chapter 1

THE OCEAN MONITORING PROGRAM

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INTRODUCTION

The Orange County Sanitation District (District) operates two wastewater treatment facilities in coastal southern California. The District discharges treated wastewater to the Pacific Ocean through a submarine outfall located offshore of Huntington Beach and Newport Beach, California (Figure 1-1). This discharge is regulated by the US Environmental Protection Agency, Region IX (EPA) and the Regional Water Quality Control Board, Region 8 (RWQCB) under the Federal Clean Water Act, the California Ocean Plan, and the RWQCB Basin Plan. Specific discharge and monitoring requirements are contained in a National Pollutant Discharge Elimination System (NPDES) permit issued jointly by the EPA and the RWQCB (Order No. R8-2004-0062, NPDES Permit No. CA0110604) in October 2004. This permit requires the District to conduct an ocean monitoring program (OMP) that documents the effectiveness of the District's source control and wastewater treatment operations in protecting coastal ocean resources and beneficial uses. A new permit (Order No. R8 2012-0035) was issued on June 15th 2012. Since this new permit was issued only two weeks prior to the end of the reporting period and after all of the required field sampling was complete, the old permit's requirements will be used for this report. Also in 2011-12, core monitoring was modified to facilitate an ongoing ZID (zone of initial dilution) investigation near the outfall. Each relevant chapter in this report will describe these core monitoring anomalies.

A large percentage of the local economies in southern California rely on beach use and its associated recreational activities, which are highly dependent upon water quality conditions (Turbow and Jiang 2004, Leeworthy and Wiley 2007). The region's Mediterranean climate and convenient beach access results in high, year-round public use of beaches. For example, although the highest visitation occurs during the summer months, beach usage in Huntington Beach and Newport Beach during the winter months can exceed 450,000 visitors per month. For 2011-12, total beach attendance for Bolsa Chica State Beach, Huntington City Beach, Huntington State Beach, Newport Beach, and Crystal Cove State Beach was 21.2 million (Figure 1-2; City of Huntington Beach 2012, City of Newport Beach 2012, California State Parks, 2012). Total monthly visitations ranged from 5,280,334 in July 2011 to 622,845 visitors in November 2011. The 2011-12 seasonal patterns were identical to previous years. (Figure 1-2).

The District's OMP has contributed substantially to the understanding of water quality and environmental conditions along the beaches and in the area adjacent to the submarine outfall. This monitoring program has generated a large data set that provides a broad understanding of both natural and anthropogenic processes that

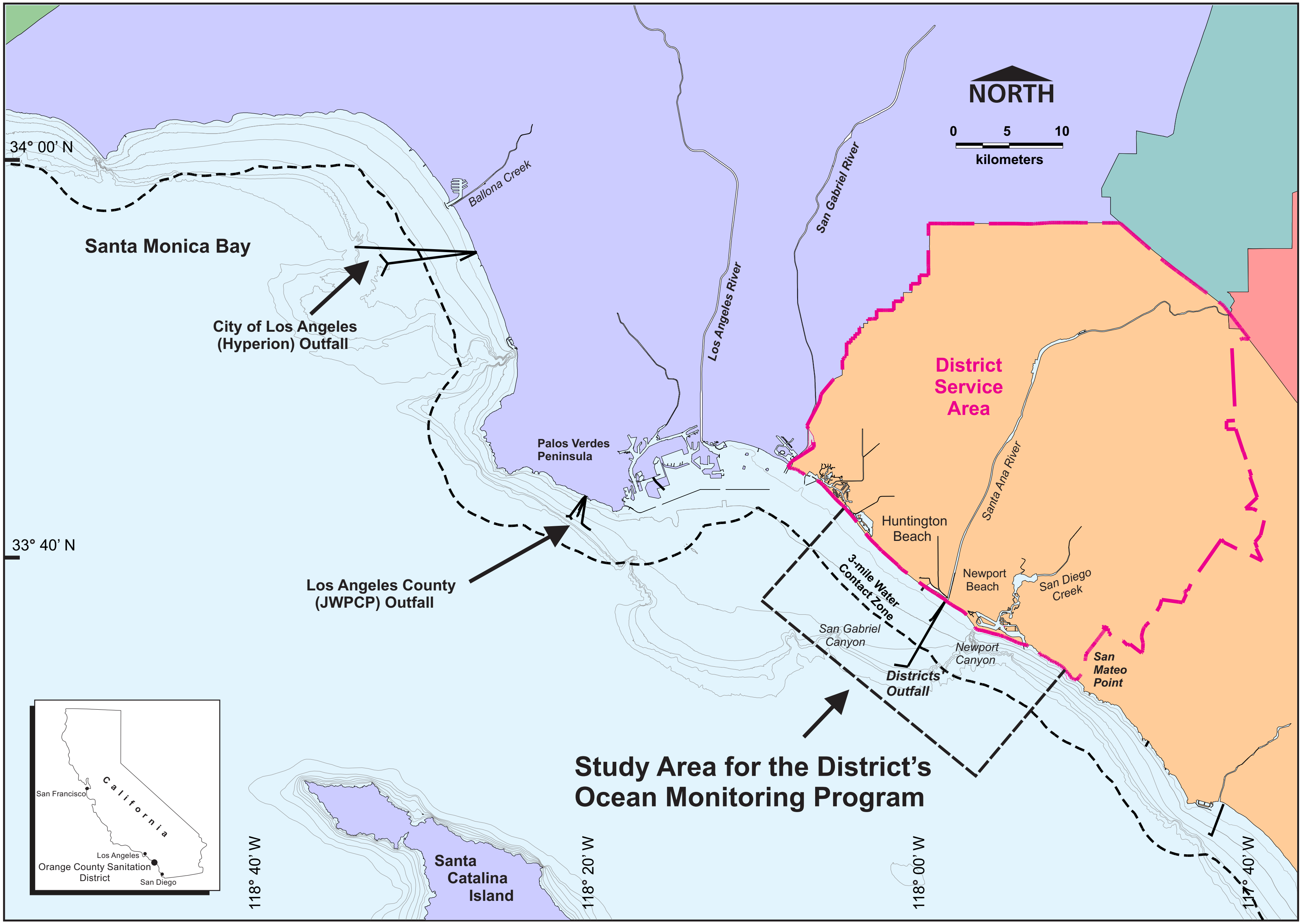

Figure 1-1. **Regional setting for the District's ocean monitoring program.**

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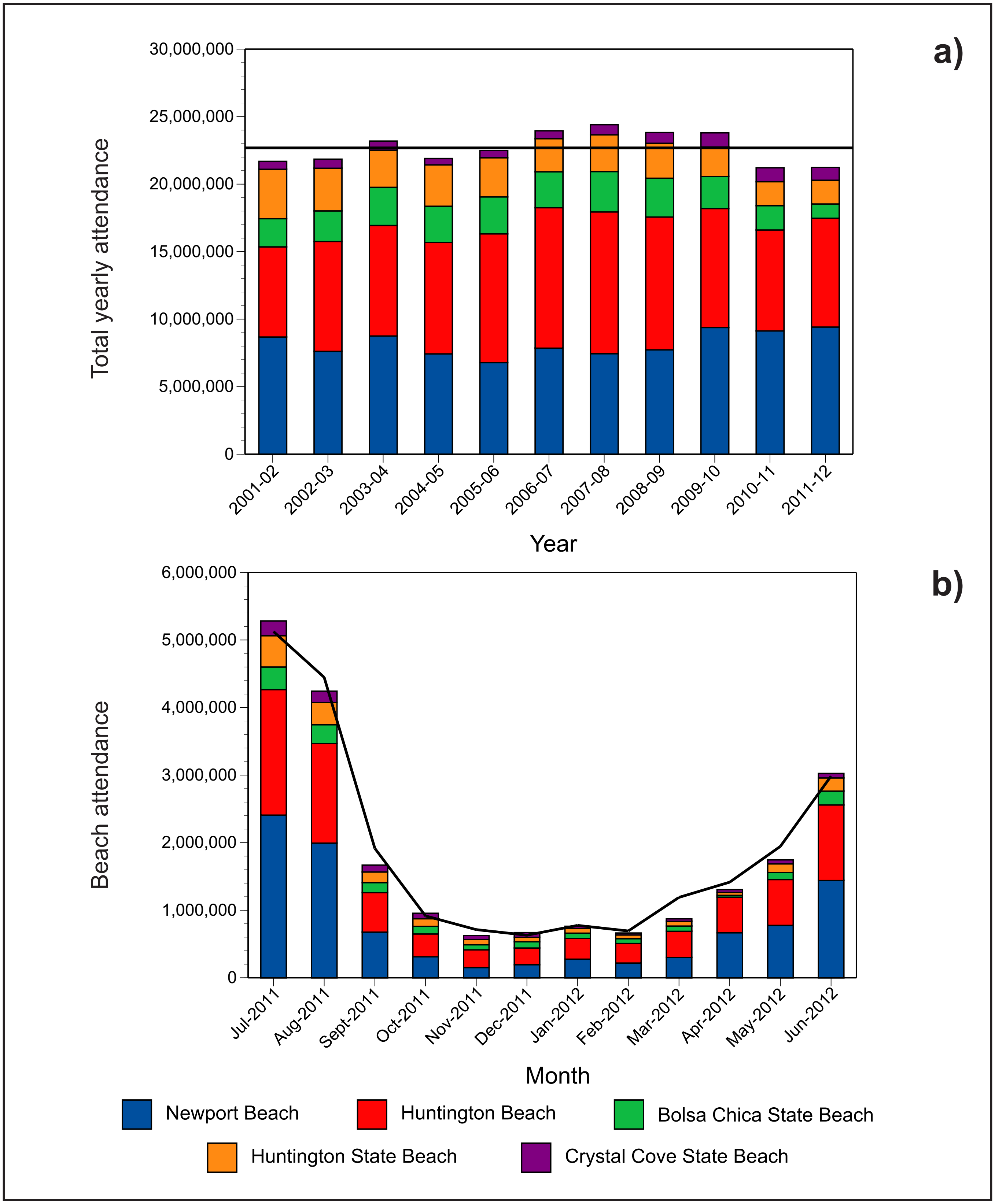

Figure 1-2. **Annual (a) and monthly (b) total beach attendance for Huntington City Beach, Newport Beach, Bolsa Chica State Beach, Huntington State Beach, and Crystal Cove State Beach. Annual values represent beach attendance from July 1 to June 30 for each year. Solid black line on each plot represents historical mean beach attendance (2001–2012).**

Source: City of Huntington Beach – Marine Safety Operations, City of Newport Beach – Fire Department and Lifeguard Operations, State Beaches – California State Parks - Orange Coast District.

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affect coastal oceanography and marine biology. These data are analyzed, interpreted, and reported annually. This report presents OMP data summaries and results from July 2011 through June 2012. This and earlier annual reports are available digitally at the District's web site: (http://www.OCSD.com/about/reports/annual_reports).

DESCRIPTION OF THE DISTRICT'S OPERATIONS

The District's mission is to safely collect, process, recycle, and dispose of treated wastewater while protecting human health and the environment in accordance with federal, state, and local laws and regulations. These objectives are achieved through extensive industrial pre-treatment (source control), a combination of primary, advanced primary, and secondary treatment processes; biosolids management, and water reuse programs. During the 2011-12 program year, the District was completing construction of new full secondary treatment facilities as mandated by a consent decree (U.S. vs. OCSD 2004).

The District's two wastewater treatment plants are located in Fountain Valley (Plant 1) and in Huntington Beach (Plant 2), California. Together, the two plants receive domestic sewage from approximately 80% of the county's 3.1 million residents and industrial wastewater from 692 permitted businesses within the District's service area. The treated wastewater (effluent) is discharged through the ocean outfall, which extends 7.1 km (4.4 miles) from the Huntington Beach shoreline (Figure 1-1). The last 1.8 km (1.1 miles) of the outfall consists of a diffuser with 503 ports that discharge the treated effluent at an approximate depth of 60 meters (197 ft).

Since 1999, influent volumes to the treatment plants have included dry weather urban runoff from diverted storm water pump stations owned by the City of Huntington Beach, the City of Newport Beach, the Irvine Ranch Water District, and from three diverted flood control channels owned by the Public Works Department of Orange County. The collection and treatment of dry-weather runoff is part of a regional effort to reduce beach bacterial pollution associated with chronic dry-weather flows within the watershed. The diverted flows range from 0.5–2.4 million gallons per day (MGD) during dry weather. The number of urban runoff diversions has remained steady for the last 12 years.

In August 2002, the District began disinfecting the treated wastewater using chlorine to reduce fecal indicator bacteria levels. The District's NPDES permit does not specify compliance limits for bacteria in the treatment plants or the final effluent, but it does contain receiving water limits for bacteria that apply within 3 miles of shore. To ensure meeting these limits, the District has operational goals for 30-day geometric mean bacteria levels in the final effluent. These goals (<250,000 MPN/100 mL total coliform, <50,000 MPN/100 mL fecal coliform, and <8,750 MPN/100 mL enterococci) are based on meeting California's single sample bacteria standards after initial dilution (OCSD 2002). Since 2002, the District has consistently met its internal operational goals for all three indicator bacteria, as well as meeting recreational water contact standards after dilution (Figure 1-3).

Historically, approximately 10 MGD of the final effluent had been transferred daily to the Orange County Water District (OCWD) where it received further (tertiary) treatment to remove residual solids. The effluent from this process was then used for public landscape irrigation (e.g., freeways, golf courses) or pumped into a local aquifer to

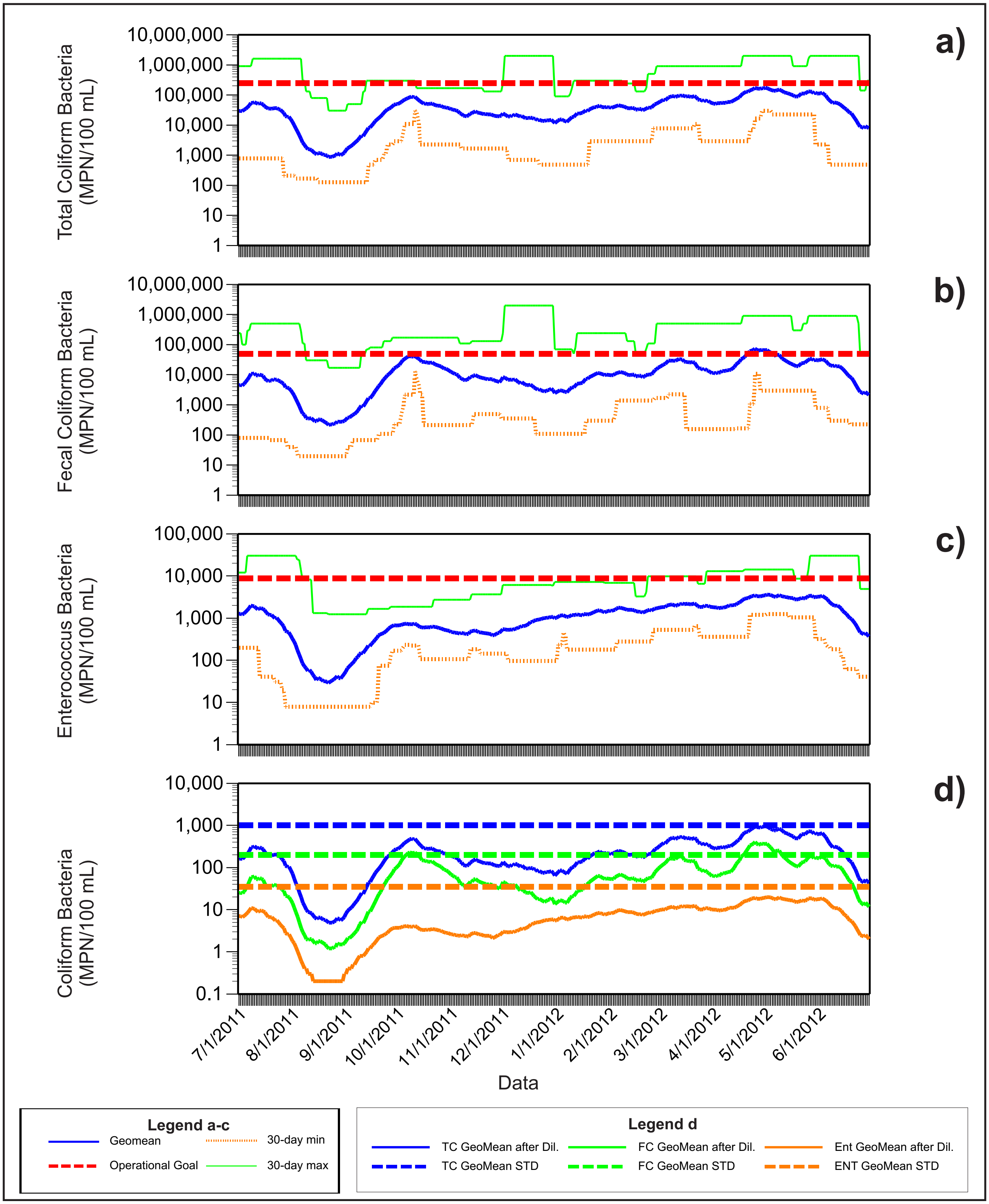

Figure 1-3. **Final effluent 30-day geometric means, running minimums, running maximums, and District operational goals for (a) total coliform bacteria, (b) fecal coliform bacteria, and c) enterococcus bacteria measured in the District's final effluent, and (d) 30-day geometric means after initial dilution of 180:1 with AB411 geomean standards from July 1, 2011 to June 30, 2012.**

provide a saltwater intrusion barrier. In January of 2008, the District began diverting ~35 MGD of secondary effluent to OCWD's Groundwater Replenishment System (GWRS). The diversion was increased to ~69 MGD in July 2008 and in 2011-12 averaged 89 MGD. This flow is treated using microfiltration, reverse osmosis, and ultraviolet disinfection to achieve constituent levels that meet or exceed drinking water standards.

During 2011-12, the two wastewater treatment plants received and processed influent volumes averaging 201 MGD (7.6 X 10^8 liters). This flow included dry-weather urban runoff that averaged 1.2 MGD. After diversions to the GWRS, the District discharged an average of 139 MGD (5.3 x10^8 L/day) of treated wastewater to the ocean, with a 98% reduction in suspended solids concentrations. Peak flows in 2011-12 were 150 MGD in March of 2012. This flow was well below historical highs of up to 550 MGD (2.1x10^9 L/day) that occurred during extreme rainfall periods in the winter of 1996. Seasonal and interannual differences in flow volumes are due to the variability in the amount of rainfall, infiltration of the treatment system by runoff, and reclamation. The 2011-12 total rainfall for Newport Harbor was 6.18 inches, well below the mean of 11.1 inches (Figure 1-4a, b). The dry year had lower than average monthly flows in the Santa Ana River (Figure 1-4c, d).

Over the past three decades, wastewater discharge volumes have generally increased due to continuing population growth within the District's service area (Figure 1-5a). For example, wastewater flows increased through 1990, but decreased in 1991-92 and remained stable through 2007 due to drought conditions and resultant water conservation measures despite the increasing population. Since 2007, average flows have declined due to conservation measures of our member agencies and the startup of the GWRS, which reclaims water that previously would have been discharged to the ocean.

Concentrations and mass emissions for many of the wastewater constituents have declined over the past three decades due to changes in the District's treatment processes and source control programs. For example, final effluent concentrations of total suspended solids (TSS), biological oxygen demand (BOD), and copper (Cu) decreased substantially during the early 1980s (Figure 1-5b, c). TSS discharges have decreased from over 200,000 lbs/day in the late 1970s and early 1980s to approximately 8,800 lbs/day today. After four full years of GWRS operation and increased secondary treatment, mass emissions rates of TSS and BOD have decreased 77% and 78%, respectively. Decreases in copper mass emissions are due to Source Control efforts, lower flow, and increased secondary treatment.

REGULATORY SETTING FOR THE OCEAN MONITORING PROGRAM

The District's permit includes a requirement to monitor influent, effluent, and the receiving water. Effluent flows, constituent concentrations, and toxicity are monitored to determine compliance with permit limits and to provide data for interpreting changes to receiving water conditions. Wastewater impacts to coastal receiving waters are evaluated by the District's OMP based on three integrated components: Core monitoring, Strategic Process Studies (SPS), and Regional monitoring. Each of the program elements is summarized below. In addition, the District conducts other special studies not required under the existing NPDES permit. Information obtained from each of these program components is used to further the understanding of the coastal ocean environment and improve interpretations of

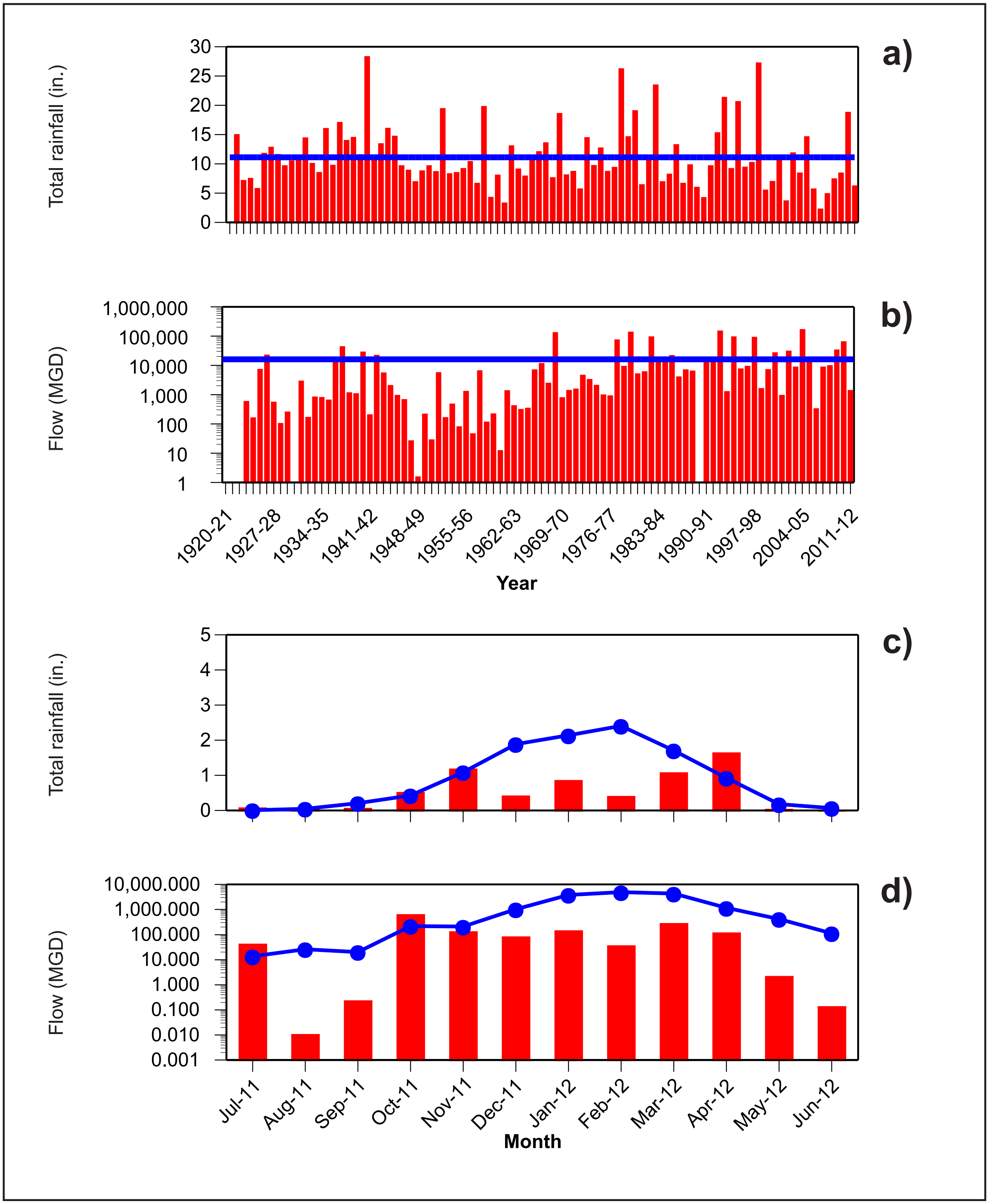

Figure 1-4. **Annual and monthly rainfall and flow, respectively, for Newport Harbor, California (a, c) and the Santa Ana River (b, d). Rainfall totals are per water year (October 1 to September 30). Solid line on each plot represents historical annual or monthly means (1923–2012).**

Source: SAR: USGS, 5th Street Station, Santa Ana, http://waterdata.usgs.gov/usa/nwis/uv?site_no=11078000**)**
Rainfall: OC Public Works; Station 88/Newport Beach

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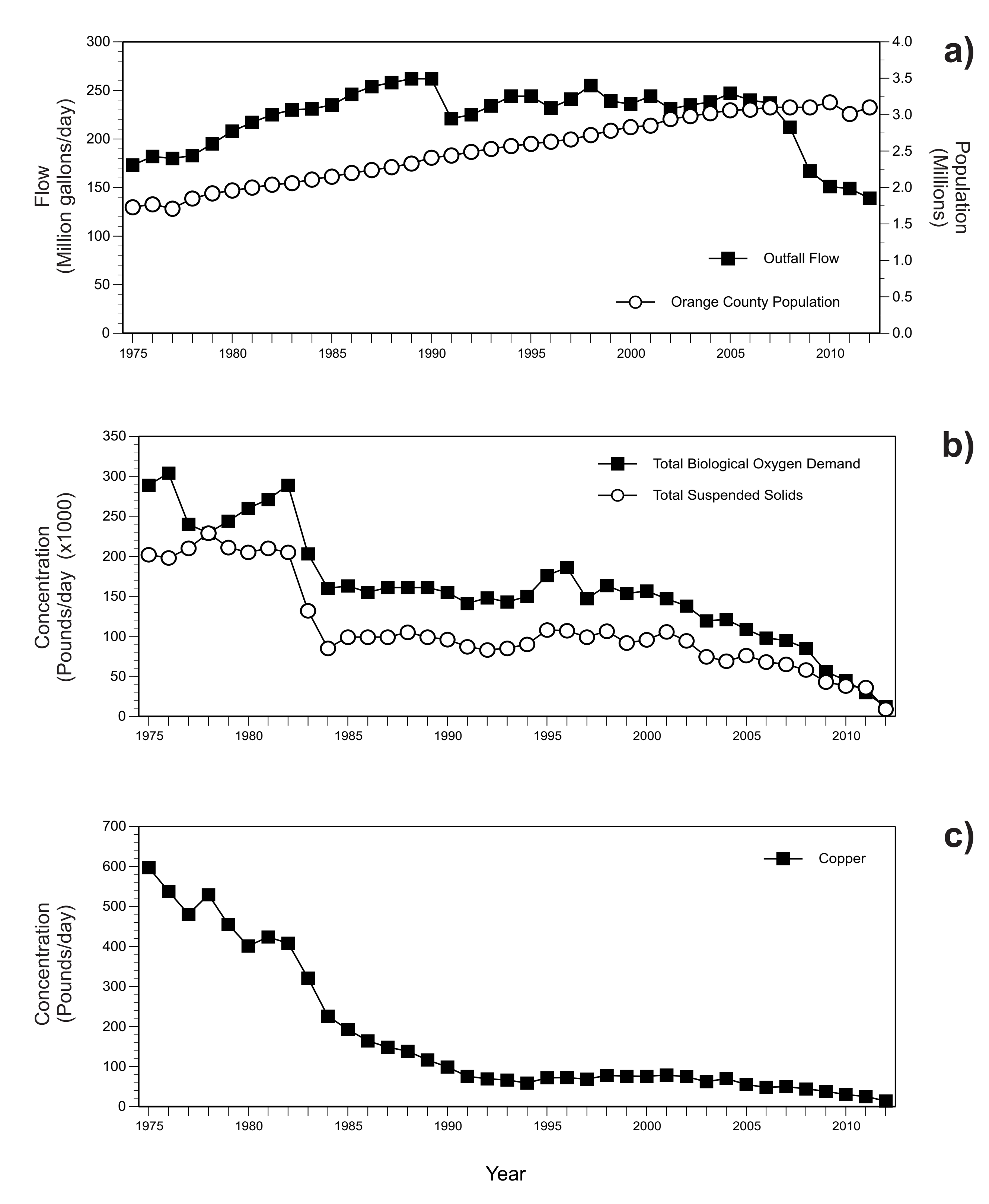

Figure 1-5. **Trends in the District's effluent flow compared to Orange County population and selected effluent constituent discharges to the San Pedro shelf region, 1975–2012.**

Orange County Sanitation District, California.

the monitoring data. Results from these studies are incorporated into relevant chapters as appropriate and summarized in Chapter 7.

The Core monitoring program was designed to measure compliance with permit conditions and trend analysis. Four major components comprise the program; (1) coastal oceanography and water quality, (2) sediment quality, (3) benthic infaunal community health, and (4) fish and macroinvertebrate community health, which includes fish tissue contaminant concentrations.

The District conducts SPS to provide information about relevant coastal processes that are not addressed by Core monitoring. These studies have included evaluating the physical and chemical processes that affect the fate and transport of the discharged wastewater, tracking wastewater particles, contributing to the development of ocean circulation models, and studying biological effects of the discharged effluent. Presently, the District is continuing studies of currents on the San Pedro Shelf, effects of endocrine disrupting compounds (EDC) on fish, and a sediment mapping study. The objective of the sediment mapping study is to determine the optimal sediment station array to accurately generate a map of the District's outfall footprint for sediment geochemistry analytes and benthic infaunal community metrics. This year the District conducted several studies to examine recent changes in infaunal assemblages near the outfall, collectively referred to as the ZID (zone of initial dilution) Investigation (see Chapters 5 and 7).

Since 1994, the District has participated in four regional monitoring studies of environmental conditions within the Southern California Bight (SCB): 1994 Southern California Bight Pilot Project (SCBPP), Bight'98, Bight'03, and Bight'08. The District has played a considerable role in all aspects of these regional projects, including program design, sampling, quality assurance, data analysis, and report writing. Results from these efforts provide information that is used by individual dischargers, resource managers, and the public to improve region-wide understanding of environmental conditions and to provide a regional perspective for comparisons with data collected from individual point sources. Program documents, data, and reports on all of these studies can be found at the Southern California Coastal Water Research Project's website (http://sccwrp.org).

Other collaborative projects organized by SCCWRP include "Characteristics of Effluents from Large Municipal Wastewater Treatment Facilities" and "Comparison of Mass Emissions among Sources in the Southern California Bight." Both of these projects involve historical data mining from large POTWs, including the District. Finally, the District has been working with the Southern California Coastal Ocean Observing System (SCCOOS) to provide real time meteorological data and historical and ongoing offshore and beach water quality data to further understand region-wide oceanographic trends (http://www.sccoos.org).

The District also partners with sister agencies in conducting studies not mandated by the NPDES permit. Recent examples include research done on source tracking of bacterial contamination and evaluating rapid tests for fecal indicator bacteria.

ENVIRONMENTAL SETTING

The District's ocean monitoring area is located on the southern portion of the San Pedro Shelf, adjacent to one of the most highly urbanized areas in the United States. The shelf is composed primarily of soft sediments (sands with silts and clays) and inhabited by biological communities typical of these environments. The seafloor increases in depth gradually from the shoreline to a depth of approximately 80 meters, after which the depth increases rapidly as it slopes down to the open basin. The outfall diffuser lies at about 60 meters depth on the shelf between the Newport and San Gabriel submarine canyons, which are located southeast and northwest, respectively (Figure 1-1). The 120-inch outfall represents one of the largest artificial reefs in this coastal region and supports communities typical of hard substrates that would not otherwise be found in the monitoring area (OCSD 2000; CDFG 1989). Together with the District's standby emergency 78-inch outfall, approximately 102,193 m^2 ($1.1x10^6$ ft^2) of seafloor was converted from a flat, sandy habitat into a raised, hard-bottom substrate

Conditions within the District's monitoring area are affected by large regional-scale current patterns that influence the water characteristics and the direction of water flow along the Orange County coastline. The predominant low-frequency current flows in the monitoring area are alongshore (i.e., either upcoast or downcoast) with minor across-shelf (i.e., toward the beach) transport (OCSD 1997, 1998, 2004, 2011; SAIC 2001, 2009, 2011). The specific direction of the flows varies with depth and is subject to reversals over time periods of days to weeks (see SAIC 2011 for detailed long-term analyses).

Other natural oceanographic processes, such as upwelling and eddies, also influence the characteristics of receiving waters on the San Pedro Shelf. Tidal flows, currents, and internal waves mix and transport the District's wastewater discharge with coastal waters and resuspended sediments. Tidal currents in the study region are relatively weak compared to lower frequency currents, which are responsible for transporting material over long distances (OCSD 2001, 2004). Combined, these processes contribute to the variability of seawater movement observed within the monitoring area.

Episodic storms, drought, and climatic cycles influence environmental conditions and biological communities within the monitoring area. For example, storm water runoff has a large influence on sediment movement in the region (Brownlie and Taylor 1981; Warrick and Millikan 2003). Major storms contribute large amounts of contaminants to the ocean and can generate waves capable of extensive shoreline erosion, sediment resuspension, and movement of sediments along the coast as well as offshore. Some of the greatest effects are produced by wet weather cycles, periods of drought, and periodic oceanographic events, such as El Niño and La Niña conditions. An understanding of the effects of the inputs from rivers and watersheds, particularly non-point source runoff, is important for evaluating trends in the environmental quality of coastal areas. River flows, together with urban storm water runoff, represent significant, episodic sources of freshwater, sediments, suspended particles, nutrients, bacteria and other contaminants to the coastal area (Hood 1993; Grant et al. 2001; Warwick, et al. 2007), although recent studies indicate that the spatial impact of these effects may be limited (Ahn, et al. 2005; Reifel, et al 2009). While many of the materials supplied to coastal waters by rivers are essential to natural biogeochemical cycles, either an excess or a deficit may have important environmental consequences.

Nearshore coastal waters of the SCB receive municipal and industrial wastes from a variety of human-related sources, such as wastewater discharges, dredged material disposal, oil and gas activities, boat/vessel discharges, urban and agricultural runoff, and atmospheric fallout. The majority of these sources are located between Point Dume and San Mateo Point (Figure 1-1). Discharges from the Los Angeles, San Gabriel, and Santa Ana Rivers are also responsible for substantial inputs of contaminants to the SCB (SCCWRP 1992; Schafer and Gossett 1988; Schiff and Tiefenthaler 2001).

A goal of the District's OMP is to provide an understanding of the effects of its wastewater discharge on beneficial uses of the ocean. However, distinguishing the effects of the District's discharge from those of natural and other human influences is difficult, especially as the "signal" (impact) from the outfall has been greatly reduced since the 1970's (Figure 1-5). The complexities of the environmental setting and related difficulties in assigning a cause or source to a pollution event are the reasons for OCSD's extensive monitoring program. Interpretations of data related to the receiving waters monitoring program relative to other potential sources of impact are included in the chapters that follow.

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