chapter 1

THE OCEAN MONITORING PROGRAM

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INTRODUCTION

The Orange County Sanitation District (District) operates two wastewater treatment facilities located in Fountain Valley (Plant 1) and in Huntington Beach (Plant 2), 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 (EPA), Region IX and the Regional Water Quality Control Board (RWQCB), Region 8 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. R8-2012-0035, NPDES Permit No. CA0110604) on June 15, 2012.

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 (OCSD 2013).

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 and secondary treatment processes, biosolids management, and water reuse programs. During the 2013-14 program year, the District completed construction and testing of new full secondary treatment facilities and brought these facilities on-line full-time.

Together, the District's two wastewater treatment plants receive domestic sewage from approximately 80% of the county's 3.1 million residents and industrial wastewater from 704 permitted businesses within the District's service area. Under normal operations, the treated wastewater (effluent) is discharged through a 305-cm (120-in) diameter 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).

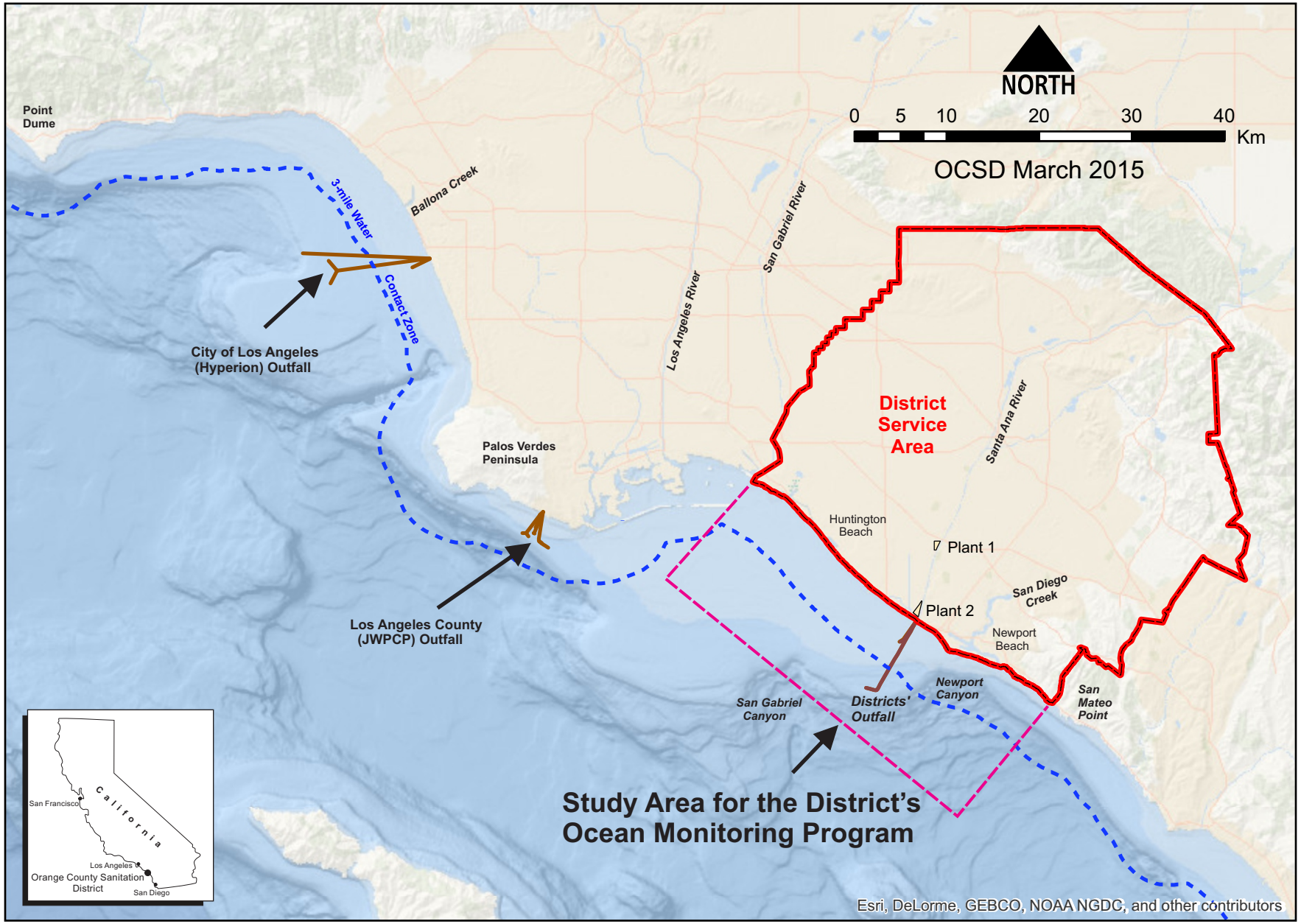

Figure 1-1. Regional setting for the District's ocean monitoring program.

Orange County Sanitation District, California.

Since 1999, influent volumes to the treatment plants have included dry-weather urban runoff from 19 diverted urban runoff locations. These include storm water pump stations owned by the City of Huntington Beach (11), the City of Newport Beach (1), the Irvine Ranch Water District (2), the Irvine Company (1), and from four 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. For 2013-14, the diverted monthly average daily discharge flows ranged from 0.59–1.72 million gallons per day (MGD) during dry weather and the total average daily discharge was 1.18 MGD. There are five new urban runoff diversions proposed for the coming year. One new diversion is almost complete and is expected to go on-line in 2015. A second diversion is in the design stage and is expected to be completed in 2016.

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 provide a saltwater intrusion barrier. In January 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 2013-14 averaged 84 MGD. This flow is treated using microfiltration, reverse osmosis, and ultraviolet disinfection to achieve constituent levels that meet or exceed drinking water standards.

During 2013-14, the two wastewater treatment plants received and processed influent volumes averaging 198 MGD (7.6×10^8 L/day). Treatment plant processes achieved a 98% reduction in suspended solids concentrations. After diversions to the GWRS, the District discharged an average of 137 MGD (5.2×10^8 L/day) of treated wastewater to the ocean. Peak flow in 2013-14 was 176 MGD in June of 2014, which was well below the historical peak flow of 550 MGD (2.1×10^9 L/day) that occurred during an extreme rainfall event 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 2013-14 total rainfall for Newport Harbor was 4.14 inches (Orange County, CA Department of Public Works 2014), well below the mean of 11.1 inches. As a result, monthly and annual flows in the Santa Ana River were below average (Figure 1-2).

Over the past three decades, wastewater discharge volumes have generally increased due to continuing population growth within the District's service area (Figure 1-2). 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 (Figure 1-2).

REGULATORY SETTING FOR THE OCEAN MONITORING PROGRAM

The District's permit includes requirements 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

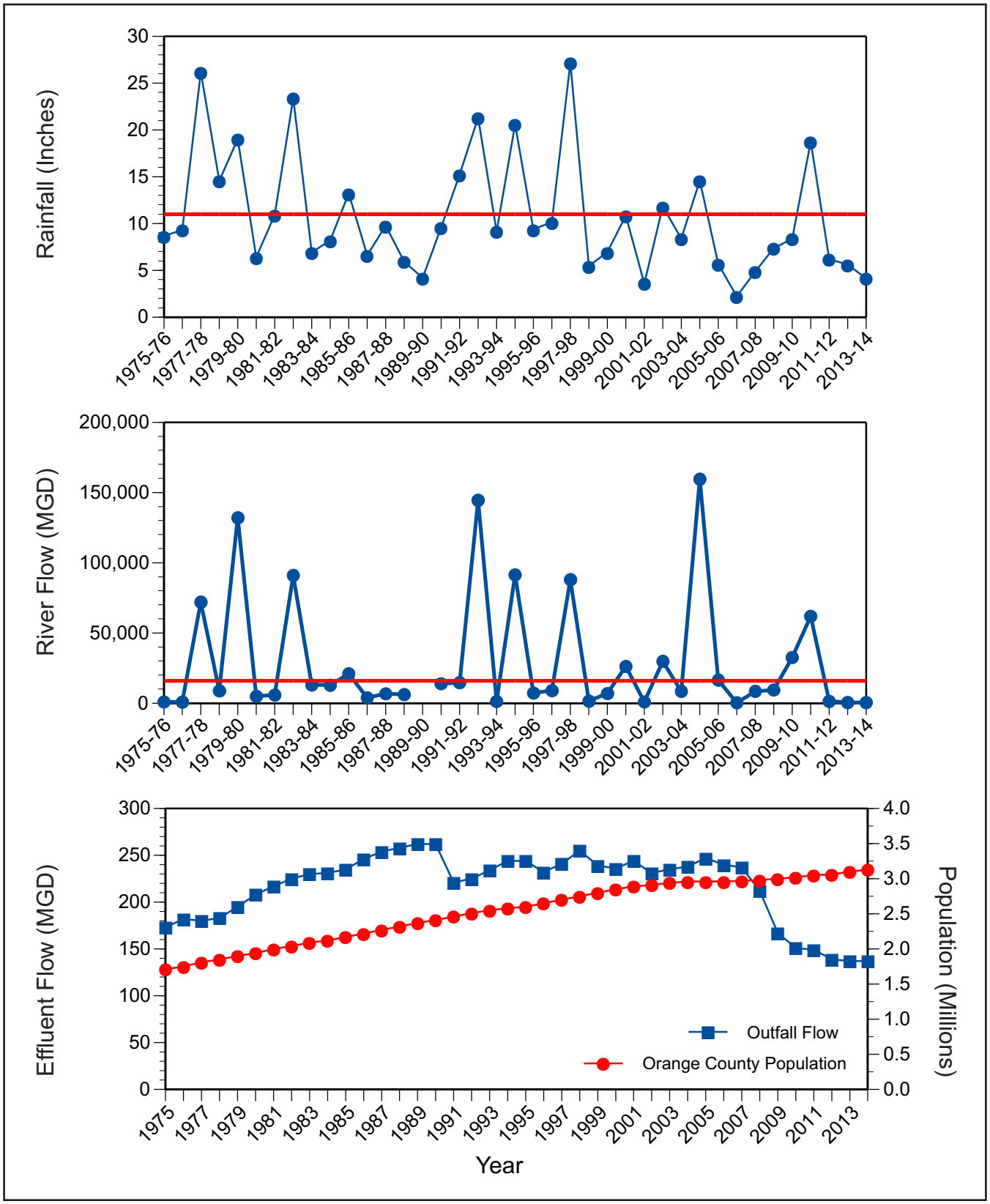

Figure 1-2. Annual rainfall for Newport Harbor, California (top), river flow for the Santa Ana River (middle), and final effluent flow and population for OCSD and Orange County, respectively (bottom). Solid line on the top and middle plots represents historical annual means (1923–2013).

Source: **Santa Ana River: USGS, 5th Street Station, Santa Ana,** http://waterdata.usgs.gov/usa/nwis/uv?site_no=11078000
Rainfall: OC Public Works; Station 88/Newport Beach, http://ocwatersheds.com/rainrecords/rainfalldata/historic_data/rainfall_data
OC Population: California Dept. of Finance, http://www.dof.ca.gov/research/demographic/reports/estimates/

ocean monitoring program (OMP) based on three inter-related components: Core monitoring, Strategic Process Studies (SPS), and Regional monitoring. 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 the monitoring data. These program elements are summarized below.

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) demersal fish and epibenthic macroinvertebrate community health, which include 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 the effects of endocrine disrupting compounds (EDCs) on fish. The District recently concluded a series of studies conducted over three years to examine recent changes in infaunal assemblages near the outfall, collectively referred to as the ZID (zone of initial dilution) Investigation. Presently, the District is continuing a sediment mapping study 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.

Since 1994, the District has participated in five regional monitoring studies of environmental conditions within the Southern California Bight (SCB): 1994 Southern California Bight Pilot Project (SCBPP), Bight'98, Bight'03, Bight'08, and Bight'13. 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. Final reports for the Bight'13 program will be available in December 2017. Program documents, data, and reports on the previous studies can be found at the Southern California Coastal Water Research Project's website (http://sccwrp.org). Since 1997, the District has also participated in the Central Bight Water Quality Program, a collaborative regional water quality effort of the City of Oxnard, the City of Los Angeles, Los Angeles County Sanitation District, the District, and the City of San Diego.

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 publicly owned treatment works (POTWs), including the District. Finally, the District has been working with the Southern California Coastal Ocean Observing System (SCCOOS; http://www.sccoos.org) to provide real time meteorological data and historical and ongoing offshore and beach water quality data to further understand region-wide oceanographic trends. The District also partnered with SCCWRP, other local POTWs, and the OC Health Care Agency in conducting studies not mandated by the

NPDES permit. Recent examples include continuing research on source tracking of bacterial contamination and evaluating rapid tests for fecal indicator bacteria.

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 affect coastal oceanography and marine biology.

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 (CDFG 1989, OCSD 2000). Together with the District's standby emergency 78-inch outfall, approximately 102,193 m^2 (1.1×10^6 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 (Schafer and Gossett 1988, SCCWRP 1992, 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 1970s (Figure 1-2). The complexities of the environmental setting and related difficulties in assigning a cause or source to a pollution event are the reasons for the District's extensive monitoring program.

This report[1] presents OMP compliance determinations for data collected from July 2013 through June 2014. Compliance determinations were made by comparing OMP findings to the criteria specified in the District's NPDES permit. Any related special studies or regional monitoring efforts are also documented.

[1] This and earlier annual reports are available digitally at the District's web site: http://www.OCSD.com/about/reports/annual_reports.

REFERENCES

Ahn, J.H., S.B. Grant, C.Q. Surbeck, P.M. Digiacomo, N.P. Nezlin, and S. Jiang. 2005. Coastal water quality impact of stormwater runoff from an urban watershed in Southern California. *Environ. Sci. Technol.* 39:5940–5953.

Brownlie, W.D. and B.D. Taylor. 1981. Sediment management for Southern California mountains, coastal plains, and shorelines. Part C. Coastal Sediment Delivery by Major Rivers in Southern California. Environmental Quality Laboratory Report 17C. California Institute of Technology, Pasadena, CA.

CDFG (California Department of Fish and Game). 1989. A Guide to Artificial Reefs in Southern California. Robert D. Lewis and Kimberly K. McGee.

Grant, S.B., B.F. Sanders, A.B. Boehm, J.A. Redman, J.H. Kim, R.D. Mrse, A.K. Chu, M. Gouldin, C.D. McGee, N.A. Gardiner, B.H. Jones, J. Svejkovsky, G.V. Leipzig, and A. Brown. 2001. Generation of enterococci bacteria in a coastal saltwater marsh and its impacts on surf zone water quality. *Environ. Sci. Technol.* 35:2407–2416.

Hood, D. 1993. Ecosystem relationships. In: Ecology of the Southern California Bight: A Synthesis and Interpretation (M.D. Dailey, D.J. Reish, and J.W. Anderson – Eds.). University of California Press, Berkeley, CA. pp. 782–835.

Leeworthy, V.R. and P.C. Wiley. 2007. Economic Value and Impact of Water Quality Change for Long Beach in Southern California. National Oceanic and Atmospheric Administration Report. 23 pp.

OCSD (Orange County Sanitation District). 1997. Annual Report, July 1995–June 1996. Marine Monitoring. Fountain Valley, CA.

OCSD. 1998. Annual Report, July 1996–June 1997. Marine Monitoring. Fountain Valley, CA.

OCSD. 2000. Annual Report, July 1998–June 1999. Marine Monitoring. Fountain Valley, CA.

OCSD. 2001. Annual Report, July 1999–June 2000. Marine Monitoring. Fountain Valley, CA.

OCSD. 2004. Annual Report, July 2002–June 2003. Marine Monitoring. Fountain Valley, CA.

OCSD. 2011. Annual Report, July 2009–June 2010. Marine Monitoring. Fountain Valley, CA.

OCSD. 2013. Annual Report, July 2011–June 2012. Marine Monitoring. Fountain Valley, CA.

Orange County, CA. Department of Public Works. 2014. Historic Rainfall Data. Station 88 – Newport Beach Harbor Master. http://ocwatersheds.com/rainrecords/rainfalldata/historic_data/rainfall_data

Reifel, K.M., S.C. Johnson, P.M. DiGiacomo, M.J. Mengel, N.P. Nezlin, J.A. Warrick, and B.H. Jones. 2009. Impacts of stormwater runoff in the Southern California Bight - Relationships among plume constituents. *Cont. Shelf Res.* 29:1821–1835.

SAIC (Science Applications International Corporation). 2001. Strategic Processes Study #1: Plume Tracking–Ocean Currents. Prepared for the Orange County Sanitation District. Fountain Valley, CA. 68 pp.

SAIC. 2009. Orange County Sanitation District Ocean Current Studies: Analyses of Inter- and Intra-Annual Variability in Coastal Currents. Final Report prepared for the Orange County Sanitation District. Fountain Valley, CA. 62 pp.

SAIC. 2011. Statistical Analysis of Multi-Year Currents at Inshore Locations in San Pedro Bay. Final Report prepared for Orange County Sanitation District. Fountain Valley, CA. 36 pp.

SCCWRP (Southern California Coastal Water Research Project). 1992. Southern California Coastal Water Research Project Biennial Report 1990-91 and 1991-92 (J.N. Cross and C. Francisco – Eds.). Long Beach, CA.

Schafer, H.A. and R.W. Gossett. 1988. Characteristics of storm water runoff from the Los Angeles and Ventura Basins. Technical Report Number 221. Southern California Coastal Water Research Project. Long Beach, CA. 58 pp.

Schiff, K. and L. Tiefenthaler. 2001. Anthropogenic versus natural mass emissions from an urban watershed. In: Southern California Coastal Water Research Project Annual Report, 1999-2000 (S.B. Weisberg and D. Elmore – Eds.). Southern California Coastal Water Research Project. Westminster, CA. pp. 63–70.

Turbow D.T. and L.S. Jiang. 2004. Impacts of beach closure events on perception of swimming related health risks in Orange County, California. *Mar. Pollut. Bull.* 48:312–316.

Warrick, J.A. and J.D. Millikan. 2003. Hyperpycnal sediment discharge from semiarid southern California rivers: Implications for coastal sediment budgets. *Geology.* 31:781–784.

Warrick, J.A., P.M. DiGiacomo, S.B. Weisberg, N.P. Nezlin, M. Mengel, B.H. Jones, J.C. Ohlmann, L. Washburn, E.J. Terrill, and K.L. Farnsworth. 2007. River plume patterns and dynamics within the Southern California Bight. *Cont. Shelf Res.* 27:2427–2448.