified for this subwatershed in two areas: those associated with the Creeks and those associated with ocean water influence by discharges from the land. Table 16 summarizes the beneficial uses designated for waterbodies in this subwatershed.

Adjacent to Santa Monica Canyon is Will Rogers State Beach, one of the most popular swimming beaches in Santa Monica Bay. The nearshore surfzone area is sandy bottom and is popular area for swimming and surfing. Like in most offshore zones of the Bay, the sea floor consists of soft-bottom habitat that supports a diverse number of organisms, including more than 100 species of demersal fish. It is also an area with high rate of recreational boat traffic.

Table 16. Beneficial uses designated for waterbodies in the Santa Monica Canyon subwatershed (Modified from Basin Plan, LARWQCB, 1994)

Waterbody	Beneficial Uses													
	MUN	IND	NAV	REC1	REC2	COM	WAR	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHEL
Santa Monica Canyon Channel	P			P	I		P		P					
Rustic Canyon Creek	P			I	I		I		E					
Sullivan Canyon Creek	P			I	I		I		E					
Mandeville Canyon Creek	P			I	I		I		E					
Adjacent Beaches			E	E	E	E		E	E				P	E
Nearshore Zone		E	E	E	E	E		E	E	E	E	E	E	E
Offshore Zone		E	E	E	E	E		E	E		E	E	E	E

E: Existing Beneficial Use
P: Potential Beneficial Use
I: Intermittent Beneficial Use

Evidence of Impairments

The Will Rogers State Beach is one of the heavily used recreational area in Santa Monica Bay. Yet the area has also developed a reputation for severe pollution as indicated by bacterial count measurements and special studies. Over the years, high indicator bacterial (total coliform, fecal coliform, and enterococcus) counts have been found in nearshore waters surrounding the drain's outlet, exceeding Ocean Plan objectives as high as thirty-seven percent of times. As a result, warning signs advising people not to swim in the adjacent area are permanently posted. However, although a SMBRP study found enteric viruses in Pico-Kenter drain, enteric viruses were not found in runoff samples collected at Santa Monica Canyon.

The strongest evidence of impairment is provided by the SMBRP epidemiological study conducted in summer 1995 (SMBRP 1996). The beach adjacent to Santa Monica Canyon was one of the three sites surveyed. Besides finding higher health risks associated with swimming near the storm drains, the study also showed that bacterial indicator counts were higher near the Santa Monica Canyon drain than farther from it. In the summer of 1995, according to the study, total coliform counts measured in surfzone water right in front of the Santa Monica Canyon exceeded the Ocean Plan 47% of time, while fecal coliform 56%, and enterococcus 80%.

Potential impacts of contamination from organic compounds, though not studied in this drainage area, are expected to be minimal.

Pollutants of Concern

The pollutants of concern identified for this subwatershed area include pathogens and total suspended solids.

Sources and Loadings

The occurrence of pathogenic contamination of runoff and surfzone water as measured by bacterial indicator concentrations is highly episodic. Generally the incidence of contamination occurs only when there is low flow. However, the frequency and magnitude of contamination does not seem to be related to the frequency and amount of the flow, nor the size of the drainage area. Surfzone water is more likely be contaminated when a storm drain discharges directly to the surfzone.

In 1994, the City of Los Angeles conducted a study of the possible sources of bacterial contamination in the Santa Monica Canyon (City of Los Angeles, 1995). In this study, samples from the Santa Monica Canyon upstream sub-drainage basin were collected at 10 locations and were analyzed for total and fecal coliform in order to isolate the pollutant sources. The test results appear to show no discernible pattern (i.e., which day and which location can best predict a high count). However, the test results did indicate consistently higher bacterial contamination counts coming from the Santa Monica Canyon branch, specifically from the upper watershed.

In contrast to what was generally believed, there seemed to be no sewage leaks (from broken or cracked sewer lines) in the channels during the sampling periods. There was only one occasion that the bacteria count exceeded 100,000 cfu/100ml for total coliform. Also, septic tanks do not seem to be a major source of bacterial contamination. Only about 2% of the total number of homes in the drainage area have no sewer connections and, therefore, have septic tanks. It is difficult, if not impossible, to determine the exact location(s) of the pollutant sources. However, the most likely bacterial contamination sources are fecal matter being released from horse stables, bird, pet and animal feces, and decomposed organic matter from trees. There are several horse stables built adjacent to Sullivan Canyon, Mandeville Canyon, and Rustic Canyon. Rustic Canyon is used as a trail by horseback riders. Finally, Will Rogers State Park has continuous equestrian activities and maintains some horse stables within the facility. The above conclusions from the City's study is similar to that of an in-house study conducted by the Los Angeles Department of Health Services in 1992.

Water Quality Improvement Strategies

There is a general consensus among stakeholders that the greatest impact and need for improvement in this subwatershed area is to reduce acute health risks associated with swimming at beaches impacted by pathogen-contaminated surfzone waters. Control of pathogen inputs into the nearshore areas should be the priority for pollutant control measures planned in this area.

However, unlike in Pico-Kenter and adjacent drain area, diversion of low flow to treatment plant is not a desirable solution to the problem at the present time because the sewer facilities in this area do not have the extra capacity to receive and transport the expected amount of added low flow. Re-design and construction of the pipeline would be costly. There are two other alternative measures that are considered more suitable at this time. The first one is a public education program. The City of Los Angeles has proposed distributing of door hangers and flyers to residents of homes located within the Santa Monica Canyon drainage basin. The second is to promote implementation of BMPs by horse stable operators, by disseminating pamphlets, conducting employee training, and installing runoff containment devices.

PICO-KENTER AND ADJACENT

Overview of the Region

Pico-Kenter drain is located where Pico Boulevard intersects the beach in the City of Santa Monica (Figure 20). The drain enters Santa Monica Bay in a 20-foot-wide by 8-foot high reinforced concrete box. The storm drain system drains a 4,147 acre area that includes much of Santa Monica and part of West Los Angeles and Brentwood. There are two drains: one owned by LA County and the other by CalTrans. Except for some upstream canyon areas, the drain is largely underground pipe. The storm drain flows year round with a typical dry flow of approximately 0.5 cubic feet per second (100-300 thousand gallons/day). Like storm drain channels in the rest of the watershed, flows in the drain can swell to an estimated hundred million gallons per day during a significant storm.

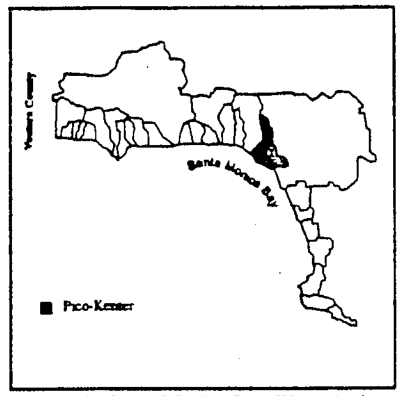


Figure 20. Santa Monica Bay Watershed, Pico-Kenter Region

Besides the Pico-Kenter drain, there are about a dozen relatively small catchment basins with beach or surfzone outlets between Pacific Palisades and Marina del Rey (see Table 17 for summary of their features). These drains are also mostly concrete underground pipes. Combined with and including the Pico-Kenter drain, they drain a subwatershed of 9,105 acres. The land use in this subwatershed is 48% single family, 21% multiple family, 6% commercial, 3% public, and 19% open space.

Table 17. Major storm drains between Pacific Palisades and Marina del Rey (Source: City of Los Angeles, 1996)

Name	Location	Drainage Area (acres)	Discharge Point	Low Flow
Montana Ave.	Santa Monica	825	on beach	intermittent
Wilshire Blvd.	Santa Monica	926	on beach	intermittent
Santa Monica Pier	Santa Monica	94	on beach	continuous
Pico-Kenter	Santa Monica	4,147	surfzone	0.5 cfs
Ashland Ave.	Santa Monica, Los Angeles	264	on beach	continuous
Rose Ave.	Santa Monica, Los Angeles	2,117	Pumped to Ashland drain	continuous
Thornton Ave.	Los Angeles, Santa Monica	267	on beach	intermittent
Brooks Ave.	Los Angeles	304	on beach	intermittent
Venice Pavilion	Los Angeles	161	surfzone	intermittent
Total		9,105		

Beneficial Uses

Beneficial uses for waterbodies in this subwatershed are primarily identified for the coastal waters that receive discharges from the storm drains. Table 18 summarizes the beneficial designated beneficial uses.

Table 18. Beneficial uses designated for waterbodies in the Pico-Kenter and adjacent drains (Modified from Basin Plan, LARWQCB, 1994).

Waterbody	Beneficial Uses											
	IND	NAV	REC1	REC2	COM	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHEL
Adjacent Beaches	E	E	E	E	E	E	E		E	E	E	E
Nearshore Zone	E	E	E	E	E	E	E	E	E	E	E	E
Offshore Zone	E	E	E	E	E	E	E		E	E	E	E

E: Existing Beneficial Use
P: Potential Beneficial Use
I: Intermittent Beneficial Use

The adjacent beaches in the area include the Santa Monica Beach and Venice Beach. These beaches are often heavily used, especially on weekends and in summer months. Santa Monica Beach is the busiest beach in the County, with up to 2.5 million visits each year.

Despite the high usage by humans, the beaches do provide habitats for many species of seabirds. A breeding site for the California least tern is located at Venice Beach.

The nearshore surfzone areas are sandy bottom and are popular swimming and surfing areas. Like most offshore zones of the Bay, the sea floor consists of soft-bottom habitat that supports a diverse number of organisms, including more than 100 species of demersal fish. It is also an area with significant recreational boat traffic.

Evidence of Impairments

Health Risks Associated with Swimming

The beaches and surfzone in the Santa Monica-Venice area are probably the most heavily used recreational area in Santa Monica Bay. Yet the area has also developed a reputation for severe pollution as indicated by bacterial count measurements and special studies. Over the years, high indicator bacterial (total coliform, fecal coliform, and enterococcus) counts have been found in nearshore waters surrounding several storm drain outlets. Prior to diversion of low flows to Hyperion treatment plant in 1992, total coliform and enterococcus counts in surfzone near Pico-Kenter storm drain exceeded Ocean Plan objectives as high as 18 percent of times. As a result, warning signs advising people not to swim in the adjacent area were posted permanently. Warning signs were also posted near other area drains with low flows. According surfzone monitoring data collected by the City of Los Angeles and Los Angeles County Department of Public Works, bacterial indicator counts also exceed Ocean Plan objectives about 20% of the time at Santa Monica Pier, Ashland Ave. drain, and Venice Beach (at Venice Blvd.). In a study conducted by the Santa Monica Bay Restoration Project in 1992, enteric viruses were found in runoff samples collected at the Pico-Kenter storm drain.

The strongest evidence of impairment is provided by the SMBRP epidemiological study conducted in summer 1995 (SMBRP, 1996) as presented earlier. Ashland Ave. storm drain is one of the three study sites surveyed during the study. Besides finding that higher health risks are associated with swimming near flowing storm drains such as Ashland, the study also showed that bacterial indicator counts were higher near the Ashland storm drain than farther from it. In the summer of 1995, according to the study, total coliform counts measured in surfzone waters immediately in front of the Ashland drain exceeded the Ocean Plan 44% of time, while fecal coliform counts were exceeded 11% of the time, and enterococcus 19% of the time.

Elevated Contaminant Levels and Toxicity

Data collected over the years have shown that contaminants have accumulated in marine organisms in the nearshore area of the watershed. Levels of copper and silver in mussel tissue in the 80s exceeded the elevated data levels (EDL) at the Santa Monica Mussel Watch sites.

Studies conducted by the SMBRP in 1993 found that dry-weather runoff from Ashland Ave. are toxic to marine organisms. Samples collected from the drain exhibited toxicity using the sea urchin fertilization test until runoff/storm water was diluted 10 times. Toxicity exhibited at this site in general was higher than the toxicity exhibited in Ballona Creek and other sites investigated during the study. Toxicity identification and evaluation indicated that the sources of toxicity likely resulted from heavy metals (SMBRP, 1994d).

In a SMBRP pilot study conducted in 1991, chemical analysis of low flow runoff samples from Kenter Canyon drain showed that mean concentrations of chromium, copper, lead and zinc exceeded Ocean Plan Water Quality objectives (5:1 dilution assumed). The levels of PAHs were about 35 times the Ocean Plan objectives. Furthermore, in a two week episode, high concentration of chlordane were detected in the runoff (SMBRP, 1992b).

The storm drains in this area also carry trash and debris to the nearshore waters. This trash and debris, either washing back onto beaches, or deposited on the sea floor, create a nuisance and health hazard to beach goers, swimmers, and boaters, and pose danger to marine life. Significant hazardous material spills infrequently occur in the drainage areas and wash down to the ocean, caused beach closures and the posting of warning signs (SMBRP, 1992b).

Pollutants of Concern

The pollutants of concern identified for this subwatershed area include pathogens, heavy metals (Pb, Cu, Zn, Cd, Ag), debris, oil and grease, PAHs, and chlordane.

Sources and Loadings

Pathogens

Besides Pico-Kenter and Ashland Ave. drains, high concentrations of bacterial indicators were also found in effluent from drains at Santa Monica, Thornton Ave., and Brooks Ave. The occurrence of pathogenic contamination of runoff and surfzone water as measured by bacterial indicator concentrations is highly episodic. Generally the incidence of contamination occur only when there is low flow. However, the frequency and magnitude of the contamination do not seem to be related to the frequency and amount of the flow, nor the size of the drainage area. Surfzone water is more likely be contaminated when a storm drain outlet discharges directly to the surfzone.

Potential sources of pathogens to storm drains include illegal sewer connection and sewer dumping, sewer leak, domestic animals, food service business, and outdoor camping. A study is being undertaken by the City of Los Angeles to evaluate the effects of street washing on loading of pathogenic materials into the storm drain system.

Heavy Metals, TSS, PAHs, and Oil and Grease

Pico-Kenter storm drain has the second (to Ballona Creek) largest drainage area in the southern urban area of the watershed. Due to its large size and urban land use, the Pico-Kenter drainage contributes significantly to total loadings of several pollutants to the Bay. The SMBRP in 1993 estimated that the drain is the third largest loading source among 28 catchment basins (second in the southern urban area) for lead, copper, zinc, total suspended solids, and oil and grease. Combined, the area contributes approximately 5% of heavy metals, 4% of total suspended solid, and 6% of oil and grease.

Nonpoint source discharge apparently is the primary source of pollutant loading in this subwatershed. There is no permitted non-stormwater discharges through storm drains in the area (1996 LARWQCB data). The number of industrial stormwater NPDES permits and construction activity permits issued in this subwatershed is unknown at this time. On the other hand, transportation-related activities are identified as probably the most important source for heavy metals, PAHs, and oil and grease. The loading of these (heavy metals and PAHs) are likely result of deposition of auto fuel exhaust and auto part wear (tires, brake pad, etc.). Other potential sources of heavy metals are excessive fungicide and insecticide use.

Chlordane

Since the use of chlordane has been restricted since 1988, the source of chlordane in runoff is believed to be from unauthorized usage and dumping of stocked chemicals.

Trash and Debris

Littering and illegal dumping are the primary sources of trash and debris found in the Ballona Creek. However, the amount of trash and debris collected (through street sweeping and annual cleanup of catchbasins and storm drain channels) is unknown at this time.

Water Quality Improvement Strategies

There is a general consensus among stakeholders that the greatest impact and need for improvement in this area is the acute health risks associated with swimming in runoff contaminated surfzone waters. Control of pathogen inputs in the nearshore water should be the priority for pollutant control measures planned in this area. Other pollutants of concern identified for this area should continue be monitored. Preferably, some of these pollutants of concern will be removed when diversion or treatment measures are put in place for control of pathogenic contamination as described below.

Several alternatives for pathogenic contamination control have been investigated and experienced in this area. The outlet of the Pico-Kenter storm drain was first extended 600 yard beyond the surfzone in 1991 Then in 1992, the Pico-Kenter storm drain became the first drain in the watershed to have its low-flow diverted to a treatment plant. Because of its temporary nature, it is not expected that the diversion project will continue to operate in the future; however it has set a precedent and proved the feasibility of diversions for similar storm drain systems.

Planned as a long-term solution, the City of Santa Monica and City of Los Angeles has planned to construct a facility that uses ultraviolet light to treat the effluent of Pico-Kenter and Santa Monica Pier storm drains on site. The project is expected to be completed in 1999. Meanwhile, the City of Los Angeles and the Los Angeles County Department of Public Works has conducted a series of studies that evaluated the feasibility and cost-effectiveness of diverting other problematic storm drains in the area. With the City's and County's own funds and 1992 Proposition A grant awards, Ashland Ave. drain, Thornton Ave. drain, and Brook Ave. drain are all scheduled for diversion within the next three years.

BALLONA CREEK

Overview of the Region

Ballona Creek, with its discharge point to Santa Monica Bay adjacent to the entrance of the Marina del Rey harbor, drains a watershed of about 127 square miles (Figure 21). It is the largest drainage tributary to Santa Monica Bay. The watershed boundary extends in the east from the crest of the Santa Monica Mountains southward and westward to the vicinity of central Los Angeles and thence to Baldwin Hills. Tributaries of Ballona Creek include Centinela Creek, Sepulveda Canyon Channel, Benedict Canyon Channel, and numerous other storm drains. Ballona Creek is concrete-lined upstream of Centinela Boulevard. All of its tributaries are either concrete channels or covered culverts. The channel downstream of Centinela Boulevard is trapezoidal composed of grouted rip-rap side slopes and an earth bottom.

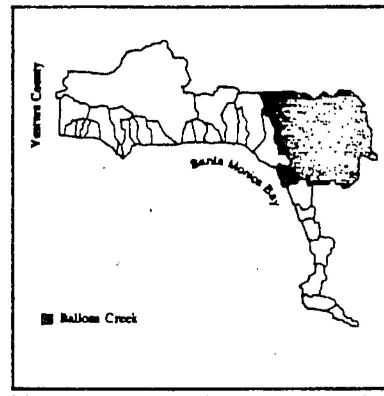


Figure 21, Santa Monica Bay Watershed, Ballona Region

Adjacent to the down stream channel of Ballona Creek are the Marina del Rey small craft harbor, Ballona Lagoon and Venice Canals, Del Rey Lagoon and Ballona Wetlands. Although they do not discharge directly into the Creek, they are grouped as waterbodies in this subwatershed because of their proximity and various forms of hydrological connection to Ballona Creek.

Flows

Ballona Creek conveys approximately 10 cfs of dry-weather flow (continuous base flow) and up to 36,000 cfs of wet-weather flow (100-year storm event). Table 19 summarizes characteristics of flow discharge from Ballona Creek (1928-1992, based on the flow rate recorded by LAC-DPW at its Sawtelle station). Table 20 shows the return periods of extreme discharges from Ballona Creek. It is noted that the maximum wet-weather flow can be about 400 times the minimum dry-weather flow. This is suggestive of the dominant influence of stormwater runoff, which is typical of stream flow patterns in Southern California.

Table 19. Characteristics of Flow Discharge from Ballona Creek (1928-1992, from US Army Corps of Engineers, 1995)

Median Discharge (cfs)				Most Frequent Discharge (cfs)				Seasonal Occurrence of Peak Flow	
Mean Daily	Min. Daily	Max. Daily	Ann'l Peak	Mean Daily	Min. Daily	Max. Daily	Ann'l Peak	Most Freq.	Least Freq.
42	5.5	2,250	12,400	33	3.5	1,110	8,723	Dec-Feb	Jun-Aug

Table 20. Return Periods of Extreme Discharges from Ballona Creek (US Army Corps of Engineers, 1995)

Return Period (Year)	Discharge (cfs)
10	22,000
25	27,500
50	32,000
100	36,000

Land Uses

Ballona Creek collects runoff from several partially urbanized canyons on the south slopes of the Santa Monica Mountains as well as from intensely urbanized areas of West Los Angeles, Culver City, Beverly Hills, Hollywood, and parts of central Los Angeles. The urbanized area accounts for 80 percent of the watershed area; the partially developed foothill and mountains make up 20 percent. Land use within the watershed consists primarily of residential, commercial, industrial, public and other urban usages. Table 21 summarizes the percentages of each land uses within the sub-watershed. There are some areas of undeveloped land in the Santa Monica Mountains on the north side of the subwatershed, and a section along the east side of Ballona Creek near the Pacific Ocean (Playa Vista). Some open space also remains in the Baldwin Hills area along with an oil field. All other areas are typically urbanized.

Table 21. Land uses in the Ballona Creek subwatershed (from SMBRP, 1993)

Single Family	Milti-Family	Commercial	Light Industrial	Public and Other Urban	Open	Total Area
47%	18%	8%	4%	7%	16%	130 sq. mile

Beneficial Uses

Beneficial uses are identified for this subwatershed in three areas: beneficial uses associated with the Ballona Creek channel, those associated with other waterbodies such as Marina del Rey, Ballona Wetlands and Lagoon, and those associated with ocean water influence by discharges from the land. Table 22 summarizes the beneficial uses designated for waterbodies in this subwatershed.

Marina del Rey/Ballona Creek Complex

The estuarine area (area subject to influence of tidal prism) of Ballona Creek and Marina del Rey together provides many important beneficial uses. Marina del Rey is the largest artificial small craft harbor in the world accommodating more than 6,000 private pleasure boats. Besides the recreational value provided by harboring and navigating boats in and out, the Marina/Creek complex is an important habitat for many invertebrates, fish, bird and mammal species.

The benthic fauna in the area is typical of areas with shallow warm waters, a fine-grained, silty bottom and, in the marina, with limited circulation. The most common benthic species in the area are roundworms that account for about 30% of the total benthic population and found primarily in the channel entrance. Polychaetes are also common in the poorly-circulated inner marina. The fish population has limited diversity due to the less favorable physical and environmental conditions in the area. About twenty species of fish are present in the area, most common were queenfish, northern anchovy, cheekspot goby and white croaker. There is evidence of increasing diversity in recent years (Soule, 1997). Certain seabirds are seasonally common in the area. The species found here are those that occur in sheltered waters of shallow depths (e.g., grebes and scooters), or generalist species (e.g., gulls). The California sea lion and the harbor seal can also be spotted in the area (often seen on the breakwater and jetties).

Several federally defined threatened, endangered, and candidate species may occur in the complex and adjacent beach areas. The species that are sensitive to environmental disturbances include the California least tern, California brown pelican, and western snowy plover.

Beaches

The adjacent beaches of the area include Venice Beach located upcoast and Dockweiler State Beach located downcoast. These beaches are often heavily used, especially on weekends and in summer months. Jetties along the channels are also regularly used by pedestrians and fishers.

Ballona Wetland Complex

The Ballona Wetland Complex (Ballona Wetlands, Ballona Lagoon, Del Rey Lagoon) is the largest of ten brackish wetlands along the edge of Santa Monica Bay. The 260-acre Ballona Wetland is the largest remaining wetland within this complex. The 16-acre Ballona Lagoon is an artificially confined tidal channel that connects the Venice canal to the Pacific Ocean. Ballona Wetlands is a mixture of habitats dominated by coastal salt marsh. Freshwater riparian habitat also exists along the foot of the bluff. The wetlands support hundreds of species of plants, insects, and animals. Common plant species include pickleweed, salt grass, frankenia, jaumea, saltbush, etc. in the salt marsh area and tule, cattail, willows, cottonwood, threesquare, umbrella sedge, etc. in the freshwater riparian area. Animal species across all major taxonomic groups are observed in the wetlands, including many special status species such as Belding's Savannah sparrow, salt marsh shrew, Dorothy's El Segundo dune weevil, and salt marsh skipper, etc. The wetlands also provide spawning ground for fish species such as California halibut.

Table 22. Beneficial uses designated for waterbodies in the Ballona Creek subwatershed (Modified from Basin Plan, LARWQCB, 1994)

Waterbody	Beneficial Uses															
	MUN	IND	NAV	REC1	REC2	COM	WAR	EST	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHEL	WET
Ballona Creek Upstream (above tidal prisms)	P			P	E		P			E						
Ballona Creek Estuary(tidal prisms)			E	E	E	E		E	E	E		E	E	E	E	
Ballona Wetlands				E	E			E		E		E	E	E		E
Ballona Lagoon/Venice Canals				E	E	E		E	E	E		E	E	E	E	E
Del Rey Lagoon			E	E	E	E		E		E		E	E	E		E
Marina del Rey			E	E	E	E			E	E		E			E	
Adjacent Beaches		E	E	E	E	E			E	E		E	E	E	E	
Nearshore Zone		E	E	E	E	E			E	E	E	E	E	E	E	
Offshore Zone		E	E	E	E	E			E	E		E	E	E	E	

E: Existing Beneficial Use
P: Potential Beneficial Use
I: Intermittent Beneficial Use

Nearshore and Offshore Areas

The nearshore and offshore zones near the discharge point of Ballona Creek are areas heavy in traffic for recreational boat activities because of its vicinity to Marina del Rey. Similar to most parts of the Bay, the sea floor consists of soft-bottom habitat that supports a diverse number of organisms, including more than 100 species of demersal fish (see Section Natural Environment, Marine Habitat for detail).

Evidence of Impairments

The Ballona Creek Subwatershed is part of the Santa Monica Bay region that has historically, and continues to experience significant development due to demand for housing and businesses with coastal amenities. Two consequences of modern human inhabitation are natural habitat replacement/destruction, and increased pollutant loading to waterbodies within the subwatershed.

Habitat Degradation

At one time, the Ballona Wetland Complex was 2,100 acres of coastal estuary and wetlands. With the development of Marina del Rey, the Venice canals, and other residential and commercial properties, the draining of wetlands for agricultural use, oil drilling, and to control insects; and the channelization of Ballona Creek; the Wetland Complex has been reduced to approximately 430 acres.

Most parts of the 260-acre Ballona Wetlands are degraded or severely degraded. After channelization of Ballona Creek, the wetland's only connection to the ocean is culverts with flap gates. However, these flap gates allow only limited amounts of sea water into the marsh. The tidal range rarely exceeds one meter. In the wetland area next to the Marina, there is no tidal exchange through the culvert to the Marina because bank height and elevation of the surrounding lands are above the tidal amplitude. Adjacent to Ballona Wetlands, Ballona Lagoon has also become degraded.

The degraded wetlands support fewer species and are less productive than they would be in a restored state. Many species characteristic of pristine salt marshes in the area are lacking. Additional adverse impacts include the introduction of non-native plants and animals, debris and bacteria from urban runoff, and recreational overuse.

Elevated Contaminant Levels and Toxicity

Data collected over the years have shown that contaminants are accumulated in the estuarine area of the watershed both in sediments and in marine organisms. Levels of lead and zinc are elevated above the Effective Range Low (ERL) level in sediment samples collected at several sites in the entrance channel. Levels of lead, cadmium, chlordane, and DDT in mussel tissue in the 1980s exceeded the median international standards or DHS health advisory levels at several Mussel Watch sites in Marina del Rey, Ballona Channel, and adjacent nearshore areas.

Studies conducted by the SMBRP in 1993 and 1995 found that both dry-weather and wet-weather runoff are toxic to marine organisms. Almost all samples collected from the main channel and two major tributaries exhibited toxicity using the sea urchin fertilization test until the runoff/storm waters were diluted 10 times. Tests conducted on sediment samples also exhibited toxic effects. Toxicity identification and evaluation indicated that the probable sources of toxicity varies. In one case the source was consistent with the presence of organic chemicals. On another occasion the source was consistent with the presence of toxic metals (SMBRP, 1994).

Bacterial indicator levels measured at stations near Ballona Creek entrance frequently exceed the level of concern as prescribed in the California Ocean Plan. As a result, warning signs are posted permanently on each side of the Creek to advise people not to swim in the area. Over years, beach areas were also closed many times due to sewage spills and illegal dumping.

Everyday, tons of trash and debris wash into the sea from Ballona Creek. When floating on the water surface, washed back onto beaches, or deposited on the sea floor, trash creates a nuisance and health hazard to beach goers, swimmers, and boaters, and pose dangers to marine life.

Pollutants of Concern

The pollutants of concern identified for this subwatershed include heavy metals (Pb, Cu, Zn, Cd, Ag), debris, pathogens, oil and grease, PAHs, and chlordane. Possible future hydrological modifications of existing infrastructure such as dredging, fill, damming, channelization, and other types of construction are also a major concern because of their potential for impairment of water quality and aquatic and marine habitats.

Although not identified as pollutants of concern at this time, DDT and PCB should continue be monitored in the runoff from this subwatershed. Traces of DDT and PCBs are still detected in sediment samples collected near the mouth of the Creek, and higher concentrations are still present in mussel tissues in the area.

Sources and Loadings

Ballona Creek

Annual Mass Loading Because of its large size and urban land use, Ballona Creek contributes significantly to total loadings of several pollutants to the Bay. The SMBRP in 1993 estimated that Ballona Creek is the largest loading source among 28 catchment basins for lead, copper, zinc, total suspended solid, and oil and grease. Table 23 shows the estimated annual pollutant loading for the above five pollutants of concern. Table 24 summarizes data on concentrations of heavy metals collected by Los Angeles County Department of Public Works between 1970s and 1990s. A reconnaissance study performed by the Army Corps of Engineers in 1995 estimated that Ballona Creek yields about 46,000 cubic yards of sandy material and about 5,300 cubic yards of silt annually (USAOE, 1995).

Table 23. Estimated annual pollutant loadings (pounds/year) from the Ballona Creek subwatershed (SMBRP, 1993)

Lead	Copper	Zinc	TSS	Oil & Grease
36,698	9,720	49,288	26,975,093	1,457,699

Table 24. Mean concentratons (µg/L) of three heavy metals in dry weather runoff of Ballona Creek (U.S. Army Corps of Engineers, 1995)

	Station			
	1 (Ballona Crk. at Fairfax Ave.)	**2** (Ballona Crk. at Sawtelle Blvd.)	**3** (Centinela Crk. at Centinela Blvd.)	**9** (Sepulveda Ch. at Culver Blvd.)
Cadmium	0.74	0.74	0.15	2.09
Chromium	0.29	1.76	0.44	2.68
Lead	10.00	6.00	6.00	28.00

Loading Distribution A runoff quality analysis performed for the 48 discharges into Ballona Creek has identified the 10 most potentially polluted runoff discharges along Ballona Creek. In this analysis, expected contaminant loads were calculated for three water quality parameters, i.e., metals(lead/copper/zinc), oil and grease, and TSS for each of the 48 discharges respectively. Ranking was determined by compositing rankings on each individual parameter. Table 25 presents the location and rankings of the top 10 confluences. Based on this analysis, the 10 discharges account for about 90% of the expected total loading for pollutants in these three categories.

Sampling and analysis conducted during the 1995/96 wet season indicated that the metals (Ag, Cd, Cu, Cr, Ni, Pb, Zn) mass load contributed by the three main tributaries is proportional to their flow (Ballona main channel > Sepulverda channel > Centinela channel). However, the load from each channel is a significant contributor to the overall pollution load from this subwatershed (Suffet, et al. 1997).

Table 25. Ranking of runoff quality along Ballona Creek (U.S. Army Corps of Engineers, 1995)

Confluence (Approx. Location)	Metals		Oil/Grease		TSS		Composite Rank
	Load (mt/ws)	Rank	Load (mt/ws)	Rank	Load (mt/ws)	Rank	
BI84 (Exposition BL)	5.7	2	78.2	2	1,567	2	1
SEPUL5 (Sepulveda Cyn Ch./Slauson)	6.3	1	56.9	5	2,005	1	2
BI57-5 (San Vicente Bl.)	4.7	3	101.4	1	1,003	5	3
DDI11-4 (La Cienega Bl)	4.6	4	70.1	3	1,230	3	4
BI57-10 (Venice Bl.)	3.4	5	68.1	4	757	7	5
BNDCT6 (Benedict Cyn Ch./La Selle)	3.2	6	41.5	7	1,063	4	6
BI1102-3 (San Vicente Bl.)	4.6	4	52.5	6	550	9	7
CNTLA2 (Centinela Crk.)	2.6	7	22.3	9	836	6	8
LA1177 (Rodeo Rd/Higuera St.)	2.1	8	22.5	8	625	8	9
BI54 (Fairfax Ave.)	1.6	9	22.3	9	456	10	10
Total Load of All 48 Confluences	43.4		604.1		11,486		
% Total Load of the 10 Ranked Confluences	91%		91%		90%		

Permitted Discharges Sources of loading for pollutants of concern identified for this subwatershed are generally of two types: point source and non-point source. There are 171 permitted non-stormwater discharges through storm drains into the Ballona Creek (1996 LARWQCB data). The majority of these permitted discharges are ground water seepage that is drained for construction site preparation and treated contaminated groundwater. Some are discharges of cooling water. These permitted discharges of non-stormwater into the storm drains have a combined discharge that is about 8% of the discharges from stormwater runoff.

Although accurate data is not available at this time, there are significant number of industrial stormwater NPDES permits issued for industrial facilities and construction activity permits issued for construction sites in this subwatershed. In addition, several dump sites and 5

RCRA sites exist in the sub-watersheds that are potential contributors for the pollutants of concern.

Transportation Related Nonpoint Sources There are many potential nonpoint sources for pollutants of concern in this region. Among them, transportation-related activities are identified as one of the important sources for heavy metals, PAHs, and oil and grease. Monitoring of highway runoff conducted by California Department of Transportation has shown high concentration of copper, lead, and zinc (Table 5). The loadings of these heavy metals are likely result of deposition of auto fuel exhaust and auto part wear (tires, brake pad, etc.). Other potential sources of heavy metals are excessive fungicide and insecticide use. In addition, natural oil seeps, which are far more abundant in this region than other parts of Santa Monica Bay, may be an important contributor of oil and grease loading to Ballona Creek.

Sources of Trash and Debris Littering and illegal dumping are the primary sources of trash and debris found in Ballona Creek. Los Angeles County Department of Beaches and Harbors collects tons of trash on adjacent beaches after major rain storm each year. Most of the trash collected by the Department are materials carried downstream by the Creek and then washed on shore by tidal action. Since 1994, the Los Angeles County Department of Public Works installed a trash net near the mouth of the Ballona Creek right above the Pacific Bridge. However, the amount of trash and debris collected behind the net is unknown at this time. The amoung of trash and debris collected through street sweeping and annual cleanup of catchbasins and storm drain channels in this subwatershed is also unknown at this time.

Sources of Pathogens Potential sources of pathogens to the Creek also include illegal sewer connections and sewage dumping, domestic animals, and the transient population. A study is being undertaken by the City of Los Angeles to evaluate the effects of street washing on loading of pathogenic materials into the storm drain system.

Sewer leaks occurred in the past at various locations within the watershed, especially in areas where sewer lines are in parallel to the storm drain system. There were always several incidences of sewer overflows during winter storms each year. However there had been no incidence of overflow over the last two years, partly due to the aggressive efforts by the City of Los Angeles to replace old sewer lines. When sewer overflow occurs, the overflows are usually stored temporarily at the North Outfall Treatment Facility and if necessary, released into Ballona Creek after disinfection.

Marina del Rey

There are four drainages that are located around and drain directly into Marina del Rey Harbor. Although these drainage areas constitute only about 1% of the total drainage area of Ballona Creek subwatershed, two of the drainages, Oxford Basin and Washington Drain are significantly more industrialized than the Ballona Creek average, and thus are potentially significant sources of industrial contaminants such as heavy metals. The area drained by the Oxford Basin contains a RCRA remediation site (Western Circuits Inc.). There are also wastes dumps within the areas that drain to Oxford Basin. Also, surface drainage of Marina del Rey Harbor area has a high percentage of commercial use and thus is a potentially significant source for contaminants such as oil and grease in the harbor. Finally, the five NPDES-permitted non-stormwater discharges to the harbor include two boat washing waste discharges and three discharges of groundwater seepage.

Contaminants due to nonpoint sources from marine activities in the harbor primarily include lead, copper, zinc, PAHs, TBT and bacteria. Compared to contaminant loadings in Ballona Creek, lead releases due to marine activities are essentially negligible but zinc releases may be higher. This estimate is based on the assumption that the extent of zinc anode use has remained essentially the same over the last decades. The use of tributyltin (TBT) as an antifouling agent in vessel paints has been restricted since 1987.

Water Quality Improvement Strategies

In accordance with the problems identified previously, greatest benefits could be achieved should water quality improvement efforts be focused on the following:

- Protect and restore remaining wetland and riparian habitats in the region (Ballona Wetlands and Ballona Lagoon).
- Prevent and reduce mass loading of pollutants that accumulate in sediments of the Creek and near shore sea floor that are toxic and/or bioaccumulate in marine organisms (heavy metals, PAH, chlordane).
- Prevent and reduce loading of pollutants that may deplete the recreational value of nearby beaches and nearshore water by either imposing health risk (pathogens) or aesthetic nuisance (trash and debris).

Restoration of Ballona Wetlands

The Playa Vista Development Project and associated Ballona Wetlands Restoration Plan have been and will continue to be over the next five years the focus of attention by stakeholders in the region. The City of Los Angeles, U.S. EPA, U.S. Army Corps of Engineering, and CA Dept. of Fish and Games are key regulatory agencies for this project. Over the past several years, the developer (Maguire-Thomas) has been working with agencies and environmental organizations to develop a restoration plan for a specific area of Ballona Wetlands. This plan, known as the "hybrid" plan, contains elements of both full and mid-tidal alternatives in a manner that reduces environmental impacts and minimizes cost. Efforts are underway to identify and locate potential funding sources for implementation of the restoration plan.

An enhancement plan for Ballona Lagoon was developed in 1992. Funding for restoration in accordance with the enhancement plan have, for the most part been secured. Restoration activities began during the winter of 1996/97. Completion of the project is expected by the end of 1997.

Strategies for Reducing Mass Loading of Heavy Metals, PAHs, and Chlordane

Over the last five years, Many storm water control BMPs have been implemented in this subwatershed, primarily under the municipal stormwater NPDES program. Most of the BMPs implemented to date are general pollution prevention measures such as public education, street sweeping, and household hazardous waste collection. Implementation of these BMPs will continue under the enhanced municipal stormwater NPDES program adopted in July 1996. Meanwhile, source-specific BMPs should be developed and implemented to address these pollutants of concern more effectively. Currently, the County of Los Angeles is developing a stormwater management program to address pollutants of concern unique to this subwatershed as required under the municipal stormwater NPDES permit. The U.S. Army Corps of Engineers in collaboration with the County is conducting a feasibility study that includes identification of sources for sediment contaminated with heavy metals in this subwatershed. These efforts will provide guidance on future implementation of source control BMPs.

Strategies for Reducing Trash Load and Incidence of Pathogen Contamination

The trash net installed by the LAC-DPW has proved to be effective in stopping trash from entering the ocean during dry-weather. However, dry-weather trash load only counts for a small portion of the annual total. Preventing trash loads during wet-weather storms must rely on thorough cleanup of the storm drain channel, the catch basins, and ultimately the streets that drain to the creek. The Regional Board should continue to ensure compliance of relevant program elements in the municipal stormwater NPDES permit, and encourage municipalities to evaluate and implement the most effective means of cleanup and education.

Given the ample size of the Creek and its flow, dry-weather diversion of its flow does not seem to be as feasible as it has been planned for many other storm drains for remediating the pathogen input problem. A study commissioned by the City of Los Angeles concluded that using the North Outfall treatment Facility to treat the dry-weather flow will not be cost-effective. Therefore, in order to reduce the pathogen input from the creek, public agencies must explore upstream options such as a better surveillance system, an effective sanitary survey tool, and an expanded public education campaign.

EL SEGUNDO/LAX AREA

Overview of the Region

The El Segundo sub-watershed drains an area of about 6,680 acres. The sub-watershed extends from Playa del Rey to the north, Westchester, the Los Angeles International Airport (LAX) area of the City of Los Angeles, the City of El Segundo, the area adjacent to Chevron refinery and adjacent area and a small portion of the City of Manhattan Beach to the south (Figure 22). Characteristics of major sub-drainage areas in this region are listed in Table 26.

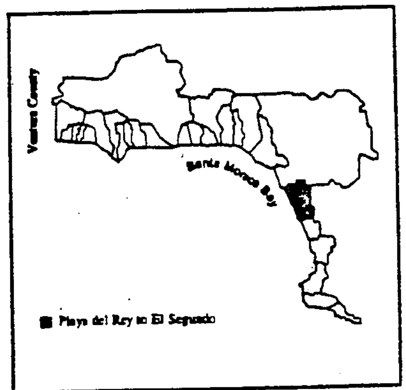


Figure 22, Santa Monica Bay Watershed, El Segundo Region

Table 26. Major Storm Drains in El Segundo/Lax Area (Source: City of Los Angeles, 1996)

Name	Location	Drainage Area (acres)	Discharge Point	Low Flow
Playa del Rey	Los Angeles	403	on beach	intermittent
North Westchester	Los Angeles (99.9%), El Segundo(0.01%)	2,416	on beach	intermittent
Imperial Highway	Los Angeles(13%), LAX, El Segundo(87%)	1,958	on beach	intermittent
El Segundo Blvd.	Los Angeles(2.2%), El Segundo(97.8%)	539	on beach	intermittent
Chevron Refinery	El Segundo, Manhattan Beach	1,129	3,500 feet offshore	intermittent
Hyperion Treatment Plant	Los Angeles	144	5-mile offshore	intermittent
Scattergood Power Plant	El Segundo	96	pumped to storm drain system outside the plant	intermittent
Total		6,680		

Land Uses

Land use in this region is a mixture of residential, industrial and commercial development and public beaches. The land use can be broken down as 53.5% commercial/industrial and other urban use, 28.7% residential use, 14.2% vacant/open space, and 2.8% public use.

Major Industrial and/or Commercial Facilities

There are several major industrial and/or commercial facilities of regional significance in this area, including an airport, a wastewater treatment plant, two electrical power generation stations, and an oil refinery. There are also some aerospace-related industries located in this region.

LAX The Los Angeles International Airport that serves as the hub of the regional airport system is in this area. It also represents one large contributor to runoff which in the past discharged to Santa Monica Bay largely via the Imperial drain. However, in late 1989 a retention basin and pretreatment facility was completed that handles about 1.8 million gallons of storm water "first flush" as well as dry weather low flow.

Hyperion Treatment Plant The Hyperion Treatment Plant is also located in the area. It is one of the largest POTWs in the country that serves over three million residents in a 480 square mile area. It also provides solids treatment for sludge discharged from two upstream facilities located in the San Fernando Valley. LAX and the Hyperion plant comprise a large percentage of the commercial and other urban land use in this region. Both facilities are either in the planning stage for or undergoing expansion and capital improvement of its treatment works.

Power Stations There are two power generation stations in this area: Los Angeles Department of Water and Power's Scattergood Generating Station, and Southern California Edison's El Segundo Generating Station. The power generating stations use seawater from Santa Monica Bay to cool steam condensers. Cool seawater is pumped into the station, circulated through a non-contact heat exchanger, and discharged at temperatures above the intake temperature. Chlorine is also injected periodically to control biological growth.

El Segundo Refinery The Chevron El Segundo Refinery has been in operation since 1911 and now manufactures various petroleum products including gasoline, jet fuel, kerosene, solvent, coke, fuel oil, liquefied petroleum gases and propylene polymer. Since the early 1970s, Chevron had discharged secondary treated wastewater through an outfall 300 feet offshore. In September 1994, the outfall pipe was extended to 3,500 feet which effectively removed the last point source discharge from the near shore environment.

Parks and Beaches

The major beach in the area is the Dockweiler State Beach which extends from Playa del Rey in the north to Manhattan Beach in the south. The beach is heavily used on weekends and in the summer.

Beneficial Uses

The major beneficial uses identified for this sub-watershed are use of seawater as industrial cooling water for power generation, use of the Bay to transport crude and refined petroleum and use of seawater for swimming, boating and sport fishing. Marine habitats and wild life habitats also exist in this region. Table 27 summarizes the beneficial uses in the El Segundo/LAX area. (in accordance with the LARWQCB Basin Plan 1994).

Table 27. Beneficial Uses Designated for Waterbodies in the El Segundo/LAX Area (Modified from Basin Plan, LARWQCB, 1994)

Waterbody	Beneficial Uses										
	IND	NAV	REC1	REC2	COM	MAR	WILD	BIOL	RARE	MIGR	SPWN
Dockweiler Beaches	E	E	E	E	E	E	E				P
Nearshore Zone	E	E	E	E	E	E	E	E	E	E	E
Offshore Zone	E	E	E	E	E	E	E			E	E

E: Existing Beneficial Use
P: Potential Beneficial Use
I: Intermittent Beneficial Use

Evidence of Impairments

Sewage Spills

Over the years, there were many incidents of untreated or partially treated wastewater overflowing from the Hyperion Treatment Plant or spills flowing through storm drain channels to the Bay due to either broken pipes, excessive quantity of flow or waste processing errors. The incidents caused beach closures or swimming warnings for a period of time.

Oil Spills /Seepage

Crude oil and refined petroleum products can enter the marine environment through tanker accidents, fueling, tank cleaning, bilge pumping, improper disposer or on-land spills into storm drains. Possible seeping of crude oil or the refined petroleum products from the pipelines as well as spills of oil occur in the Bay (including the ocean area adjacent to this subwatershed), each with the potential for serious impacts on the water quality and marine resources.

Elevated Contaminant Levels

Data collected over the years have shown that contaminants are accumulated in marine organisms in the nearshore area of the watershed. Levels of lead, copper, chromium and silver in mussel tissue in the 1980s exceeded the elevated data levels (EDL) at the Playa del Rey and El Segundo (Grand Ave.) Mussel Watch sites. In addition, zinc also exceeded EDL at the Playa del Rey site.

Wildlife Habitat

The El Segundo Dunes are a remnant of a once-vast coastal ecosystem. The physical features of the dunes themselves constitute an endangered landform. Nine hundred species of plants and animals have recently been recorded on these dunes, 35 of which are limited in range to Southern California. At least 11 species exist only within the boundaries of the El Segundo Dunes and all of them are in danger of extinction. The best example is the El Segundo blue butterfly which is a federal and state-listed endangered species.

Pollutants of Concern

The pollutants of concern identified for the El Segundo/LAX sub-watershed area include pathogens, debris, heavy metals, oil and grease, PAHs and chlordane.

Source and Loading

Potential sources of pathogens to storm drains include illegal sewer connections and sewage dumping, sewer leaks, domestic animals, food service business, and outdoor camping. During major sewage spills, the Hyperion Treatment Plant also becomes the source of pathogen inputs into the Bay.

Sources of debris include illegal waste dumping into storm drains, improper solid waste disposal, and construction activities. Sources for pollutants such as heavy metals, PAHs, oil and grease are more likely from transportation-related activities. The waste jet fuel from LAX and petroleum piping activities from the oil refinery are also considered possible pollutant sources.

Chlordane found in the runoff is believed to be from the unauthorized usage and dumping of stocked chemicals into storm drains.

Water Quality Improvement Strategies

Source reduction of pathogen inputs in near shore waters should be the priority for water quality improvement in this region. Other pollutants of concern should also be monitored regularly. Source control BMPs should be implemented to reduce the sources of pollutants loading into storm runoff. If feasible, diversion of some problematic storm drains into the sewer system should also be pursued.

Another priority is augmenting the ongoing restoration of the El Segundo Dunes and creating an El Segundo Dunes Habitat Preserve. Restoration is urgently needed in order to halt the spread of invasive species, and avoid further extinctions and the extirpation of native species. The long-term goal of the restoration program is to create a Dunes Habitat Preserve of approximately 200 contiguous acres and to restore and preserve the natural ecology of the area (including the adjacent acreage owned by Chevron).

SOUTH BAY

Overview of the Region

The South Bay sub-watershed drains an area of approximately 7,054 acres (Figure 23). The sub-watershed includes major portions of the Cities of Manhattan Beach, Hermosa Beach, Redondo Beach, and Torrance. Storm drains in the area are all narrow and rather small. The notable drains include Redondo Pier Drain, Herondo Drain, and Avenue I Drain.

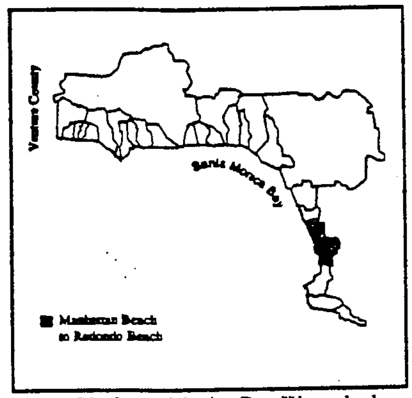


Figure 23, Santa Monica Bay Watershed, South Bay Region

Land Uses

The major land use of the region is high density single- or multiple-family residential use. The land uses include 80.9% residential use, 8.5% commercial/industrial and other urban use, 7.8% public use, and 2.6% vacant/open space.

Major Industrial and/or Commercial Facilities

Although most land uses are residential, the Redondo Generating Station, an electric power generating station operated by Southern California Edison, is located in this area. There are also some aerospace-related industries established in various places within the region.

Parks, Beaches and Harbors

There are three very popular beaches in this region: Redondo Beach, Hermosa Beach, and Torrance Beach. Three piers are located at Manhattan Beach, Redondo Beach, and Hermosa Beach respectively. These piers draw a large crowds on weekends and in summer time. King Harbor, located in Redondo Beach, docks 1500 recreational boats.

Beneficial Uses

The major beneficial uses identified for this sub-watershed are use of seawater as industrial cooling water for power generation, and various recreational uses including swimming, boating and sport fishing. Marine and wild life habitats also exist in beach and nearshore areas. For example, beaches in the area provide spawning ground for California grunion each year. The shallow nearshore protected areas (Torrance Beach, Redondo Beach) serve as important nurseries for local marine fishes (e.g., juvenile California halibut, juvenile white seabass). Table 28 summarizes the beneficial uses for the South Bay area. (in accordance with the LARWQCB Basin Plan 1994).

Table 28. Beneficial Uses Designated for Waterbodies in the South Bay Area (Modified from Basin Plan, LARWQCB, 1994)

Waterbody	Beneficial Uses											
	IND	NAV	REC1	REC2	COM	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHEL
Manhattan Beach		E	E	E	E	E	E				P	E
Hermosa Beach		E	E	E	E	E	E				E	E
King Harbor		E	E	E	E	E	E		E			
ERedondo Beach		E	E	E	E	E	E		E	E	E	E
Torrance Beach		E	E	E	E	E	E			E	E	E
Nearshore Zone	E	E	E	E	E	E	E	E	E	E	E	E
Offshore Zone	E	E	E	E	E	E	E		E	E	E	E

E: Existing Beneficial Use
P: Potential Beneficial Use
I: Intermittent Beneficial Use

Evidence of Impairments

Enteric viruses were found in Herondo drain in a SMBRP study (SMBRP 1990). Beaches in the area were infrequently closed due to sewage spills in storm water drains.

Data collected over the years have shown that contaminants are accumulated in marine organisms in the nearshore area of the watershed. Levels of lead, copper, and silver in mussel tissue in the 1980s exceeded the elevated data levels (EDL) at the Manhattan Beach, Hermosa Beach and Redondo Beach Mussel Watch sites. In addition, chromium also exceeded EDL at the Manhattan Beach site.

Trash and debris were often found on the beaches and there is continuous need for beach cleanup.

Pollutants of Concern

The major pollutants of concern within the South Bay sub-watershed are debris, pathogens, oil and grease, heavy metals, and PAHs.

Source and Loading

Potential sources of pathogens to storm drains include illegal sewer connection and sewage dumping, sewer leaks, domestic animals, food service business, and outdoor camping. During major sewage spills, the Hyperion Treatment Plant also becomes the source of pathogens to surfzone in this area.

Sources of debris include illegal waste dumping into storm drains, improper solid waste disposal, and construction activities. Sources of pollutants such as heavy metals, PAHs, oil and grease are more likely from transportation-related activities in the area. Advection from the adjacent wastewater treatment facility outfall is also a potential source.

Water Quality Improvement Strategies

The reduction of the pathogen inputs in the near shore water should be the priority for pollution control measures in this region. Storm water source control BMPs should be implemented to reduce the loading of pollutants of concern. Alternatively diversion of problematic storm drains into sewer system could be considered.

PALOS VERDES PENINSULA

Overview of the Region

The Palos Verdes Peninsula sub-watershed extends from the Southern boundary of the City of Torrance to Point Fermin along the coastline (Figure 24). Inland the sub-watershed consists of a 10,977 acre area on the north west slope of the Palos Verdes Peninsula. Municipalities in this area include the Cities of Palos Verdes Estates, Rolling Hills Estates, and Rancho Palos Verdes.

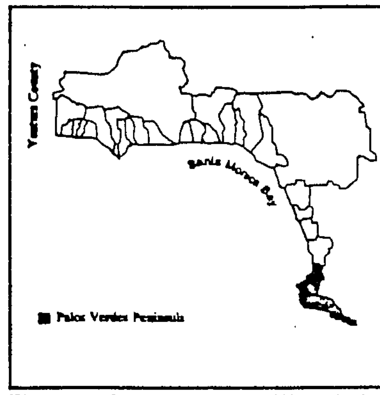


Figure 24, Santa Monica Bay Watershed, Palos Verdes Region

Land Uses

The majority of land uses in this region is low-density residential development with some horse properties. There are some open spaces including beaches, wildlife habitats and natural preserves. Only limited areas within this region are identified for commercial or industrial uses. The land uses include 59.1% residential use, 36.3% vacant/open space, 2.6% commercial/industrial use, and 2.5% public use.

Beaches and Coves

Along the rugged coast there are several coves and bays including Malaga Cove, Bluff Cove, Lunada Bay, and Abalone cove. These coves and bays provide the habitats for a variety of marine life. In addition, areas such as Pt. Vincente, Abalone Cove County Beach, Portuguese Pt. , Inspiration Pt. , Portuguese Bend, Royal Palms Beach, and Whites Point County Beach are popular destinations that attract tourists or residents for recreational purposes.

Beneficial Uses

Beneficial uses identified in this sub-watershed are primarily recreational uses including swimming, diving, boating and sport fishing. The waterbodies in this region also contain important marine and wild life habitats. The rocky tidal and nearshore zones provide unique habitats for filter-feeding shellfish (e.g., clams, oysters,abalone, and mussels). With the biodiversity of tidepools, spawning ground for the California grunions and other marine organisms, the whole coastal area of this region is designed as "significant ecological area" by the County of Los Angeles. Table 29 summarizes the beneficial uses for the Palos Verdes Peninsula area.

Table 29. Beneficial Uses Designated for Waterbodies in the Palos Verdes Peninsula (Modified from Basin Plan, LARWQCB, 1994)

Waterbody	Beneficial Uses											
	IND	NAV	REC1	REC2	COM	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHEL
Point Vincente Beach		E	E	E	E	E	E				P	E
Royal Palm Beach		E	E	E	E	E	E				P	E
White Point Beach		E	E	E	E	E	E				E	E
Nearshore Zone	E	E	E	E	E	E	E	E	E	E	E	E
Offshore Zone	E	E	E	E	E	E	E		E	E	E	E

E: Existing Beneficial Use
P: Potential Beneficial Use
I: Intermittent Beneficial Use

Evidence of Impairments

Elevated concentrations of contaminants such as PCBs. DDT and heavy metals including: lead, copper, chromium, nickel, silver, zinc and mercury were found in the Bay sediments in this region. Highly contaminated discharges through the JWPCP's White Point outfall prior to the 1980's left a contamination zone of several square miles with approximately 100 tons of DDT deposition.

The accumulation and biomagnification of such contaminants have been observed in various species of fish and shellfish. According to a comprehensive seafood contamination study and risk assessment conducted by the State Office of Environmental Health Hazard Assessment (OEHHA) and SMBRP, elevated concentrations of several contaminants (including PCBs and DDTs) in fishes was found, especially from this region. White croaker was found to be the most contaminated fish from this area as well as in other areas of the Bay. Other species found to be relatively contaminated are California corbina, queenfish, surfperches and California scorpionfish.

Land slides in the area have destroyed some coastal habitats. Population declines of some bird species and certain species of shellfish such as black abalone have also been observed in this region.

Pollutants of Concern

Tthe main pollutants of concern in this subwatershed are total suspended solid (TSS) and nutrients. Historical deposits of PCBs and DDT on the Palos Verdes Shelf continues to be of concern because the risk that it poses to marine organisms and individuals who consume seafood from this area.

Sources and Loading

TSS originate primarily from the erosion of hillsides. Nutrients originate from application of fertilizers. Some horse properties may also be sources of excessive nutrient inputs in this region. Historic deposits is the primary source of DDT, PCB, and heavy metals in sediments offshore of the Peninsula.

Water Quality Improvement Strategies

Nonpoint source best management practices (BMPs) should be implemented to reduce the nutrients and TSS inputs to the Bay from this subwatershed. Restoration and protection of intertidal habitats and protection of endangered species (either from over harvesting or water pollution) should continue to be water quality improvement priorities.

U.S. EPA has initiated a superfund investigation for the contaminated area off Palos Verdes shelf. EPA is currently determining the feasibility of various technologies for remediating the contaminated sediments.

OCEAN

This section provides characterization of the nearshore and offshore regions of Santa Monica Bay (from the low-tide line to the outer boundary of the Bay). The areas surrounding the two POTW outfalls are highlighted in this section because more information is available and/or more impacts have been observed.

Overview of the Region

Santa Monica Bay is the submerged portion of the Los Angeles Basin. The sea floor of the Bay is primarily soft bottom which consists of fine to moderately coarse sediments. Far less in acreage than soft bottom, hard bottom areas are generally restricted to the subtidal regions at 20 to 70 feet west of Malibu and around the Palos Verdes Peninsula. There is only one naturally occurring deep rocky area. Called Short Bank, it is located approximately 6 miles offshore of Ballona Creek, between Santa Monica and Redondo Submarine Canyons.

The two largest POTWs in the region have for years discharged treated municipal wastewater directly into the Bay through their ocean outfalls. Over the last 50 years, the City of Los Angeles' Hyperion Treatment Plant has constructed and used three offshore pipes into Santa Monica Bay. A 1-mile offshore pipe was used between 1950 and 1960s at a water depth of 50 ft. to discharge approximately 190 mgd of chlorinated secondary effluent. This pipe is still used occasionally to divert overflows from a 5-mile offshore pipe. The 5-mile offshore pipe has been in full service since 1960 discharging, at a water depth of 190 ft, primary-treated effluent in the early years, and secondary-treated effluent at the present time. Finally, a 7-mile long sludge pipe was constructed to discharge at the head of Santa Monica Canyon to a depth of 320 ft. The pipe became operational in 1957 but use was discontinued in 1987. Since that time, alll sludge has been either transported to a landfill or used to produce a clay-like product.

The Los Angeles County Sanitation Districts' Joint Water Pollution Control Plant (JWPCP) began ocean disposal of wastewater onto the Palos Verdes Shelf in 1937 through a 5-ft diameter pipe; a 6-ft. diameter pipe was added in 1947. These outfalls discharged at water depths of 110 and 160 ft., respectively. Today these two pipes are only used as standbys for hydraulic relief during heavy rains. The current outfalls are a 7.5 ft. diameter pipe completed in 1956 that ends in a Y-shaped multiport diffuser, and a 10 ft. diameter pipe added in 1966 with a dog-legged, multi-port diffuser. Both are discharging 1.9 mile offshore at 200 ft. depth.

In addition to the two ocean POTW outfalls, the Chevron El Segundo Refinery has an outfall pipe 3,500 ft. offshore which discharges primary and secondary-treated wastewater. The pipe was extended from a 300 ft. pipe in 1994.

Chevron also maintains a two-berth offshore tanker mooring facility in 42 to 66 feet of water. This facility transports crude oil and refined products to tankers at a frequency of approximately 20 tankers per month. Except for this tanker movement, most commercial and naval shipping activities occur outside Santa Monica Bay, in the shipping lanes offshore, and in nearby Los Angeles and Long Beach Harbors.

Three power generating stations (the City of Los Angeles Department of Water and Power's Scattergood Plant, and Southern California Edison's El Segundo and Redondo Beach Plants) use seawater from Santa Monica Bay to cool steam condensers. Cool seawater is pumped into the station, circulated through noncontact heat exchangers, and discharged at temperatures above the intake temperature. The locations of offshore intake and discharge at these three power generating stations are described in Table 30. In addition to elevated tempertures, the once-through cooling water may include treated wastewater which is determined to be non-hazardous as defined by state and federal regulations. Chlorine is also injected periodically to control biological growth.

Table 30. Locations of offshore intake and discharge at the three power generating stations in Santa Monica Bay

Station	Intake		Discharge	
	Extension	Depth	Extension	Depth
Scattergood	1,600 ft	18 ft	1,200 ft	15 ft
El Segundo (Units 1 & 2)	2,600 ft	20 ft	1,900 ft	16 ft
El Segundo (Units 3 & 4)	2,600 ft	16 ft	2,100 ft	16 ft
Redondo Beach (Units 5 & 6)	Within King Harbor	20 ft	1,600 ft	25 ft
Redondo Beach (Units 7 & 8)	1,000 ft	20 ft	within the Harbor	20 ft

Although oil and gas reserves are believed to occur on the Santa Monica Bay shelf, oil and gas development in or near Santa Monica Bay has been limited. However, two natural oil seeps are known in Santa Monica Bay. One, with three seepage zones, is located about 2.3 miles off Redondo Beach, near the head of the Redondo Submarine Canyon; the other has two seepage zones and is located about 4.6 miles off Manhattan Beach. The daily flow (to the surface) is estimated to range from 84 to 756 gallons per day, but may be several times this amount during and after local earthquakes.

At present, there is one permitted dumpsite (LA-2) near, but outside of, Santa Monica Bay. The material dumped at this site originates from maintenance and construction dredging in Los Angeles and Long Beach Harbors. It may contribute to contamination of the Bay via advection.

Beneficial Uses

Twelve beneficial uses are identified for nearshore and offshore areas of Santa Monica Bay, including industrial and navigational uses, recreational uses, and biological/ecological uses. Table 31 summarizes the beneficial uses identified in the 1994 LARWQCB Basin Plan.

Table 31. Beneficial uses designated for waterbodies in the Pico-Kenter and adjacent drains (Modified from Basin Plan, LARWQCB, 1994).

Waterbody	Beneficial Uses											
	IND	NAV	REC1	REC2	COM	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHL
Nearshore Zone	E	E	E	E	E	E	E	E	E	E	E	E
Offshore Zone	E	E	E	E	E	E	E		E	E	E	E

E: Existing Beneficial Use
P: Potential Beneficial Use
I: Intermittent Beneficial Use

The Bay provides a variety of habitats for a great diversity of plant and animal species -- at least 5,000 at last count. Soft bottom, the dominant *benthic habitat* in Santa Monica Bay, has few attached plants as residents but has an abundant and diverse invertebrate population. Kelp beds, located in hard bottom areas in the subtidal regions west of Malibu and around the Palos Verdes Peninsula, provide cover and protection and thus habitat for more than 800 species of fishes and invertebrates, some of which are uniquely adapted for life in the beds. Consequently, kelp beds are important for sport fishing, commercial harvesting of abalone and sea urchins, and recreational diving. Short Bank, the only naturally occurring deep rocky area, thrives with populations of several rockfish species and unique invertebrates.

The *pelagic, or open-ocean habitat* is the primary home to fish such as Pacific sardine, northern anchovy, Pacific mackerel, and Pacific bonito; as well as marine mammals such as seals and sea lions. Many species of whales and dolphins are also observed in Bay waters, passing through the Bay during the winter/spring migration. The pelagic habitat (microlayer) is also home to the eggs and larvae of many invertebrates. One of the unique habitats is the *shallow nearshore* protected areas of the Bay (e.g., Torrance Beach, Redondo Beach), which serve as important nurseries for local marine fishes (e.g., juvenile California halibut, juvenile white seabass), and are comparable to the productive estuaries of the East Coast. Finally, the pelagic habitat is utilized for foraging by several endangered bird species such as California brown pelican and California least tern.

Seawater nearshore has been used by three power generation stations in the area to cool steam condensers. Tankers travel in and out of the Bay to transport oil at Chevron's mooring facility. Otherwise, no major shipping lanes cross into the Bay. Commercial fishing has been prohibited in about 62% of the Bay proper to protect local fish populations. Since December 1993, commercial fishing using gill and trammel nets are banned withing three nautical miles of the mainland.

Evidence of Impairments

The marine habitats of Santa Monica Bay have historically experienced severe impacts from human activities. The most obvious impacts are changes observed in benthic habitats as a result of POTW ocean discharges. Overfishing/picking has been linked to depletion and/or decline of many marine species. Finally, natural phenomena such as El Nino have also played an important role in downturn and upturn of habitat conditions in the Bay.

Over the years, discharge of biosolids from the Hyperion Treatment Plant and the JWPCP created a large sludge field around outfalls. These sludge fields, especially those formed before the 1980s, contain high concentrations of toxic chemicals. Between 1950 and 1970s, large amounts of DDT and PCBs from local chemical manufacturers and other industrial facilities were dumped into the ocean through the POTW outfalls. What remains today is a heavily contaminated zone of 15 square miles on the Palos Verdes Shelf (where the DDE concentration exceeds 1 ppm). Besides DDT and PCBs, there has been little evidence that the concentrations of toxic organic compounds such as PAHs, and heavy metals (including cadmium, copper, chromium, nickel, silver, zinc and lead) are at levels deemed harmful to marine organisms. However, the concentrations of these metals are significantly higher than the background levels in most parts of Santa Monica Bay (Table 32). They are also relatively higher than the rest of the Southern California Bight (Table 32).

Table 32. Percent of area in Santa Monica Bay and Southern California Bight above background concentrations (unpublished data from Southern California Bight Pilot Project, 1994)

	SB Bay		SC Bight	
	Detectable	Enriched	Detectable	Enriched
Cadmium	100	72	99.1	31
Chromium	100	88	100	21
Copper	100	56	100	16
Lead	100	79	100	17
Nickel	100	8	99.9	3
Silver	100	85	98.5	20
Zinc	100	64	100	17

DDT in white croaker, dover sole, and brown pelicans are well-known examples of the damage caused by sediment contamination. High concentrations of DDT were found in muscle tissues of these organisms. In the 1970s, biomagnification of DDT in these organisms resulted in fin erosion and other diseases in fish, and eggshell thinning and a subsequent species decline in the population of brown pelicans. Although tissue concentrations of DDT have declined since the 1970s, it has not changed significantly over the last decade and is still above the level (100 ppb wet weight) that triggers fish consumption advisories (Figure 25).

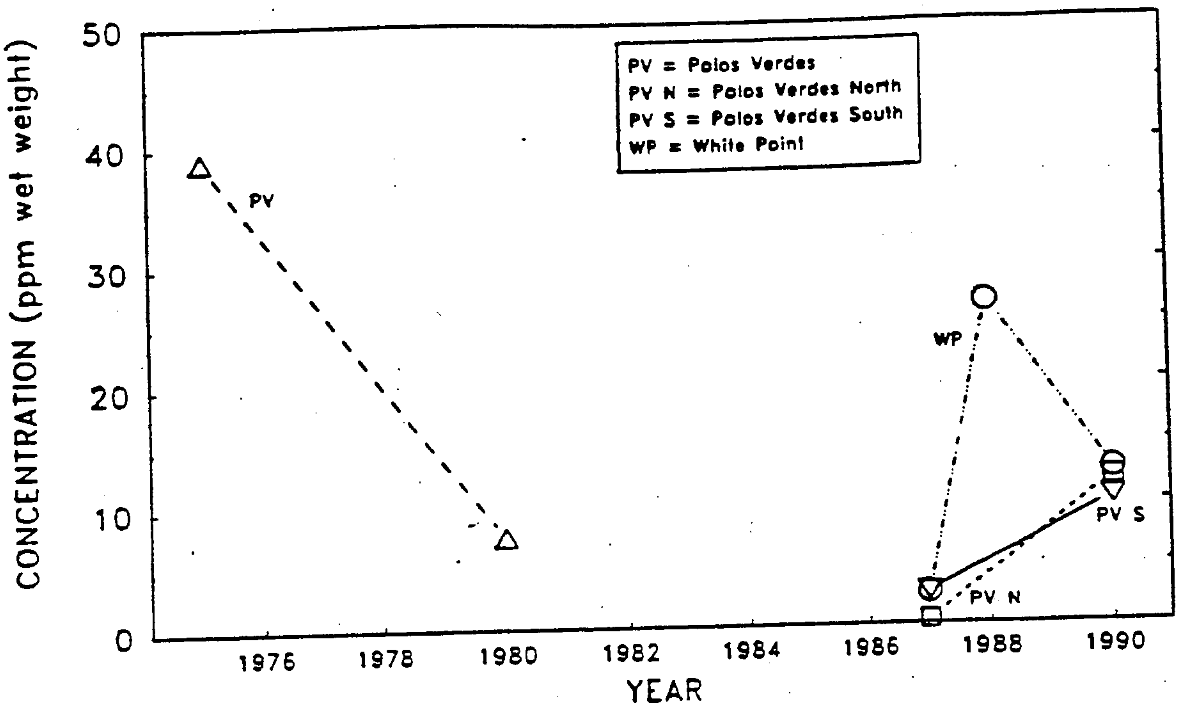


Figure 25. Mean concentration of total DDT (DDT+DDE+DDD) in muscle tissue of white croaker (Genyonemus lineatus) collected from the Palos Verdes Shelf from 1975 to 1990 (data from Young et al. 1978, Schafer et al. 1982, Gossett et al. 1983, Risebrough 1987, CSDLAC 1988, Jarman et al. 1991, Pollock et al. 1991a).

In addition to the risks posed to human and animals by contaminated sediment, the health of benthic community has been affected by discharge of solids from wastewater treatment plants. Assemblages of benthic fauna in sludge fields near the outfalls had relatively lower diversity compared with other areas in the Bay, and were dominated by several opportunistic species. There has been substantial improvement of the benthic community from the condictions of the mid-1980s in the vicinity of the Hyperion 5-mile outfall, for example, since the tremendous reduction of solids discharge through this outfall (Figure 26). Today (1994), the area is moderately impacted within a 2-km radius of the outfall.

Oil spills have historically caused damage to beneficial uses of the Bay. In March 1991, approximately 9,000 gallons of diesel oil were spilled from Chevron's mooring complex. The floating oil eventually reached the nearshore water at Malibu. However, the diesel oil sheen stayed offshore at Malibu, with no detection of oil reaching the shore.

Pollutants of Concern

The pollutants of concern identified for the ocean area of Santa Monica Bay include TSS, DDT, PCB, heavy metals (Pb, Cu, Zn, Ni, Cd, Cr, and Ag), PAHs, and trash and debris (marine debris). Although not identified as a pollutant of concern in this area, pathogen should continue to be monitored in popular nearshore recreational areas. The possibility of oil spills and damage caused by such spills should also be assessed.

Sources and Loadings

The region's two largest POTWs used to contribute significant mass loadings of TSS to areas adjacent to their outfalls. However, the annual mass emissions of TSS have decreased steadily, from 160,000 metric tons (combined) in the early 1980s to approximately 43,000 metric tons in 1994, due to advances in treatment technologies and land disposal of solids. The mass load of TSS estimated for storm water in 1994 was 54,000 metric tons. However, it is unknown to what extent the mass load in storm water should be considered a natural phenomenon.

Since DDT and PCBs were banned in early 1970s, sediment resuspension of historical deposition has been and will continue to be the major loading source for these toxic chemicals, especially on and near the toxic "hot spot" on the Palos Verdes Shelf. Concentration of DDT and PCBs in surface sediments on the PV Shelf has shown a temporal decrease as the heavily contaminated layer produced principally in the 1950s to early 1970s was gradually covered by less contaminated effluent and natural sediment. However, the concentrations of total DDT and p,p'-DDE (the dominant metabolite of DDT and a good proxy for total DDT and total PCBs) in the surface sediments have remained relatively high since late 1980s (Figures 27 and 28). This suggests that a portion of the "historical" DDT (largely as the metabolite p,p'-DDE) is being brought to the sea floor surface by a combination of natural physical, chemical or biological processes that operate within or on the sediment. Currently (1992), the maximum concentration of buried p,p'-DDE exceeds 200 ppm near the outfall pipes (Figure 27). The subareas with surface concentration of p,p'-DDE greater than 1 ppm cover more than 15 square miles (Figure 28). The total mass of DDT remaining is over 100 metric tons and the total mass of PCBs is over 10 metric tons. However, the exact

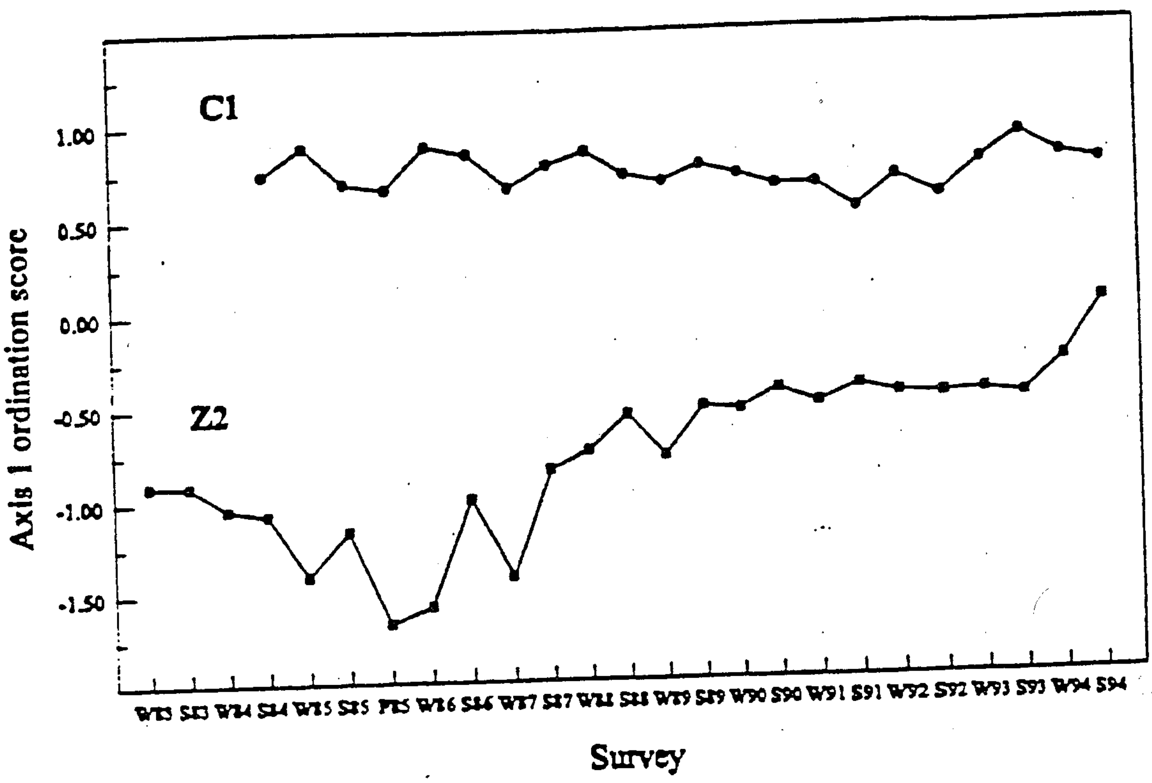
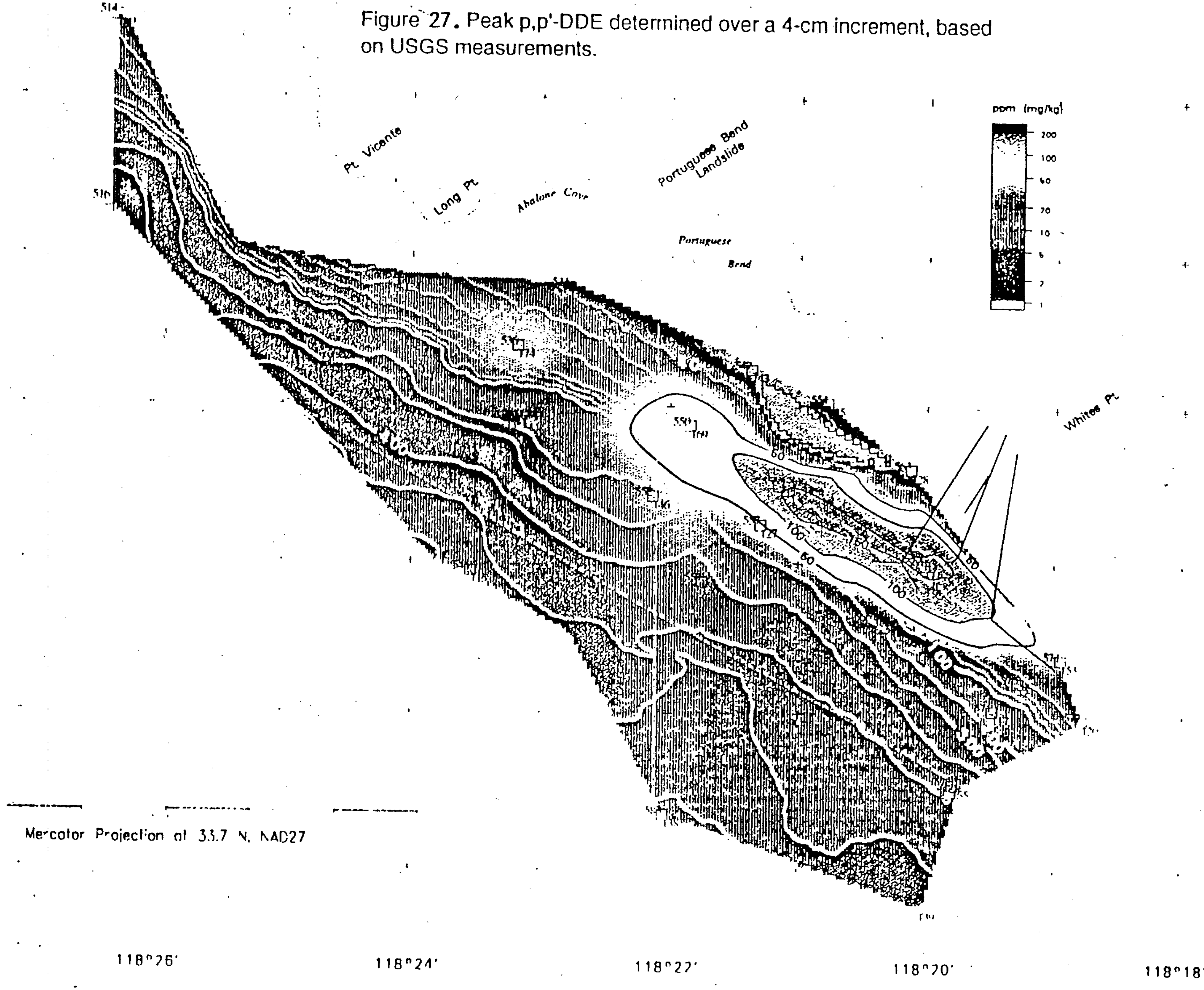


Figure 26. Comparision of benthic community conditions between the stations near the 5-mile outfall (Z2) and the station containing the typical soft-bottom community (C1). Higher axis 1 ordination score indicates increased diversity measured by larger number of species and higher abundance.

Figure 27. Peak p,p'-DDE determined over a 4-cm increment, based on USGS measurements.



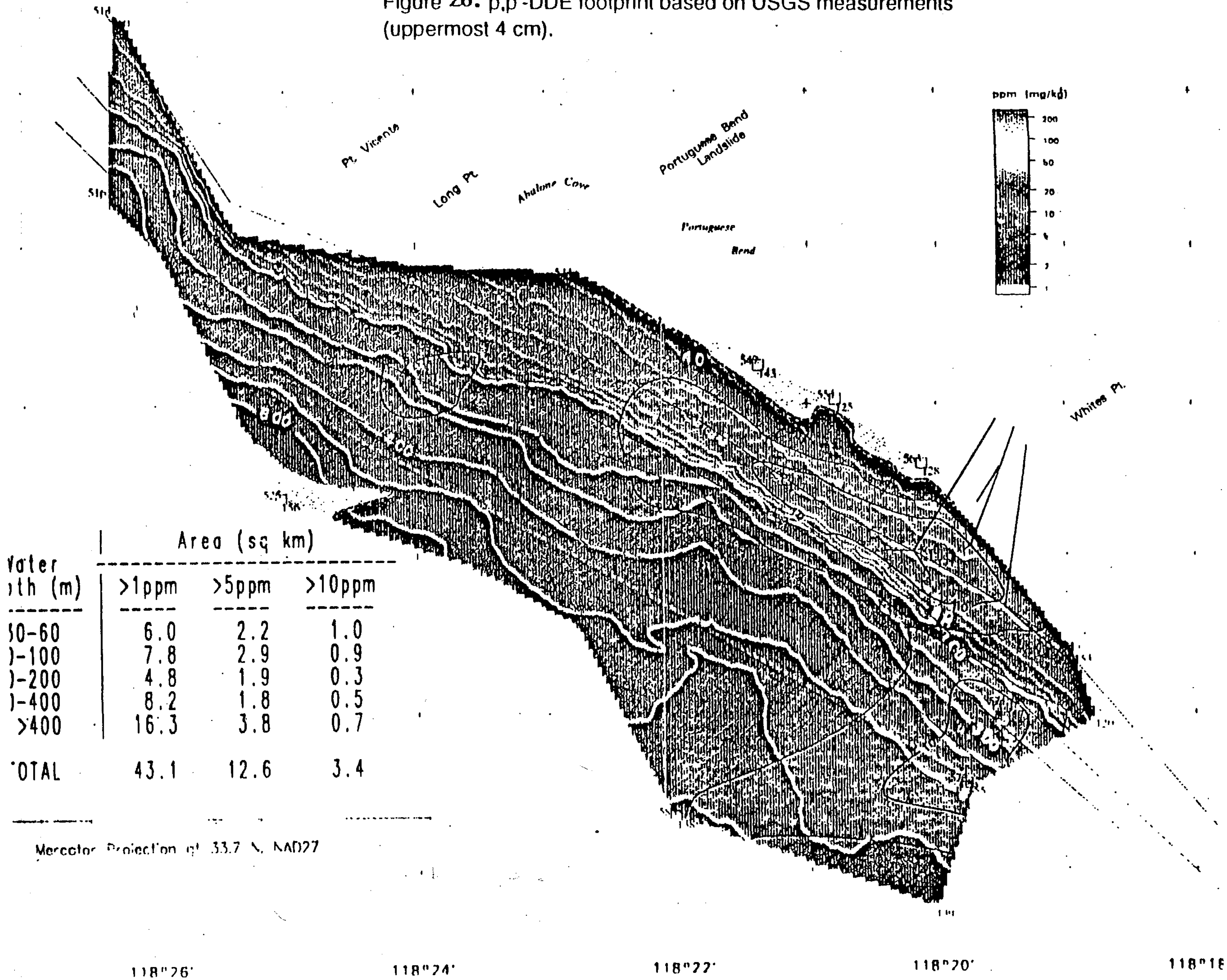


Figure 28. p,p'-DDE footprint based on USGS measurements (uppermost 4 cm).

Vater ɿth (m)	Area (sq km) >1ppm	>5ppm	>10ppm
ʃ0-60	6.0	2.2	1.0
)-100	7.8	2.9	0.9
)-200	4.8	1.9	0.3
)-400	8.2	1.8	0.5
>400	16.3	3.8	0.7
'OTAL	43.1	12.6	3.4

amount of DDT and PCB loading through resuspension and other process is not well understood.

Current loading of DDT and PCBs from effluents of POTWs and storm water is considered minimal (below detection limits most of the time). Atmospheric deposition and advection (from LA Harbor which receives runoff from the Dominguez channel drainage area, where many DDT-contaminated land sites are located) are considered potential sources of DDTs. Additional monitoring and research are needed to assess the extent of their contributions.

As for TSS, the two POTWs used to be the largest source of loading for the six heavy metals of concern. However, mass emissions of most metal constituents have decreased in recent years due to better source control and an upgrading of treatment levels at the two POTWs (Figure 29). As a result, mass emissions of lead and zinc from storm water runoff are probably greater now than those from POTW effluent (Figure 14). In general, sediment concentrations of lead, copper, zinc, and cadmium are higher in areas influenced by POTW effluent, primarily due to historical discharges. There is also evidence of enrichment of these metals in nearshore areas impacted by storm water runoff (Figure 30). If the current trend in metal loading continues, the distribution of metal concentration in sediments may be different in the future. It is uncertain at this time to what extent these metals are bioavailable from those sediment hot spots, or from current point and nonpoint sources of loading.

Sources of PAH loadings are more diverse. POTWs are a significant (but probably not the largest) source of PAHs to the Bay. A larger portion of PAHs likely originates from nonpoint sources such as storm water runoff and atmospheric deposition. A portion of loadings measured in storm water runoff may originate from indirect atmospheric deposition as well. PAHs are also an important component of oil and grease. Advection from the Los Angeles-Long Beach Harbor may be another source of PAHs to the Bay.

Sources of marine debris include storm water runoff, beach litter, boating activities, illegal dumping, and occasionally, discharge from POTWs. Besides fragmentary information collected on beach litter and trash and debris carried by storm runoff, very little is known about the current loading and deposition of trash and debris in Santa Monica Bay.

Water Quality Improvement Strategies

Progressive water quality improvement efforts over the last two decades have brought many significant improvements. There are many signs that the Bay has been recovering and no longer deserves its reputation as one of the most contaminated ocean areas in the nation. However, restoring the Bay remains a daunting task. Two of the major challenges are how to continue the trend of pollutant loading reductions as projected population growth occurs in the region, and how to effectively remediate the historical deposition of DDTs and PCBs in the Bay's sediment.

With information provided by long-term, extensive compliance monitoring conducted by POTWs and industrial dischargers, the general environmental conditions of the Bay are relatively well-understood. However, the information is still limited: far more data have been gathered from soft and hard bottom benthic habitats where the POTW and industrial discharge

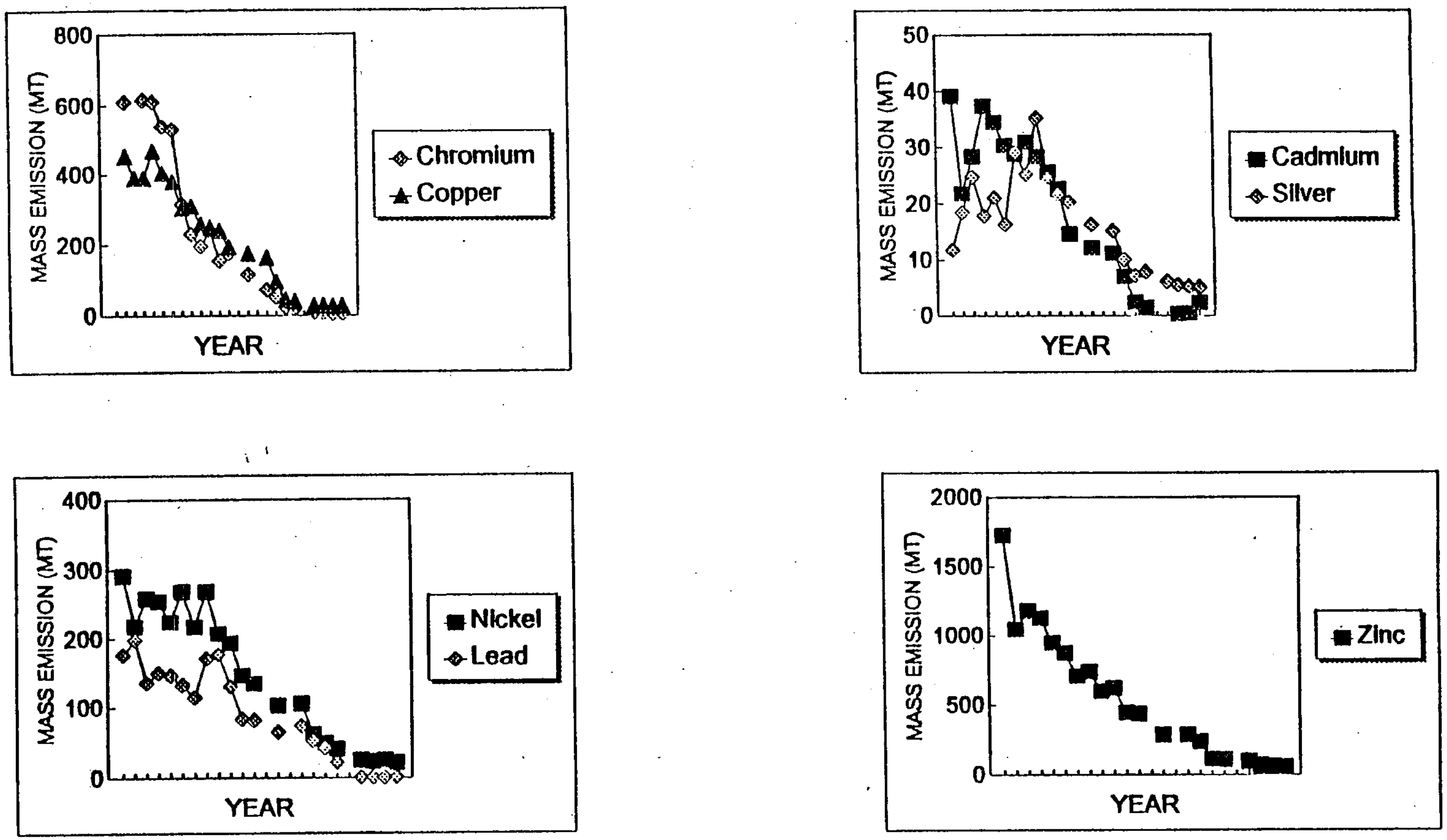


Figure 29. Combined mass emissions of trace metals from the Hyperion and JWPCP between 1971 and 1994.

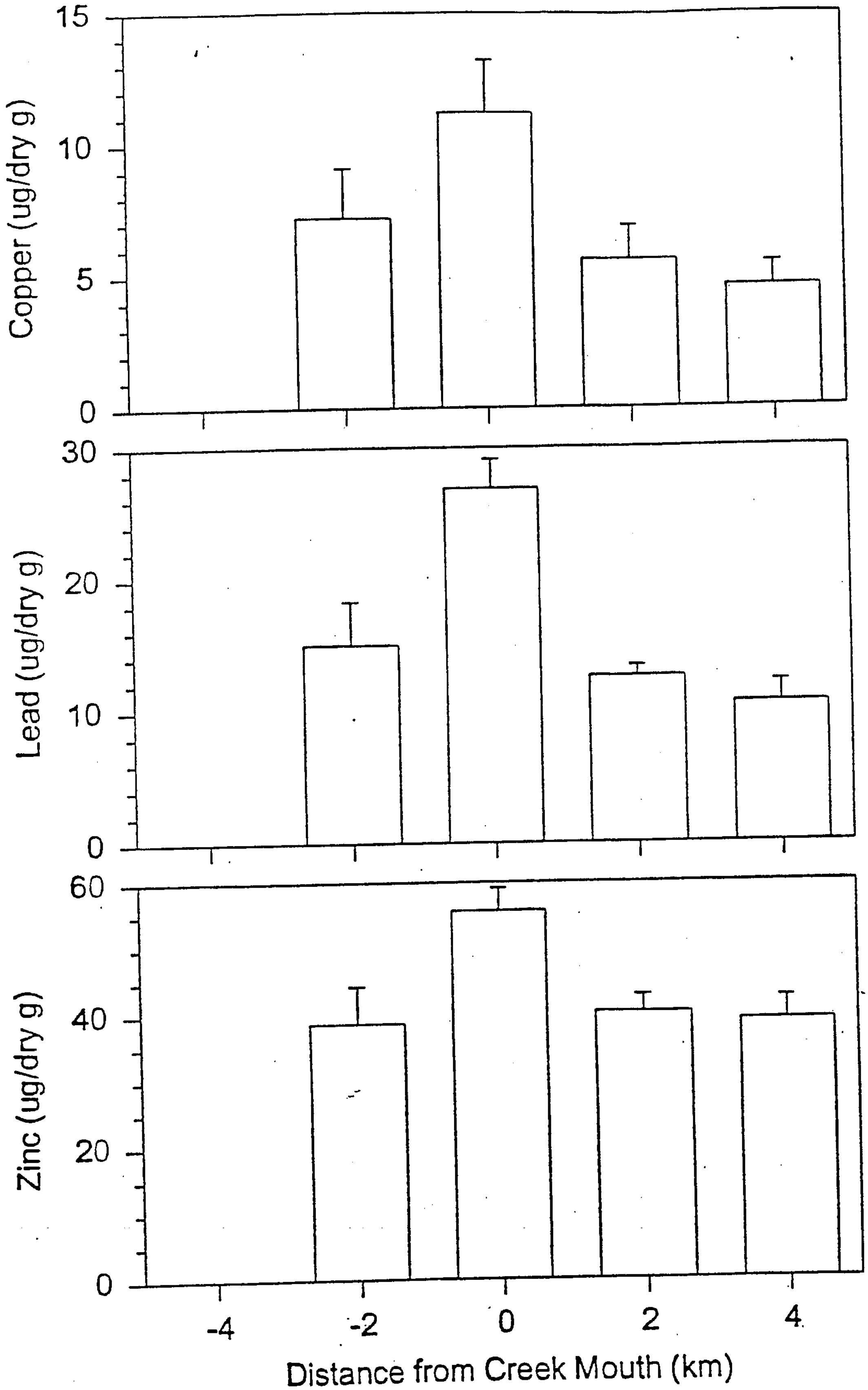


Figure 30. Mean (±95% CI) concentrations of trace metal constituents offshore Ballona Creek during the 1995-96 wet season (Burton Junes, et al. 1996)

outfalls are located, while much less is known about the conditions of habitats (primarily hard bottom and rocky intertidal) in other areas of the Bay where no direct discharges occur. On the other hand, mass loadings of pollutants from sources other than POTWs and direct industrial dischargers cannot be reliably made due to lack of monitoring data.

Aimed at solving the identified problems, marine water quality improvement efforts should focus on the following areas:

- Continue to prevent and reduce mass loading of pollutants that accumulate in the Bay's sediments through completion of the treatment upgrades at POTWs and implementation of storm water runoff BMPs;

- Implement a mass emissions policy for pollutants of concern taht accumulate in marine environment and integrate the approach into NPDES permits.

- Investigate and determine the most effective alternative for remediation of historic DDT/PCS deposits in the Bay's sediments; and

- Develop and implement a comprehensive Bight-wide monitoring program to collect information on the relative loading, distribution, and impacts of pollutants of concern, which are crucial for determining the best pollutant management approach.

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APPENDICES

APPENDIX A

Regional Board Water Quality Assessments

The Clean Water Act (Federal Water Pollution Control Act of 1972 as amended) requires that states submit biennial 305(b) reports that describe the status of the nation's waters. Reports from each state are compiled into the "National Water Quality Inventory Report to Congress." The nine California Regional Water Quality Control Boards prepare individual Water Quality Assessment databases that the State Water Resources Control Board compiles into the 305(b) Report.

The 1996 report, as in previous years, will be used to target areas for water quality control programs and special funding efforts. Waterbodies listed on the 303(d) list (described below), a subset of the 305(b) waterbodies, composed of the region's impaired waterbodies, qualify for certain USEPA funding programs. In addition, the Regional Board staff plans to use the assessment information as a starting point for work with watershed stakeholder groups developing watershed plans.

In most areas, additional data will be needed in order to link impaired waterbodies with sources of pollutants. It appears that most of the pollutants causing impairments are of a nonpoint source nature. The data for the assessment will be used for some Board tasks, as in developing appropriate limits in certain Waste Discharge Requirements. In general, however, Regional Board staff do not intend to use the assessment or the impairments noted on the 303(d) list as a basis for recommending new, advanced, and/or upgraded treatment technologies for POTWs. Rather, these issues will be considered in greater depth by stakeholders within the context of individual watersheds.

In this report, six types of waterbodies are assessed: inland surface waterbodies (including lakes and wetlands), estuaries, nearshore zones, beaches, bays and harbors, and groundwater basins. In this 1996 assessment cycle, most of the major rivers and creeks in the Los Angeles Region are assessed but many small tributaries, small coastal streams, channel island streams are not assessed. Waterbodies that are not frequently sampled (but do have some data) are not assessed in detail at this time due to limited staff resources.

Data

For this report, Regional Board staff supplemented Regional Board ambient water quality data with data from a large number of agencies. These agencies include: United States Geological Survey, Ventura County Flood Control District, Los Angeles County Department of Public Works, City of Thousand Oaks, San BuenaVentura, City of Pasadena, City of Los Angeles, Metropolitan Water District of Southern California, Water Replenishment District of Southern California, Central and West Basin Municipal Water Districts, and local water purveyors. Self-monitoring data was used from major dischargers in the Ventura and Calleguas Creek watersheds (these two areas were Regional Board "target watersheds" in 1995-1996). In general, six years of water quality data (1988 to present) were used for this assessment; for bioaccumulation and sediment toxicity data, up to ten years of data were used. Most of the water column and sediment data were generated from grab samples. In addition to data, information from various articles and reports were used for the assessment.

Data used for this assessment were limited; a compete suite of water quality parameters were not available for measurement against appropriate water quality standards for each waterbody (e.g., all of the Safe Drinking Water Act constituents or USEPA priority pollutants). **Therefore, it is not correct to assume that constituents *not* cited in the assessment are *not* causing water quality problems.**

Assessment methodology

The Regional Board's water quality assessment follows USEPA (1995) guidance as outlined in the *Guidelines for Preparation of the 1996 State Water Quality Assessments (305(b) Reports)*. The guidance specifies that seven broad beneficial use categories be assessed (each use is described below).

Each of these federal beneficial uses is assessed according to the following designations: fully supporting, fully supporting but threatened, partially supporting, not supporting, and not assessed. The fully supporting but threatened category relates to waterbodies where a use is supported but may not be in the future (because of anticipated sources or adverse pollution trends) unless pollution prevention or control action is taken . Waterbodies that are assessed as partially supporting and not supporting are considered "impaired."

When comparing data against standards, the "worst case approach" is used. That is, if one parameter, such as temperature, ammonia, or an organic chemical, indicates impairment for a particular use, the waterbody is designated as impaired for the use affected by this parameter. For example, a waterbody that is not supporting the aquatic life use due to high ammonia concentrations and is partially supporting the use due to elevated metal concentrations would be given an overall classification of "not supporting." Exceptions to this are as follows:

1. For the drinking water use, if constituents (with the exception of volatile organic chemicals) exceed *secondary standards* (i.e., secondary MCLs), and thus are not supporting the use, the overall use is classified as "fully supporting but threatened." If constituents less frequently exceed secondary standards and thus are partially supporting the use, the overall use is classified as "fully supporting."

2. For the contact recreation use, if constituents exceed *secondary drinking water or taste and odor standards* (i.e., pH, turbidity, color, ammonia) and thus are not supporting the use, the overall use is classified as "partially supporting." If these constituents less frequently exceed the secondary standards and thus are partially supporting the use, the overall use is classified as "fully supporting but threatened."

3. For the secondary contact recreation use, if *color or turbidity* are elevated and are not or are partially supporting the use, the overall use is classified as "fully supporting but threatened" because these parameters may be seasonally controlled and further observations are needed to determine the definitive impairment status.

Each watershed in the region is divided into waterbody reaches (a specified segment of river or creek) and lakes or reservoirs that match those designated in the 1994 Water Quality Control Plan (hereafter referred to as Basin Plan). For this report, some individual reaches are combined into longer reaches while other reaches are listed as "not assessed" due to lack of data. Beneficial uses in each reach are assessed and are given a number of miles (or square miles/acreage for lakes and groundwater basins) that are supporting that use (e.g., 3.5 miles of the xx reach fully supports the agriculture use but 2.5 miles only partially support the aquatic life use support). Data collection stations are located within each reach and cover areas no more than 25 miles but usually no more than a few miles. Ocean water data are not assessed in this report other than from seafood consumption advisories and review of literature.

In the assessment, potential sources of contamination are identified to the level that is known at this time. For most waterbodies, data were not sufficient to link specific sources to specific pollutants so this is not done in the 1996 assessment. In future assessments for this region, linkage may be possible. Sources are listed for a waterbody that do not contribute necessarily to the listed "causes" of impairment. These potential sources are listed in order to assist staff performing future assessments; incomplete data for waterbodies precluded making a complete list of causes of impairments at this time (many waterbodies have not been analyzed for metals and/or priority pollutants).

Some beneficial uses, notably agriculture and in some cases aquatic life and contact recreation, are impaired due to constituents that have naturally high concentrations within a watershed or subwatershed. Examples of these constituents include total dissolved solids, chlorides, boron and sulfate that are leached from rock formations. In some lakes and estuaries, coliform counts may be high due to a large population of waterfowl. Not enough information is available at this point to classify any of the affected uses as "unattainable". Under the sources column (or in the sources filed in the database), "natural source" is listed for these waterbodies.

Criteria used for assessing each Surface Water Beneficial Use

The USEPA *Guidelines for Preparation of the 1996 State Water Quality Assessments (305(b) Reports)* provides formulas for conducting assessment of the six 305(b) beneficial uses. These guidelines are described below along with the criteria or standards against which the data is compared. References for standards are included in each section.

Aquatic Life Use Support

Aquatic life use support can be assessed based on ***biological and habitat factors*** or on ***physical and chemical data.***

Biological/habitat assessments

Biological/habitat assessments in this region are limited to reported or observed sediment and erosion impacts and personal communication with federal Fish and Wildlife, state Fish and Game biologists and other local experts. The Regional Board does not have resources at this time to perform detailed field biological/habitat assessments. In addition, the Regional Board used best professional judgement to indicate a few localized habitat-related problems such as areas of high sedimentation, fish kills, barriers to fish migration, and impairment of benthic communities. Information from published documents such as the Santa Monica Bay State of the Watershed Report (1993) was also used.

Physical and chemical water column data

Most of the aquatic life use support assessments in the Los Angeles Region are based on physical and chemical water, as well as sediment, toxicity and bioaccumulation data (described below). Physical and chemical data (water column) includes toxic substances (priority pollutants, chlorine and ammonia) and conventional constituents or stressors (dissolved oxygen, pH, and temperature). Criteria for aquatic life use support are drawn from the region's 1994 Basin Plan and the USEPA Water Quality Criteria for Water (1986 and updates).

Sediment chemistry and toxicity, water column toxicity, benthic community and bioaccumulation data

Lacking USEPA guidelines, the Regional Board developed assessment guidelines for sediment chemistry and toxicity, benthic community and bioaccumulation data for purposes of this water quality assessment report. These general guidelines are described below.

Virtually all of this Region's *sediment toxicity* data has been generated through the Bay Protection & Toxic Cleanup Program (BPTCP). The most commonly used sediment toxicity test is the amphipod (a crustacean) survival test. A review of all the data for the region reveals the number of tests in which less than 60% of the amphipods survive is much less than the number of tests in which at least 60% or more amphipods survive. Consequently, the "significant toxicity" line is drawn at 60% survival. Below that number it's more likely that impairment is occurring (especially since existing benthic data at those sites support this). No statistical analyses or comparison to reference sites were done, however. This is a qualitative analysis utilizing Best Professional Judgement. Also, no conclusions are drawn based solely on one-time toxicity testing.

The region's probable "background" numbers for the more common *sediment chemistry* pollutants were used, based on best professional judgement. These numbers are approximate and based on pollutant levels found in areas removed from direct point sources where impacts do not appear to be occurring in the benthic community. Often background concentrations are due to natural sources or are due to persistent organic chemicals that have not yet biodegraded completely. The background levels were determined by evaluating data from areas that are remote from point sources and significant nonpoint sources. For *bioaccumulation in sediment*, "background" numbers are also utilized.

For *bioaccumulation in aquatic organisms*, data from the State Mussel Watch and Toxic Substances Monitoring program were used. These two state programs provide information about the occurrence of toxic substances in fresh, estuarine, and marine waters through analysis of fish, mussels and other aquatic life (referred to as "tissue" in this report). Ten metals and approximately 45 pesticides and other organic chemicals are analyzed from the tissue of these organisms. Not every sample is analyzed for all metals or organic chemicals. For this 305(b) assessment, Mussel Watch data were used only to evaluate the aquatic life use. Toxic Substances Monitoring data were used to evaluate both the fish consumption and the aquatic life use.

Bioaccumulation data collected from tissue are compared to criteria such as Maximum Tissue Residue Levels (MTRLs), U. S. Food and Drug Administration (FDA) action levels, Median International Standards (MIS), and the National Academy of Sciences (NAS) recommended guidelines for predator protection.

Fish tissue Elevated Data Level (EDL) values are an internal state comparative measure that ranks a given concentration of a particular substance with previous data from the state programs. EDLs are calculated by ranking all of the results for a given chemical from the highest concentration measured down to and including those records where the chemical was not detected. The 85th percentile (EDL85) was chosen as an indication that a chemical is elevated from the median and the 95th percentile (EDL95) was chosen to indicate values that are highly elevated. EDLs were used in the assessment as follows: If no other constituents exceed standards, but if one or two constituents were above the EDL85 or EDL95, then those constituents are listed as "fully supporting but threatened." If three or more constituents are above the EDL then those constituents are listed as "partially supporting".

For *water column toxicity*, the Basin Plan (1994) objective of "no less than 70% in a single test and no less than a mean of 90% in any three consecutive tests" is used.

Combining these different data types (sediment chemistry and toxicity, water column toxicity, and bioaccumulation) into an overall assessment for each waterbody requires balancing quantity of evidence and type of evidence. A weight-of-evidence approach, heavily influenced by best professional judgement, is used to judge aquatic life beneficial use support for coastal areas. Ideally, this approach would utilize field-replicated triad data (benthic, sediment toxicity, and sediment chemistry) collected at the same time at least twice over some fairly short time period and use a reference site for comparison purposes. Instead, what is mostly available are data collected under different programs, measuring different media, at different sites, over a number of years, without good reference sites for statistical purposes.

Primary Contact Recreation Use

One of the goals of the Clean Water Act is that all waterbodies of the nation be "swimmable." Many of the waterbodies of the Los Angeles region are designated as "swimmable" or usable for water-contact recreation. Some of these designated waterbodies, however, are inaccessible due to gates and fences installed for flood control or drinking water reservoir protection purposes. In spite of this, residents, homeless individuals and occasionally children often gain access and use these areas. Therefore, all waterbodies with a water-contact recreation use have been included in this report. On the 303(d) list table, access restrictions are indicated with a footnote.

Assessment of primary contact recreational uses is based on closure data for bathing areas, coliform bacteria data, hazardous substances and aesthetics. Bathing closure data was acquired from the Los Angeles and Ventura County Departments of Health Services. Inland surface waterbody coliform data is not collected on a frequent basis; only fecal coliform standards are used. Dry weather beach data are collected frequently, weekly or daily, in the surfzone by major ocean dischargers and by the Los Angeles County Department of Health Services. Wet weather coliform data is collected during storms. These data are compared to Ocean Plan standards and include both total and fecal coliform.

Hazardous substances in water and bottom sediment are evaluated on a case by case basis. Secondary Drinking water MCLs related to contact recreation are also assessed. Additional factors such as persistent scum, oily films, excessive algae growth, significant trash, and persistent observations of non-natural foam and/or odor were also considered.

Secondary Contact Recreation Use

Most of the waterbodies of the region are designated for non-contact recreational use. This use includes activities where water is not normally ingested. The assessment for this use includes many of the same factors as for primary contact recreation but to a somewhat less stringent standard for coliform bacteria. Chemical and physical data are assessed, and field observations at stations along many of the reaches were tabulated for aesthetic factors such as significant excessive algae growth, significant trash, persistent non-natural foam and odor.

Fish and Shellfish Consumption Use

Fish and shellfish consumption use is assessed based on status of fishing advisories and bioaccumulation data.

Drinking water Use

Assessment of the use of waterbodies in the region for drinking water is based on concentrations of constituents that are regulated for drinking water. In this 305(b) report, ambient or raw (untreated) surface and ground waters are assessed (Note that such water would be treated and disinfected, in accordance with requirements from the State Department of Health Services, prior to distribution for potable use). Contaminants that are generally not source-water related (e.g., corrosion byproducts, lead or copper from distribution system, or TTHMs) are not considered. Assessment of waterbodies for drinking water use differs from other uses in that median rather than mean of data area considered. Assessed under the "federal" drinking water use are two "state" beneficial uses, namely MUN (municipal supply) and GWR (ground water recharge).

Agriculture Use

Water quality standards can vary by area and by crop. Due to a lack of state or federal standards, assessment of water quality for agricultural use is based upon local guidelines.

Criteria used for assessing lakes

Although the general guidelines for surface waters apply to lakes of the region, special consideration is given to urban lakes. For lakes, trophic status is assessed. Assessment is additionally based on, where available, the following factors: total phosphorus, chlorophyll a, secchi transparency, frequency of algal blooms, surface scum and mat, turbidity, reduction of water depth due to sediment, extent of nuisance macrophyte growth, and aesthetics.

Criteria used for assessing Nearshore, Open Bays, Estuaries, and Ocean

Due to lack of staff resources at this time, the assessment of nearshore areas, open bays, estuaries, and ocean areas is mostly limited to the review of published reports. Fish consumption advisories and some bioaccumulation data are also used.

Criteria used for assessing Ground Water

Neither the US EPA nor State Board has established a set methodology for assessing the quality of ground waters. Staff at the USEPA recognize that such assessments are monumental tasks. Accordingly, the USEPA Guidance document suggests that agencies do what is practicable during the 1996 reporting period, focussing on demand for and vulnerability of ground waters.

Regional Board staff did not compile a database on the quality of ground water, due to limited staff resources. Nor did Regional Board staff assess the quality of ground water based upon numbers of known contaminated sites. These data would not accurately reflect water quality, since the data (from monitoring wells) are inherently skewed toward water quality problems. Regional Board staff also rejected the idea of assessing the quality of ground water based upon data from production wells, as such data might inherently overstate water quality.

Assessments of the quality of ground waters in the Los Angeles Region, therefore, are based upon the extent to which beneficial uses have been, or are threatened to be, impaired. Beneficial use categories that were assessed include drinking water and industrial uses, which were lumped together (since industrial users in the Region typically require ground water that meets Title 22 standards. The quality of ground waters to support agricultural uses was not assessed in most areas; exceptions were made in certain areas of Ventura County, where agriculture is an important industry.

In order to determine impairments to ground waters, Regional Board staff gathered information on the extent to which production had been curtailed or cut back due to water quality problems. Ground waters that were pumped in spite of contamination, and then treated at wellhead or blended to meet water quality standards, also were considered impaired. Production data for the assessments were obtained from many sources, including published reports and communications with water purveyors, wholesalers, and watermasters.

The attached Data Summary Tables present the results of the Regional Board's assessments. Ground waters in the "partially supporting" or "not supporting categories" are considered impaired with regard to respective beneficial uses; however, these ground waters are not entered on the 303(d) list, as the scope of the 303(d) list is limited to surface waters.

Ground waters in this assessment are generally considered to be single units with the exception of two basins, the Central Basin and the West Coast Basin that were divided into upper and lower, or production, aquifers. The total area given in square miles is the same for both the upper and lower aquifers, therefore, care needs to be taken to not double count these areas when looking at total square miles of impaired groundwater basins for the Los Angeles Region.

303(d) List

Impaired surface waterbodies included in the 305(b) assessment are also listed on the region's updated 303(d) list. Under Section 303 of the Clean Water Act, each state must submit a list of those waters that do not, or are not expected to, attain water quality standards after application of required technology-based controls. This list, known as the 303(d) list, serves to focus water quality efforts and resources toward the most significant water quality problems.

Waterbodies are placed on the 303(d) list if any uses were either "not" supported or "partially" supported for any beneficial use with the following exceptions:

1. Waterbodies where the sources of elevated constituents are most likely natural (i.e., chlorides, sulfates, and boron in areas where natural levels of these constituents are high).

2. Waterbodies for which color and/or turbidity (aesthetic constituents) for contact and non-contact recreation uses are the only elevated constituents. We did not separate wet weather sampling from dry weather sampling and these two constituents should be sampled on a more frequent and consistent basis in order to be sure that they are problems. They are noted, however, in the general 305(b) assessment.

3. Waterbodies that had only trash and/or algae impairing contact or non-contact recreation. Staff felt that these problems alone, did not make a waterbody eligible for listing given the more serious nature of other water quality problems in the Los Angeles area. Only a few waterbodies were exempted from the 303(d) list for this reason.

The Regional Board will use a variety of approaches to address water quality problems affecting waters on the 303(d) list. In addition to water quality controls in Waste Discharge Requirements, these approaches may include: new watershed-based management efforts, enhanced stormwater programs for releases from municipal, industrial, and construction sources, and estimates of total maximum daily loads (TMDLs) of pollutants. TMDLs are a way to quantify pollutants loads from point and nonpoint sources, and can be used to allocate allowable loads in order to meet water quality standards.

TMDL priorities (high, medium, or low) on the draft 303(d) list, sent to the public in December, 1995, were based on a combination of many factors, including the severity of the problems, the value of the resources, the watershed schedule, staff resources and practicality/availability of solutions. As a result of discussions with staff from dischargers and members of the public, all TMDL priorities were downgraded to low with the exception of the targeted high priority efforts (Los Angeles River- nitrate and Malibu Creek- nutrients) already underway on two watersheds. The priority of all future TMDLs will be discussed and evaluated by stakeholder groups under the Watershed Approach. Staff and stakeholder resources will be key factors in determining the number of TMDLs we can undertake in the future.

As mentioned above, TMDL efforts are already underway for the Los Angeles River and Malibu Creek watersheds. Other efforts to estimate and reduce pollutant loadings will be initiated as the Watershed Initiative in the Los Angeles Region proceeds and as Regional Board resources allow.

APPENDIX B

Santa Monica Bay Watershed - Results of Three Statewide Monitoring Programs

A considerable number of short-term as well as more long-lived monitoring programs have been implemented in the Santa Monica Bay Watershed, particularly over the last twenty years. Sampling efforts center around urban runoff effects in general along the coastline and reservoirs of PCBs and DDT contaminated sediment in the area of the Palos Verdes Shelf. This report summarizes information gathered from three statewide monitoring programs, State Mussel Watch, Bay Protection and Toxic Cleanup, and Toxic Substances Monitoring, which focus on biological measurements. The goals of each program, as they have been used in the Los Angeles Region, are summarized and the programs' results are presented as well as discussed.

I. STATE MUSSEL WATCH PROGRAM

The first sampling in the Los Angeles Region under this program occurred in 1977 along the Palos Verdes coastline and on Santa Catalina Island. Most State Mussel Watch (SMW) sampling involves either collecting resident mussels found on rocks or piers in the sampling area or transplanting in mussels from a "clean" collection area, generally Bodega Bay in northern California. These mussels are placed in mesh sacks and suspended from fixed points, such as piers, several feet below low tide for three to five months before being harvested for analysis. Transplanted mussels are usually deployed in late summer and collected in early winter before heavy winter rains (and possible flooding) which may cause the transplanted mussels to be lost. Freshwater clams may be used in areas of low salinity while in areas of greatly fluctuating salinity where both clam and mussel survival would be doubtful, sediment may be collected for analysis. For the most part, however, sampling concentrates on collecting resident or transplanted mussels. These animals are filter-feeders and accumulate toxicants in their tissues from the surrounding water. These bioaccumulated toxicants are then analyzed for and reported on by the program. California Department of Fish and Game personnel conduct the field and laboratory work under contract with the State Water Resources Control Board (SWRCB).

In the program's earlier years, much of the sampling focus was on establishing trends in open coastline contamination. Thus, many sampling stations were located off points of land or on piers offshore utilizing resident mussels found at those sites. While some of these long-term "trend" stations were maintained, the later years of the program focused on finding "hot spots", especially in the region's harbors and marinas and utilized clean transplanted mussels for that purpose. Thus, SMW sampling sites may be divided loosely into "open coastline" and "enclosed bay" groups and graphical comparisons may be made within and between these groups.

Resident and transplanted mussels are generally of different species and can be expected to bioaccumulate at different rates. Additionally, mussels resident in a contaminated area will often actively depurate (rid themselves of) contaminants from their tissue. Thus contaminant levels in transplanted mussels will often be higher than in resident mussels. Of concern is whether data from these different species and sampling techniques may be combined to address general trends and make broad comparisons. If one accepts there may be some limitation in these data when used in such a manner, it may be useful to do so. Data collected over several years may also be combined for comparison sake, with some limitations noted.

SMW data cited below may be found in SWRCB, 1988, 1995, and 1996 (draft).

<u>Open Coastline Stations - Results</u>

A number of sites were sampled in 1990. All sampling sites are mapped in **Figure 1**. Starting with **Figure 2**, copper and zinc levels are compared among stations from Malibu Pier to Angel's Gate. The latter site is outside of the Santa Monica Bay per se but may be influenced by its contaminants at times due to ocean currents. Zinc shows a fairly minor increase from Malibu to Royal Palms while copper levels are fairly uniform. Levels of zinc off of Royal Palms are somewhat higher than elsewhere but copper is at its lowest here. **Figure 3** shows zinc levels along the coast over a number of years. Here again, a slight increase in zinc levels is evident in the south but there is a great deal of fluctuation between years which may be dependent on whether the mussels were collected before the first winter rains fell.

Figure 4 shows copper levels over several years. Overall, levels are quite low and fluctuate a good deal over time. **Figure 5** depicts lead levels over several years. Lead is somewhat higher at Santa Monica Pier than elsewhere for most years. A major storm drain, Pico-Kenter, is located there which may be a contributing factor.

PCBs, DDT, and chlordane were also tested for at a number of sites along the coast in 1993 (**Figure 6**). PCBs and chlordane were much higher at Santa Monica Pier than elsewhere. Chlordane was highest just south of Santa Monica Bay at Pt. Fermin and all three constituents were lowest at Malibu Pier.

Figure 7 depicts ten years of tissue data at the Royal Palms site which is in the general vicinity of the County Sanitation Districts of Los Angeles County Joint Water Pollution Control Plant outfall. Although fluctuating greatly from year to year, DDT levels have been gradually increasing after years of decreasing during the late 1970's/early 1980's. PCBs are neither as high nor fluctuate as greatly but have tended toward a slight increase over the years. The reversal of the downward trend started in 1988, the year after a number of major storms, one of which broke open the San Pedro Breakwater. Levels of DDT in the outer Los Angeles Harbor also increased after 1988 and there is some evidence that "buried" DDT on the Palos Verdes Shelf was re-exposed at that time. A slackening of levels in recent years may indicate a stabilization of that situation.

Embayments - Results

Much of the SMW embayment sampling took place during the mid to late 1980's. **Figure 8** shows these sampling sites. Marina del Rey sampling sites were located to establish whether a gradient of contamination could be detected within the marina. Several thousand boats are moored there at any one time and the majority are painted with copper-based antifouling bottom paints which have leaching or sloughing properties. Zinc anodes are also used on the majority of boats for its anti-corrosive properties. The Oxford Flood Control Basin drains into Basin E at the back of the marina. Ballona Creek drains a large part of west Los Angeles and its entrance is located near the mouth of the marina.

Figures 9 and 10 show copper and zinc in embayments. It is clear levels of these chemicals are higher in the back basins (where they are higher than in most of Los Angeles Harbor) than toward the entrance of the marina. Levels in mussels transplanted to Ballona Creek are low albeit the exposure time was during dry weather. King Harbor exhibits somewhat more moderate levels. Lead levels follow a similar pattern but fluctuate greatly. Lead levels in Ballona Creek declined sharply from 1985 to 1987 (**Figure 11**). **Figure 12** depicts the results of chlordane analysis. Levels fluctuate greatly from year to year but are in general much higher within the marina than near the entrance, in Ballona Creek, or in King Harbor. **Figures 13 and 14** show a similar pattern for DDT and PCBs.

Figures 15 and 16 focus on Marina del Rey and Ballona Creek sampling in 1988. Levels of copper, lead, zinc, and cadmium, are clearly higher in the back basins of the marina than at the marina entrance or in Ballona Creek. **Figure 17** indicates that PCBs and DDT were also higher toward the back of the marina and the Basin E station near the Oxford Flood Control Basin outlet was usually lower than other Basin stations. However, there is not as dramatic a difference in chlordane levels among the stations although a slight trend consistent with the other constituents is seen.

Coastal Versus Embayment Data

Using all of the available SMW data from 1985 to present, and with the previously noted limitations on combining data from different species of mussels, coastal data collectively may be compared to data for enclosed waters and these comparisons are shown in **Figures 18 through 23**. Almost universally, constituents such as lead, copper, zinc, and chlordane in the enclosed waters of the Santa Monica Bay Watershed are much higher than along the open coast. Also, levels in enclosed waters range much more widely. The exceptions to this trend are DDT and, to a lesser extent, PCBs concentrations. Average DDT levels are higher along the open coast than in enclosed waters although their ranges do overlap considerably. Average PCBs concentrations are overall higher in enclosed waters than along the open coast but the two ranges overlap greatly.

One must be cautious in drawing conclusions from these comparisons, however, since embayment SMW data are concentrated in the mid to late 1980s whereas coastal SMW data encompass a longer (and later) timespan.

II. TOXICS SUBSTANCES MONITORING PROGRAM

The Toxic Substances Monitoring (TSM) Program samples fish throughout the state to analyze for tissue pollutant levels and provide a quick and cost-effective way to identify problem waterbodies and pollutants. These pollutant levels may be compared to two criteria: U.S. Food and Drug Administration (FDA) action levels and National Academy of Sciences (NAS) guidelines. FDA action levels are intended to protect humans from the chronic effects of toxic substances in foods. The levels are based on specific assumptions about the quantities and frequency of food consumed. NAS guidelines were established to protect aquatic life from the effects of toxic substances and also to protect the species that consume contaminated organisms. NAS guidelines apply to "wholebody" which means the whole fish was ground up and analyzed for the pollutants. The guidelines are set this way because animals consuming a fish normally eat the whole fish (including the liver which acts as a filter for toxicants and thus can become heavily contaminated). Humans, on the other hand, normally fillet their catch and eat only the flesh.

California Department of Fish & Game personnel conduct the field and laboratory work under contract with the State Water Resources Control Board.

Table 1 indicates whether NAS guidelines were exceeded at any of the waterbodies sampled. The majority of the samples were fillets which make comparison to wholebody NAS guidelines problematic. A fillet sample exceeding a NAS guideline would not necessarily mean the whole fish, if analyzed that way, would have exceeded the guideline. As can be seen from the table, PCBs and chlordane in Marina del Rey Harbor and Ballona Creek may be considered a potential problem as well as the one FDA exceedance for mercury in Lake Sherwood is noted (SWRCB, 1993 and 1995).

III. BAY PROTECTION AND TOXIC CLEANUP PROGRAM

The Bay Protection and Toxic Cleanup Program (BPTCP) was initiated in 1989 by amendment of the California Water Code. The goals of the program include identification of sediment "hot spots" in the bays and estuaries of the state's coastal waters, prevention of toxic hot spots, and remediation of hot spots.

Identification of hot spots is generally accomplished through collection of effects data such as sediment toxicity and followed with collection of "triad" data: sediment toxicity (including sediment porewater toxicity), sediment chemistry, and benthic infauna. Benthic infauna analyses were only recently added to program sampling on a regular basis and no data is available for the Santa Monica Bay Watershed. Thus, data presented are limited to sediment toxicity and/or sediment chemistry.

Santa Monica Bay Watershed sample sites were located off the Palos Verdes Peninsula (off Palos Verdes Point in 65-75 meters of water), in a back basin of Marina del Rey, near the mouth of Ballona Creek, and in Malibu Lagoon. The latter was sampled only once, for sediment toxicity, while other locations were sampled on at least two occasions for sediment chemistry and sediment toxicity.

Generally, amphipods (a type of crustacean) are used for testing bulk sediment toxicity. However, when testing sediments from estuarine waters, a different species of amphipod is used than that used for testing marine sediments. Porewater is either squeezed or centrifuged from sediment and evaluated for toxicity. Porewater is often tested since this water comes in direct contact with organisms living within the sediment. Urchins are normally used to test for porewater toxicity in marine waters while mussels are used under estuarine conditions. Subsurface water samples were also collected at some locations and abalone were generally used to test for toxicity.

California Department of Fish and Game personnel conduct the field and laboratory work under contract with the State Water Resources Control Board. All data cited below are currently unpublished but have undergone a rigorous QA/QC program check (SWRCB, 1994).

RESULTS

Sediment Chemistry

Polynuclear aromatic hydrocarbons (PAHs) are a large group of chemicals. In order to evaluate concentrations of these chemicals, it is more useful to group them into low molecular weight PAHs (LPAHs) and high molecular weight PAHs (HPAHs). LPAHs are considered indicative of spills or recent releases of oil from natural seeps. HPAHs are indicative of hydrocarbon combustion such as would be found in runoff from streets or in marinas from boating activities. Grouped in that fashion, LPAHs and HPAHs can be roughly indicative of sources.

Figure 24 depicts concentrations of PAHs in the Santa Monica Bay Watershed sediment. Ballona Creek sediment is clearly more contaminated with PAHs than the other sites sampled. Approximately 80-90% of the PAHs found at all of the sampled sites are HPAHs which are indicative of combustion.

Polychlorinated biphenyls (PCBs) may also be evaluated in a similar manner. PCBs are composed of mixtures of various congeners which differ mostly in the number of chlorine atoms they contain. The number of chlorine atoms determines the chemical and physical characteristics of the final PCB mixture. A higher number of chlorine atoms is associated with thicker, heavier PCBs while less chlorine atoms are associated with lighter PCBs. Heavier PCBs are also more injurious to animals and humans.

Graphing the results of sediment analyses by the number of chlorine atoms (the PCB "number") gives a characteristic "fingerprint" which may reveal a common source. Figure 25 shows a graph of PCB congener data for Palos Verdes, Marina del Rey, and Ballona Creek. There is no clear indication of a common fingerprint among the three areas which could mean there is either no common source or no recent common source since PCBs do degrade over time.

Figure 26 shows copper, lead, and zinc levels in the Santa Monica Bay Watershed sediments. Marina del Rey sediments contain the highest levels of these constituents overall with copper levels especially high. Ballona Creek contains very high levels of zinc and lead but not copper. These numbers are to be expected since copper is used extensively in antifouling bottom paints which is likely used on the majority of boats moored in the marina. On the other hand, copper is not as large a component in urban or storm water runoff and thus should not be as high in Ballona Creek. However, lead and zinc are still commonly found in urban runoff although lead occurs in much lower concentrations now since the advent of unleaded gasoline.

Figure 27 depicts concentrations of three commonly found organic chemicals in the sediments of the watershed. It is clear DDT is still at highly elevated levels in sediments off of the Palos Verdes Peninsula, almost certainly due to past discharges and dumping practices. Chlordane is a banned insecticide that was used to control ants and termites. It is highly persistent and is likely still being used in residential areas where individuals may have remaining stocks. This is reflected in the higher levels found in Ballona Creek.

Sediment Toxicity

Malibu Lagoon amphipod survival in bulk sediment was quite good at 87.5%. Sampling took place during heavy rains which may have been a factor in the lower survival of mussels in a subsurface water sample (41.5%) (Table 2). However, mussel development in porewater was good (100% normal development) despite relatively high ammonia levels in the water overlying the sediment.

The average survival of amphipods tested during four sampling runs spanning three years in the Palos Verdes area was 88% (Table 2). Marina del Rey and Ballona Creek were sampled on two occasions over two years. Amphipod survival in Ballona Creek sediment averaged 51% while survival in Marina del Rey sediment averaged 41%. Factors which may complicate evaluation of sediment toxicity are sediment grain size and sediment porewater hydrogen sulfide and ammonia levels. Excessively fine sediment (over 90% total fines) may itself cause physical damage to the test organisms and cause mortality. Also, finer sediments are physically able to retain more contaminants. Hydrogen sulfide and ammonia in the porewater can cause toxicity and these pollutants may be naturally generated or may result from excessive anthropogenic organic loads. Ammonia was high in a number of the samples tested.

A third, less sensitive, polychaete (a marine worm) survival and growth test was also conducted. Survival was greatly reduced in one Ballona Creek sample and growth was greatly inhibited in both Marina del Rey and Ballona Creek samples. However, ammonia levels were also quite high in these samples.

Sediment Quotients

Establishing direct cause and effect between toxicity and a particular pollutant, such as might result from conducting sediment Toxicity Identification Evaluations, is very useful but generally quite expensive. Another more cost-effective way to evaluate sediment contamination has recently been proposed and used in the BPTCP at a limited number of locations elsewhere in the state with some success (Fairey, pers. comm.). The degree of chemical contamination at each site was characterized by summation of ERM quotients. ERM (Effects Range Median) values have been derived for 32 chemicals or chemical classes by examining a large number of previous studies to determine associations between chemical concentrations and adverse biological effects (Long et al., 1995). These studies have indicated that adverse biological effects are probable when chemical concentrations in test sediments are higher than the ERM values. Concentrations of these chemicals measured in samples from the BPTCP sampling efforts were divided by the ERM value to derive the ERM quotient. ERM quotients available at each sampling site were summed and then divided by the total number of chemical constituents being evaluated to give an average ERM quotient. This gives a relative measure of the level of pollution at a site. Average ERM quotients of less than one indicate no ERM values were exceeded. Average ERM levels of more than one indicate one or more ERM values were exceeded.

The results of applying this approach are shown in Table 3. DDT may be greatly elevated at Palos Verdes but it is the only excessively high constituent and by itself does not seem to result in high sediment toxicity. When considered without DDT, the average quotient value is well below 1.0.

On the other hand, both Marina del Rey and Ballona Creek have average quotient values of near or over 1.0, with or without DDT being considered and amphipod survival was low in these sediments during toxicity testing. In Marina del Rey, chlordane, DDT, copper, mercury, and zinc are implicated while in Ballona Creek, chlordane and DDT are of concern. **Tables 4 through 7** present the sediment chemistry data used to derived average ERM quotients.

A number of factors contribute to a substance's bioavailability. A high sediment organic load (usually measured as Total Organic Carbon (TOC)) generally reduces bioavailability and thus reduces toxicity. In effect, the sediment can hold more contaminants without adversely affecting aquatic life. TOC was measured for all samples. High acid volatile sulfide concentrations can reduce the bioavailability of many metals. Other humic material present may also reduce bioavailability. Exceedance of an ERM value is only predicted to have an effect if the physical parameters of the sediment fall within certain designated ranges.

IV. CONCLUSIONS AND SUMMARY

Although not extensively sampled under the BPTCP, to the extent they have been investigated, Marina del Rey Harbor and the mouth of Ballona Creek exhibit both more sediment pollutants and the potential for impacts from those pollutants than either the Palos Verdes Shelf or Malibu Lagoon. The area draining into Marina del Rey Harbor and Ballona Creek is highly urbanized and has been for a number of years whereas the area draining into Malibu Lagoon is largely rural with some denser residential development in the upper watershed. Additionally, Marina del Rey Harbor is home to thousands of recreational boats and to considerable boating activities which contribute pollutants to its waters. The Palos Verdes Shelf site is in deep water and relatively removed from active pollutant sources except for the nearby treatment plant outfall. However, the plant's effluent has improved over the years and does not appear to be influencing levels of toxic pollutants found on the Shelf as much as historic deposits of pollutants in the area.

The SMW Program has found that the open coastline of the Santa Monica Bay Watershed is much cleaner than its enclosed waters, at least for most substances that are both bioaccumulative and bioavailable to mussels either placed in a location or that naturally occur at a site. The pattern of accumulation for DDT and PCBs is different, however, and this may represent the residual effects of past coastal discharges and historic sediment contamination as seemed reflected by the BPTCP data. Fish bioaccumulation problems which might have human health implications (FDA action level exceedances) are relatively minor in those fresh and estuarine waters sampled while the potential for aquatic life impacts (indicated by NAS guideline exceedances) exists in Marina del Rey Harbor and Ballona Creek.

V. LITERATURE CITED

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(TABLES AND FIGURES ARE NOT INCLUDED IN THIS DOCUMENT)

APPENDIX C

Hyperion Treatment Plant

I. BACKGROUND

The City of Los Angeles operates the Hyperion Treatment System, which consists of the Hyperion Treatment Plant on the coast near El Segundo and two upstream plants - the Donald C. Tillman Water Reclamation Plant and the Los Angeles-Glendale Water Reclamation Plant. The Hyperion Treatment Plant is the City's largest project undergoing extensive modernization and upgrade under its wastewater Capital Improvement Program (CIP). The CIP was conceived in early 1986 to improve wastewater collection systems, replace and rehabilitate pumping stations and to achieve full secondary treatment for Hyperion. From 1986 to 1996, about $2 billion has been spent for the CIP. It is one of the largest public works efforts to clean up the environment in the history of the City. Over $300 million worth facilities were completed for Hyperion and about $400 million of projects are in progress. With the scheduled completion of the remaining projects in December 1998, the City will be in compliance with the full secondary requirement mandated by a decree with the U.S. Environmental Protection Agency (EPA) and the California Regional Water Quality Control Board.

The system serves about 4 million people, over 100,000 businesses and industries in a 600 square mile area, and 29 agencies and contract cities. Among the cities with contracted for sewer services are San Fernando, Burbank, Glendale, West Hollywood, Beverly Hills, Santa Monica, Culver City and El Segundo.

II. OCEAN OUTFALL

The Hyperion Treatment System has two existing ocean outfalls that discharge into Santa Monica Bay and one discontinued seven-mile outfall. The five-mile effluent pipeline terminates at a depth of 190 feet (58 meters), and the one-mile emergency pipeline terminates at a depth of 50 feet (15 meters). Both are 12 feet (3.66 meters) diameter concrete pipes. The five-mile pipeline discharges a blend of primary and secondary treated effluent and ends in a Y-shaped diffuser with two 4,000 feet (1,219 meters) legs each having 83 ports.

The one-mile outfall is used for discharge of chlorinated secondary effluent during emergencies caused by extremely high flows, and during scheduled maintenance. During January 1995 through September 1996, there were three emergency and maintenance related discharges into this outfall. Of the three incidents, the release on August 10, 1996, with a volume of 10 million gallons of treated primary/secondary effluent was the highest; however, the effluent met all full secondary permit requirements. The emergency diversion was the result of a two hour power outage in one DWP grid which caused the plant to divert to the one-mile outfall. This could have been prevented or minimized if the plant were prepared for this of emergency. The City has outlined several corrective measures in a hearing on their Amended Consent Decree to prevent diversion to the one-mile outfall in case of power outage or other type of incident.

No clogged effluent ports on the diffuser section of the five-mile outfall were found during inspections conducted in mid-1995. All three outfalls appeared to be structurally sound with no major damage or problems. Schools of rockfish were seen over the structures during the inspections. Results of the receiving water monitoring program showed no apparent impact of the five-mile effluent discharge along the shoreline or inshore (1000 feet offshore) stations.

III. DISCHARGE CAPACITY

Hyperion has a design capacity of 420 mgd of wastewater coming from the central Los Angeles area and excess flow from the San Fernando Valley. During the period from August 1995 through September 1996, Hyperion discharged an average of 360 mgd of treated wastewater into Santa Monica Bay through 5-mile outfall. The effluent was a combination of about 50 percent advanced primary and 50 percent secondary effluent.

III. TREATMENT PROCESS

The construction of new pure oxygen activated sludge facilities included installation of an intermediate pump station that pumps primary treated effluent into the secondary process and a cryogenic oxygen plant that delivers oxygen to the secondary process. Besides replacement and expansion of the secondary treatment facilities, the City upgraded and expanded the primary treatment and auxiliary facilities such that the hydraulic capacity has been increased from 650 to 850 mgd. Additional primary treatment modules are being constructed to bring the hydraulic capacity up to 1.2 billion mgd by year 2000.

The City started operating four of the nine modules planned for pure oxygen activated sludge process in August 1995. Each module has a nominal design capacity of 50 million gallons per day (mgd) that increase the secondary treatment capacity to 200 mgd. The old activated sludge facilities which utilized fine bubble aeration (air rather than pure oxygen) were demolished to create room for construction of the remaining five modules.

IV. SLUDGE DISPOSAL

Biosolids dewatering began in 1986 in preparation for cessation of ocean disposal of biosolids in 1987. An aggressive and continuous state-of-the-art digester tank cleaning program which started in 1988 resulted in improved and upgraded sludge flow and a tripling of gas production at the Hyperion Energy Recovery System (HERS). Additionally, by developing a diversified biosolids management program, the City beneficially reused 100 percent of its biosolids, and significantly reduced the amount spent on recycling its biosolids from $19.2 million in 1988 to $7.6 million in 1995. Also, an improved dewatering performance resulted in a decrease in tonnage of sludge generated from 1991 through 1996.

Sludge Destination	Hyperion Annual Sludge Generation, in wet tons*					
	1991	1992	1993	1994	1995	1996
Percent solids of digested sludge	22	23	24	24.5	25.5	26
Reused on-site	73,000	55,000	47,000	66,000	44,000	37,000
Hauled off-site	358,000	329,000	299,000	285,000	248,000	256,000
Total	431,000	384,000	346,000	351,000	292,000	293,000

* Approximate values

Another positive result has been a decrease in the truck traffic needed to haul the sludge. Only 30 trucks per day were needed in 1996 compared with 42 in 1990, 39 in 1991, 36 in 1992 and 33 in 1993. The increase of on-site reuse in 1994 was due to the start of operation of the steam dryers in early 1994.

The City is considering shutting down a portion of the HERS because of operating costs and hauling more biosolids off-sites. There are five sites where sludge are hauled. Presently, two of the sites are for composting, one for landfill disposal and two for land applications. Up to 85 percent of the sludge hauled off-site is used for land application.

V. STORM WATER

Extensive studies conducted by the City indicate that effluent from five-mile outfall does not encroach on the inshore area of Santa Monica Bay. All indicators point to storm drain runoff as the primary source for shoreline contamination, especially during wet weather. During calendar 1995, a total of 6,383 beach observations in 18 inshore stations were made. The highest number of plastic goods were found at Hermosa Beach Pier and the most numerous rubber goods south of Ballona Creek. During June and August of 1995, beach observations also noted marble size grease particles along the shoreline for several days. It was concluded that the grease particles had escaped from the plant's primary treatment units. Those materials escaping from the plant are due to construction-related activities. Maximum effort in the operation of the plant was then directed towards eliminating the escape of materials from the unit processes.

Some shoreline stations were moved closer to storm drains and sampling at other stations was shifted between the City of Los Angeles and the Los Angeles County Department of Health Services due to logistics. Compared to previous years, the levels of the three indicators (total and fecal coliform and enterococcus bacteria) are considerably higher following the sampling site changes.

VI. PLANT PERFORMANCE

A. Effluent Quality

In 1992 through 1996, the plant continued to perform at levels well below the Consent Decree discharge standards and below all full secondary treatment standards, except for BOD. It met all effluent discharge standards during 1995-96 except for some acute toxicity limitation exceedances. The following table shows that Hyperion continues to maintain high levels of performance in the four conventional parameters:

Parameters (mg/l)	ANNUAL AVERAGE					30-day Interim Limits	30-day Full Secondary Requirement
	1992	1993	1994	1995	1996*		1998
Susp. Solids	37	35	30	34	31	60	30
BOD	82	82	82	84	67	175	30
Oil&Grease	11	11	12	12	10	25	25
Set. Solids (ml/l)	0.2	0.1	<0.1	<0.1	<0.1	1.5	1.0

* September 1995 - September 1996

The trend of improved effluent quality resulted from the implementation of a series of projects under the Capital Improvement Program during which time the plant achieved an average of 93% removal for solids. With the exception of a single exceedance for chronic toxicity in November 1993 and DDT in October 1994, effluent discharged was in complete compliance for every parameter during 1993-1994.

The high level of plant performance has come despite the disruptive impacts of the construction activities in the plant. As mentioned earlier, the important changes within the plant came after the successful completion of the first phase of the new Hyperion Pure Oxygen Activated Sludge Reactors. Also, the plant capacity has been increased which, when coupled with several offsite ancillary projects, has greatly reduced unanticipated discharges of sewage into Ballona Creek that used to plague the system and degrade the health of Santa Monica Bay in the mid 1980's.

B. Receiving Water

Extensive bacteriological monitoring of total and fecal coliform and enterococcus bacteria continue to show that effluent discharged from the five-mile outfall does not encroach into shoreline recreational waters. The dry weather mean bacterial concentrations at shoreline sites and at nearshore stations, both at the surface and near the bottom, are well within the recreational water standards for all three indicators. Occasional exceedances of bacterial counts occur primarily during wet weather. Total coliform levels return to the dry weather level three days after rains stop.

Also, extensive depth profiles of parameters (temperature, pressure, salinity, transmissivity, dissolved oxygen, pH) which are used to detect the presence of the wastewater field around 17 kilometers from the terminus of the five-mile outfall showed no evidence that effluent had moved into nearshore waters. The Hyperion outfall is functioning as a large underwater freshwater river that interacts with natural processes such as upswelling and regional currents causing a seasonal oscillation in salinity. Whether this variation in salinity impacts marine life in the Bay, either positively or deleteriously, is unknown.

County Sanitation Districts of Los Angeles County -Joint Water Pollution Control Plant

I. LOCATION

The County Sanitation Districts of Los Angeles County (CSDLAC) operates the Joint Water Pollution Control Plant (JWPCP), a regional wastewater treatment facility, at 24501 South Figueroa Street in Carson, California. The plant occupies a site area of approximately 310 acres and serves 2.6 million people. The plant is part of a Joint Outfall System (JOS) and treats municipal and industrial wastewater (approximately 85% and 15%, respectively), as well as sludge from five of the CSDLAC's upstream water reclamation plants (Whittier Narrows, San Jose Creek, Pamona, Los Coyotes and Long Beach).

II. TREATMENT

The JWPCP advanced primary treatment facility has a dry weather average flow design capacity of 400 million gallons per day (mgd) with an National Pollution Discharge Elimination System (NPDES) permitted capacity of 385 mgd and a peak design capacity of 540 mgd. Currently, treatment at JWPCP consists of screening, grit removal, advanced primary treatment (polymer addition prior to sedimentation to improve process efficiency) and secondary treatment. Secondary treatment employs a pure oxygen, activated sludge system and is provided for only 200 mgd of wastewater. Secondary effluent is combined with the remaining primary effluent and chlorinated prior to discharge.

III. .DISCHARGE OUTFALLS

The final effluent, which is a blend of advanced primary and secondary effluents, travels 6.5 miles through tunnels to Whites Point where it is discharged through two outfalls : Discharge Serial No. 001 is a 120-inch ocean outfall about 12,000 feet south off the shoreline of Whites Point, San Pedro, and about 200 feet below the ocean surface (about 65 % of the effluent is discharged through this outfall) and No. 002 is a 90-inch ocean outfall 10,400 feet southwesterly off the shoreline of Whites Point, San Pedro, and about 200 feet below the ocean surface (about 35 % of the effluent is discharged through this outfall). A third shorter ocean outfall is used only during heavy rains for hydraulic relief, when necessary, and the fourth (shortest) ocean outfall serves as a standby.

IV. SECONDARY TREATMENT

In 1979 CSDLAC requested a variance from secondary treatment requirements for JWPCP under the provisions of Section 301 (h) of the Clean Water Act. The variance request underwent several modifications, and on December 21, 1990, the U.S. Environmental Protection Agency (USEPA) Region IX issued a final decision to deny CSDLAC's request.

On November 28, 1988, the Board issued Cease and Desist Order No. 88-134 requiring CSDLAC to cease discharge of centrate (liquid left over from the process of dewatering sludge) to the ocean from JWPCP. The Order requires CSDLAC to comply with the interim limits for BOD, suspended solids, oil & grease, settleable solids, turbidity, residual chlorine, total chromium, and phenolic compounds. In January 1989, CSDLAC ceased direct discharge of centrate to the effluent stream. They are also in compliance with the interim limits.

Secondary treatment is regulated in terms of three parameters: BOD_5, suspended solids, and pH (40 CFR 133.102). The concentration requirements for BOD_5, and suspended solids are that the 30-day average shall not exceed 30 mg/l, the seven day average shall not exceed 45 mg/l, and the 30-day average percentage removal of suspended solids shall not be less than 85 percent. The effluent values for pH shall be maintained between 6.0 and 9.0.

V. BIOSOLIDS

All solids produced in the JOS are processed at the JWPCP. Primary and waste activated sludge solids from the five water reclamation plants are returned to the Joint Outfall trunk sewers which convey the solids to the JWPCP, where most solids are captured for further processing. Primary solids, mixed with thickened waste activated sludge, are anaerobically digested. Digesters are maintained at approximately 95°F and their contents are mixed to facilitate efficient digestion. Digested solids are dewatered and the average cake produced is approximately 25 percent solids. The residual solids in this form are called "biosolids" and may be reused in a number of ways.

Digester gas, which contains approximately 65 percent methane and 35 percent carbon dioxide, has multiple applications. It is combusted in a power plant to generate electricity directly and also to produce steam for additional power production and supplemental digester heating. The digester gas also fuels internal combustion engines for pumping various plant flows and fuels boilers to produce process steam for digester heating. Use of digester gas allow the JWPCP to satisfy all of its energy needs. Standby flares are maintained to dispose of surplus gas or all gas when the power plant is out of operation.

The CSDLAC began composting of biosolids at JWPCP on-site in 1972. The JWPCP composting operation continued until 1991 when it was moved offsite; it is now privately operated. Compost products are bagged for consumer use and a portion is marketed in bulk quantities for plant growers.

Subsequently, the CSDLAC entered into contracts with additional private operators of composting facilities and direct land application operations to process and/or reuse CSDLAC's biosolids. The CSDLAC contracted with Tecyc, Inc. for composting services in 1992. The facility is located in the Temescal Canyon area of Riverside County, and the markets for the processed material are bulk agriculture, horticulture, and bagged consumer use.

Direct land application of biosolids to supply crop nutrients and amend soils commenced in 1993 through a contract with Ag Tech Company in Yuma, Arizona (Ag Tech has since opened a site near Bakersfield, California). Sub-surface injection of biosolids is practiced at this site. In 1994 and early 1995, the CSDLAC initiated new contracts at two land application sites: the Yakima Company site near Buttonwillow, California, and the McCarthy Farms site near Corcoran, as well as a short term contract with Biogro Systems for land application near Blythe, California.

Co-disposal of biosolids with municipal solid waste at the Puente Hills Landfill began in 1977 and continues today. The area of the landfill that accepts biosolids is equiped with a plastic liner and a leachate collection system. The close proximity of the landfill to the JWPCP makes the site attractive because of reduced air emissions from hauling and reduced transportation costs.

A summary of the manner in which biosolids are currently managed is presented below. The CSDLAC processes approximately 1,300 wet tons per day (wtpd) of biosolids (9,000 wtpw). This quantity of biosolids is composed of approximately 325 tons per day of residual "dry" solids from the JWPCP treatment process and 975 tons per day of water.

JOS BIOSOLIDS MANAGEMENT

Company	Contract Maximum (wet tons/week)	Treatment Method	Disposal Site
Ag Tech	2000	Land Application	Yuma, AZ
Biogro Systems	2000	Land Application	Blythe, CA
McCarthy Farms	2000	Land Application	Corcoran, CA
Yakima	1000	Land Application	Buttonwillow, CA
Recyc	1000	Compost	Riverside, CA
CSDLAC	*	Co-disposal	Puente Hills Landfill

* All biosolids that are not reused are hauled to the CSDLAC's Puente Hill Landfill for co-disposal.

VI. NPDES PERMIT

On October 28, 1991, the Regional Board renewed the JWPCP NPDES permit (NPDES No. CA0053813) under waste discharge requirements contained in Board Order No. 91-112, reaffirming full secondary treatment requirements pursuant to Section 301 (b) of the Federal Clean Water Act.. The requirements contained in Order No. 91-112 are based on Basin Plan, Ocean Plan, other federal and state plans and policies, current plant performance, and best engineering judgement. Effluent limitations that are based on the California Ocean Plan numerical objectives (carcinogens and pesticides) were calculated using a minimum dilution ratio of 166:1, i.e., parts sea water to one part effluent. CSDLAC cannot comply with the full secondary treatment requirements with its existing treatment system. Until such time when full secondary treatment system is operational, CSDLAC-JWPCP will operate under interim limits. Regional Board Cease and Desist Order No. 88-134 contain these interim limits.

The NPDES permit also contains receiving water limitations. Bacteriological limits are based on water-contact standards and shellfish harvesting standards in the Water Quality Objective Chapter of the California Ocean Plan. CSDLAC have seven shoreline monitoring stations and six nearshore monitoring stations along the Palos Verdes Peninsula for bacteriological monitoring. Monitoring is required daily at the shore stations. Monitoring is required five times a month at three different depths at the near shore stations. CSDLAC has an extensive ocean monitoring program to ensure that the marine environment is not degraded. CSDLAC monitors ocean water conditions around Palos Verdes Peninsula, on the shelf and slope, via monthly hydrographic surveys of temperature, salinity, pH, dissolved oxygen, and light transmission at 34 sites.

VII. CONSENT DECREE

On January 6, 1992, attorneys for USEPA Region 9 and the Regional Board filed a complaint against CSDLAC for civil penalty and injunctive relief for failure to provide full secondary treatment to its discharge from JWPCP and for raw sewage spills from the collection system. Subsequently, Heal the Bay and Natural Resources Defence Council (NRDC) were named plaintiff-intervenors.

The case was settled and the consent decree was entered into federal court records on June 8, 1994. The consent decree requires CSDLAC to complete construction of full secondary treatment facilities at the JWPCP by December 31, 2002. CSDLAC is also required to submit a report 90 days after the entry of the decree and thereafter semiannual reports for its progress in the planning, design, and construction of the full secondary treatment facilities.

In July 1995, CSDLAC adopted the Joint Outfall Systems (JOS) 2010 Master Facilities Plan and Program Environmental Report (DEIR) on compliance with full secondary treatment and service needs up to 2010. The JOS 2010 Master Facilities Plan (2010 Plan) addresses the challenges of providing for long-term wastewater treatment needs, opportunities for reuse of reclaimed wastewater, and effluent and biosolids management needs through 2010. Financing of the 2010 Plan can be divided into two components: upgrade (for the benefit of existing users) and expansion (for the benefit of future users). The respective costs are approximately $309 million and $ 93 million. The upgrade of the JWPCP will be funded by the existing users through the CSDLACs' Service Charge Program (an annual user charge). A $50 million federal grant will be provided for the JWPCP secondary treatment facilities.

Preparation of plans and specification for the reactors and clarifiers for full secondary treatment at JWPCP is currently in progress with completion scheduled by December 31, 1997. A comprehensive investigation to assess the geotechnical suitability of subsurface soils to provide support for the proposed structures and assess the environmental quality of soil and ground water had been completed, and the recommendations are being used in the design plans and specifications.

The Districts has completed the Plan for Beneficial Use of Reclaimed Water as required by the Consent Decree. The plan identifies and evaluates the potential for reuse of reclaimed water produced by the Districts; delineates and examines the impediments to the use of reclaimed water, including technical, regulatory and institutional barriers; and proposed a strategy for avoiding and overcoming the identified impediments. The plan will be revised as progress is attained or new information becomes available.

The Consent Decree requires CSDLAC to spend $1.2 million by July 1, 1998, for household Hazardous Waste Collection (HHW) events over and above the amount spent on the Countywide HHW Collection program by the County of Los Angeles. To date the CSDLAC has not yet spent any of the stipulated amount although the number of collection events has increased since 1994 (27 in 1994, 30 in 1995, and 40 events are planned for 1996). The CSDLAC, however, is continuing to evaluate options to augment the existing HHW program. The CSDLAC is planning four additional collection events in the cities of Glendora, El Segundo, Torrance, and Long Beach in the second half of 1996 to be funded pursuant to the Consent Decree. The CSDLAC will fund a ten minute educational video to be used in conjunction with the HHW Collection Program. The video would be provided to all cities within a collection event's service area for broadcast on the local cable system prior to each collection event..

VIII. PRETREATMENT

Concentrations of the majority of wastewater constituents are highest at the JWPCP for three reasons: the JWPCP receives all primary and secondary solids from the upstream Wastewater Reclamation Plants (WRP); a greater industrial flow is generated within the JWPCP service area; and poorer quality wastewater is generally routed around the WRPs to the JWPCP to allow production of high quality reclaimed water at the WRPs.

The general pretreatment regulations, which were adopted as part of the Clean Water Act (40 CFR Part 403) requires that municipal treatment plants regulate nonresidential waste discharges in public sewers. The CSDLACs' existing pretreatment began in 1972 with the adoption of the Wastewater Ordinance. Local discharge limits for industrial wastewater dischargers were adopted in 1975. These limits specified maximum allowable discharge concentrations for various pollutants to assist in meeting State Ocean Plan standards included in the NPDES permit. Adoption and enforcement of local discharge limits and federal categorical standards are now required parts of the pretreatment program. The CSDLACs' program was approved by the EPA and the RWQCB in March 1985. Local industrial wastewater discharge limits for each particular constituent are calculated to ensure compliance with treatment plant NPDES permit limits and waste discharge requirements, as well as to protect treatment plant operations and biosolids quality. Proposed modifications to the existing local limits were developed in 1990. Due to the CSDLACs' pre-treatment program, the presence of trace metals and priority pollutants in the JOS wastewater is minimal. The majority of metals and priority pollutants in industrial wastewaters are removed during pretreatment prior to discharge to the JOS. Implementation of the pretreatment program has enabled the CSDLAC to meet permit requirements for JOS treatment facilities.

IX. VIOLATIONS

There were a total of five violations of toluene, benzene, and selenium in last three years.