# EXECUTIVE SUMMARY

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The Orange County Sanitation District (District) conducted extensive ocean monitoring to evaluate potential environmental and public health effects from the discharge of treated wastewater off of Huntington Beach and Newport Beach, California. The data collected were used to determine compliance with receiving water conditions as specified in the District's National Pollution Discharge Elimination System (NPDES) permit, which was jointly issued in 2004 by the U.S. Environmental Protection Agency, Region IX (EPA) and the Regional Water Quality Control Board, Region 8 (RWQCB). The monitoring program was designed to determine compliance with permit criteria and to maintain the District's long-term data collection used for trend analyses. This report focuses on monitoring results and conclusions from July 2009 through June 2010.

Results of the monitoring program continued to show that ocean depth is the primary determinant of the distribution of organisms within the monitoring area. Changes to receiving water and sediment chemical and physical characteristics were identified near the outfall, but these changes were typically small and were not suggestive of causing adverse effects on biota. Biological communities more than 1 km outside the zone of initial dilution (ZID) were generally healthy, diverse, and comparable to those occurring under similar environmental conditions throughout the Southern California Bight. A trend of decreasing diversity for the infaunal (small invertebrates) communities within the ZID that began in 2005 now extends to the closest stations beyond the ZID (<1 km), indicating that the wastewater discharge impact may now be affecting invertebrate communities away from the outfall.

## WATER QUALITY

Natural water quality conditions during 2009-10 were typical of previous years with ocean waters characterized by temperature stratification (layering) of the water column throughout most of the year. Currents and stratification were primary factors in determining the location of the discharged wastewater plume. Predominant alongshore current flows and strong temperature stratification in spring and summer kept the plume below the ocean surface and away from shore. Even when strong stratification was not present, as was the case for the winter quarter, water quality monitoring data indicated that the wastewater plume remained at depth most of the time.

Dissolved oxygen, pH, and salinity had both natural and plume associated patterns. Observed changes in oxygen, pH and salinity were associated with changes in water depth and the transport of lower salinity water or the upwelling of low oxygen water into the local study area. Plume-related changes in temperature, salinity, dissolved oxygen, pH, and transmissivity were measurable beyond the initial mixing zone, but they usually extended only into the nearfield stations and remained below about 20 m depth. Other changes in temperature and oxygen were considered indirect effects since they were caused by deeper, oxygen poor water being entrained by the buoyant discharge plume.

Regardless of whether the effect was direct or indirect, the plume-related changes were well within the range of natural variability. There were no significant effects observed from the offshore discharge

Permit compliance criteria for oxygen, pH, and transmissivity were met more than 96% of the time. All measured values for these parameters were within natural historical ranges measured for the program since 1985, and would not be expected to cause significant environmental effects. Permit compliance criteria were fulfilled 100% of the time for surface observations related to water clarity, water color, and floatables. No grease particles were observed at any of the shoreline stations. Compliance with recreational bathing standards for bacteria was met 100% of the time for offshore waters and over 96% for the nearshore (surfzone) waters.

The District measures ammonium and fecal indicator bacteria as tracers for the wastewater plume because these constituents are not expected to be present in the receiving waters or present in very low concentrations naturally. Maximum ammonium values for 2009-10 were 10 times less than California Ocean Plan receiving water objectives for toxicity and, when detected, typically found below the surface and the near the outfall. There were also no associations with phytoplankton or indications of ammonium within water contact zones. Since disinfection began in August 2002, offshore bacterial concentrations have been mostly undetected with all detected values generally located below 20 m depth. Bacterial contamination in the nearshore (surf zone) was primarily limited to five contiguous stations (9N to 3S) that are either impacted by the Santa Ana River (3N, 0, and 3S) or associated with continued chronic bacterial contamination (9N and 6N), but are unrelated to the District's wastewater discharge. The low concentrations and limited distributions for both ammonium and bacteria indicate that there were no environmental or human health impacts from the District's wastewater discharge.

## SEDIMENT QUALITY

Sediment quality (chemistry and physical characteristics) measurements in 2009-10 were consistent with results from previous years suggesting that the wastewater discharge has minimal potential for adverse impact on biota outside the ZID for those measured constituents. Organic loading was minimal and did not create anaerobic sediment conditions or exceed thresholds that would promote a shift towards declining conditions beyond the ZID. There were only minor changes to sediment grain size, which were localized near the outfall. Sediment sulfide concentrations were generally low, but higher within the ZID than at other mid-shelf stations. Stations near the discharge site, but outside the ZID were comparable to farfield sites.

Sediment quality guidelines, effects-range low (ERL) and effects-range median (ERM), were used as benchmarks in evaluating the potential for degradation by chemical contaminants. Most sediment metal concentrations throughout the monitoring area

were below both benchmarks, including within the ZID. Beyond the ZID, copper and nickel exceeded the ERL at several canyon and slope sites.

Concentrations of polychlorinated biphenyls (PCBs) were higher in sediments near the outfall as compared to other 60-m stations; however, no concentration exceeded the ERL. Sediment dichloro-diphenyl-trichloroethane (DDT) concentrations exceeded the ERL at most 60-m sites, but did not exhibit any patterns related to the outfall. DDT is considered a legacy contaminant that is wide spread throughout the Southern California Bight (SCB). Polycyclic aromatic hydrocarbons (PAH) were higher at the outfall compared to farfield sites, but at concentrations well below the ERL.

Mean Effects-Range Median Quotient (mERMq) analysis indicated a very low probability of sediment toxicity at non-ZID sites based on sediment contaminant levels, while whole-sediment toxicity testing at the quarterly 60-m stations showed significant toxicity at within-ZID Station 0 in October 2009.

Though no sediment quality metric indicated a strong potential for adverse effects on biota, the infaunal invertebrate communities at and near the outfall diffuser have degraded within the ZID and characterize as changed at several stations outside, but closest to the ZID (see below).

## BIOLOGICAL COMMUNITIES

### Infaunal Invertebrate Communities

Similar to previous years, the 2009-10 results showed that natural features of the study region, including bottom depth, sediment grain size, and complex bathymetry (e.g., submarine canyon habitats), accounted for the larger-scale spatial patterns of infaunal communities within the monitoring area.

Since 2005, invertebrate communities within the ZID have been declining to the point of being considered degraded by the Infaunal Trophic Index (ITI) and as having a loss of biodiversity by the Benthic Response Index (BRI). Several long-term trends now show decreases over time as compared to a year ago. Additionally, in 2009-10, several stations nearest the outfall (<1 km away) were categorized as changed (ITI) or as marginally deviating from reference (BRI) indicating that the discharge of the treated wastewater impacted these biological communities. Invertebrate communities at the other mid-shelf stations beyond the ZID were characteristic of reference conditions, with the exception of Station C2, which is located within the Newport Canyon and supports a much different community. Several stations within the submarine canyons, slope, and basin areas are also classified as stressed, but it is not clear if these were related to the effluent discharge.

The causes of the decline in the infauna and the expansion of impacts away from the outfall are not known at this time. It does not correlate to currently monitored sediment

and effluent chemicals and physical conditions. There have been several major changes in District treatment processes and operations prior to and during this decline. These include, but are not limited to, the initiation of effluent disinfection, construction of and implementation secondary treatment facilities, and implementation of the Ground Water Replenishment System. Studies are being conducted and more are planned to investigate the cause(s) of these impacts on the biological community.

**Demersal Fishes and Macroinvertebrates**

Results for demersal fish and macroinvertebrates were consistent with past findings. Bottom depth, regional influences (e.g., El Niño, La Niña), and normal oceanographic cycles were more important than the effluent discharge in affecting the distribution and abundance of fish in the study area.

Fish communities near the outfall were comparable to those at farfield and regional reference stations. There was no indication that the wastewater discharge caused adverse effects on the fish community near the outfall.

Macroinvertebrate communities near the outfall were comparable to local and regional reference stations with results within the range of values for both large publicly owned treatment works (POTW) and non-POTW sites throughout the SCB. The results indicated that the outfall area was not degraded and that it supported normal macroinvertebrate populations.

**Tissue Contaminants in Fish**

The accumulation of contaminants by fish can occur due to direct exposure to contaminated water and sediments, and the ingestion of contaminated prey. Contaminants were examined in fish muscle, liver, and whole fish tissue. Findings for 2009-10 were representative of previous years. Contaminant concentrations were low and no significant spatial differences were found in the muscle tissues of target fish species that could be attributed to the District's discharge. Concentrations of mercury, DDT, and other chlorinated pesticides in all edible fish tissues collected at near-outfall and farfield locations were below federal and state action levels and/or health advisory limits. Two fish had muscle tissue PCB concentrations exceeding the state fish consumption guideline. One of the fish was captured at the farfield site and 1 at the outfall. PCBs are legacy contaminants that are still found in sediments due to their long degradation times. The detection of PCBs in fish tissues is the result of this prolonged exposure, and not current discharge practices.

**Fish Health**

The types and frequencies of external health problems for fish can be important indicators of environmental health. Examinations of fish for ectoparasites, tumors, fin erosion, and skin lesions showed that fish in the monitoring area were generally healthy. External parasites and other external abnormalities occurred in less than 1% of the fish

collected, with no outfall influence evident. These results were consistent with previous years and indicate that the outfall is not an epicenter of disease.

## CONCLUSION

With the exception of the infauna, the findings and conclusions for the 2009-10 monitoring effort were consistent with previous years, showing limited impacts to the receiving water, sediment, and trawl fish and macroinvertebrate communities. Plume-related changes in temperature, salinity, dissolved oxygen, pH, and transmissivity observed beyond the ZID were well within the range of natural variability. Low concentrations of bacteria in water contact zones, in concert with the limited distributions of ammonia and absence of associations of the wastewater plume with phytoplankton blooms, suggest that the discharge had no discernable impact on environmental or human health. The low levels of contaminants in fish tissues and the low incidents of external abnormalities and diseases in fish demonstrated that the outfall was not an epicenter of disease.

Invertebrate communities away from the outfall were normal and similar to reference areas in the Southern California Bight. Infaunal community changes were localized to stations within the ZID and several non-ZID stations closest to the outfall. This indicates a direct effect from the wastewater discharge, though no definitive causative agent(s) was apparent. District staff is working with scientists from the Southern California Coastal Water Research Project to develop a comprehensive plan to investigate the cause of this phenomenon. Long-term data analysis is already underway by District scientists examining infaunal community trends with respect to changes in species over time, receiving environment conditions, effluent quality, and plant processes.