EXECUTIVE SUMMARY

The Terminal Island Water Reclamation Plant (TIWRP; for a list of acronyms and abbreviations, see Appendix A) is mandated by the California Regional Water Quality Control Board, Los Angeles Region, (RWQCB) to conduct a comprehensive marine monitoring program in the Outer Los Angeles Harbor under the National Pollutant Discharge Elimination System (NPDES) permit No. CA0053856 for the City of Los Angeles. The permit operated under Order No. 93-014, which became effective on March 11, 1993 and remained in effect until May 27, 2005 when new Order No. R4-2005-0024 became effective. Under permit No. CA0053856, extensive monitoring of effluent quality, microbiology, ambient water quality, benthic sediments and macrofauna, demersal fish and invertebrates, and priority pollutant concentrations in white croaker tissue and another sportfish throughout the Outer Harbor was required to determine impacts, if any, from the discharged effluent from TIWRP.

The Terminal Island Water Reclamation Plant of the City of Los Angeles serves the Los Angeles Harbor area and has been in operation since the early 1930's. The plant was upgraded and expanded to full secondary treatment in 1977 and to secondary filtration treatment in December 1996. This filtered secondary-treated wastewater, although lacking disinfection through chlorination, is considered to have received tertiary treatment. TIWRP has a design capacity to provide tertiary treatment for an average dry-weather flow of 30 million gallons per day (MGD) with both liquid and solids handling capabilities. The Plant also generates about 50 wet tons per day of biosolids, which are 100% beneficially used.

The Terminal Island Water Reclamation Plant has long been a partner in the development of the Port of Los Angeles and the industrial, commercial, and residential areas of historic San Pedro, Wilmington, and Harbor City. Through a series of renovation efforts beginning in the early 1930's and continuing to the present time, TIWRP has worked to improve the treatment processes. The Advanced Wastewater Treatment Facility (AWTF) at TIWRP, a joint venture with the Los Angeles Department of Water and Power, was essentially completed in October 2001. Currently, AWTF treats approximately 5 MGD of tertiary effluent through micro-filtration (MF) and reverse osmosis (RO) processes. Beginning March 2006, the effluent from the AWTF process has been used in the Dominguez Gap Barrier Project for groundwater recharge and the Harbor Water Recycling Project (HWRP) for non-potable applications.

From 1994 to 1996, major dredging and construction activities associated with the Pier 300/400 Implementation Program (PIP) in the Outer Los Angeles Harbor impacted a major portion of the original NPDES-mandated monitoring stations. The construction of the main portion of Pier 400 and the extension of the existing outfall beyond Pier 400 was completed in July 1996. A Post-Pier-400 monitoring program was submitted, approved, and implemented in July 1996. The construction

activities in and near Outer Los Angeles Harbor were completed in mid-1999, and the final stage of dredging and other construction activities for Pier 400 was completed by April 2000.

Additional construction activities related to the Port of Los Angeles Channel Deepening Project began in the Inner Los Angeles Harbor in September 2002. The project, which increased depths to accommodate deeper container vessels, has impacted the area near the TIWRP outfall through the Pier 400 Submerged Storage Site (P400 SSS). This site, constructed adjacent to the existing TIWRP outfall pipe, received dredged sediments from the Channel Deepening Project. During 2004-2005, three water quality/microbiology, two trawl, and two infaunal/sediment stations were completely inaccessible following the construction of the P400 SSS. The two trawl stations were repositioned as was one additional trawl station that no longer could be sampled due to a submerged obstruction. The other stations were not replaced.

The PIP and on-going construction activities in the vicinity of the TIWRP outfall could continue to mask or alter the effects of the TIWRP effluent on the marine benthos and trawled communities of Outer Los Angeles Harbor for several years. The results of data analyses indicate a continuing impact in relation to previous and on-going Los Angeles Harbor construction activities. The signals are mixed and not fully informative, but signs of the recovery process are now being noted in the ecosystem of the Outer Los Angeles Harbor. As time progresses, these communities should recover from effects resulting from the dredging and fill operations allowing for a more accurate assessment of the potential impacts of the TIWRP effluent discharge on the biological communities in the Outer Los Angeles Harbor. This projection is predicated, however, on the assumption that a sustained period without dredging, filling, or other disruptions to the Outer Harbor sediments occurs.

The following are the summarized information collected from January 2006 through December 2007 and general conclusions of this biennial assessment report.

EFFLUENT QUALITY

In 2006, TIWRP discharged an average of 15.9 MGD of tertiary-treated wastewater into the Outer Los Angeles Harbor. The average concentrations for key constituents in the effluent during this year were as follows: suspended solids, <1 mg/L; BOD, < 2 mg/L; oil & grease, < 3 mg/L; settleable solids, <0.03 mg/L; and ammonia-N, <0.39 mg/L.

In 2007, TIWRP discharged an average of 15.8 MGD of tertiary-treated wastewater into the Outer Los Angeles Harbor. The average concentrations for key constituents in the effluent during this year were as follows: suspended solids, <1 mg/L; BOD, < 2.5 mg/L; oil & grease, < 3 mg/L; settleable solids, <0.03 mg/L; and ammonia-N, 0.8 mg/L.

The annual average removal efficiencies of these key constituents remained high. During both 2006 and 2007, the average percent removals ranged from 94% for oil and grease, 98% for ammonia, 99% for BOD, to greater than 99% removal of both suspended and settleable solids. Throughout 2006, the Terminal Island discharge was in complete compliance with NPDES permit limitations for all effluent constituents except for chronic toxicity. With the exception of ongoing chronic toxicity problems and one exceedance for lead, the TIWRP discharge met all permit limitations in 2007. The cause of the ongoing effluent toxicity is under investigation.

MICROBIOLOGY

Microbiological data indicates that the TIWRP discharge has a relatively small impact on the bacterial community of the Los Angeles Harbor. Bacterial indicator counts decreased with distance from the outfall (Figure 3-1, page 43), indicating that the discharge is quickly dispersed and any impact to the shoreline would be non-detectable. Bacterial densities tend to increase at the LA Harbor Main Channel and the entrance to the Cabrillo Marina,

both of which are subject to influences from storm drains. All Harbor stations, both weekly and monthly sampling sites, were in compliance with the permit standards and had lower counts than the shoreline stations, indicating that the discharge had little to no impact on the shoreline.

Generally, high counts of indicator bacteria (i.e., total coliform, fecal coliform/E. coli, and enterococcus) have occurred within the swimming area of Inner Cabrillo Beach. Since the TIWRP discharge is not impacting the Cabrillo Beach shoreline (located well beyond the TIWRP outfall area), other possible sources are more likely the cause of the higher counts and non-compliance at the shoreline stations. The persistence of high bacterial indicator counts at Inner Cabrillo Beach and the LA Harbor Main Channel has placed them on the 2002 Clean Water Act 303 (d) list of impaired water bodies. Possible sources of contamination have been identified and include storm drain runoff, fecal contributions by birds that congregate near the swimming area, waste disposal from boats, and sidewalk wash downs, among others. A Total Maximum Daily Load (TMDL) to address these water impairment issues was developed and incorporated into the Basin Plan by the RWQCB. The Los Angeles Harbor Bacterial TMDL was approved in November 2005, and a one-year special study was initiated in May 2006. Mitigation measures to improve water quality includes, but are not limited to, extending or altering the bird exclusion structure, replacing the sand, increasing the number of trash cans at the beach, repairing the sanitary sewer lines and storm drains, and other educational and service programs at Inner Cabrillo Beach. The mitigating measures are still being implemented.

WATER QUALITY

When the new NPDES permit, became effective (May 27, 2005), the frequency of water quality monitoring changed from monthly to quarterly. Discrete surface receiving water sampling was mandated quarterly for ammonia and both acute and chronic toxicity, biannually for dioxin, and a one year monthly study for ammonia, metals, dieldrin, dioxin (TCDD), cyanide, and MBAS.

The location of the wastewater field in Los Angeles Harbor was detected as areas of low salinity, and correspondingly higher colored dissolved organic material (CDOM) measurements. The Terminal Island Water Reclamation Plant wastewater outfall produces a small, dilute wastewater field in the Outer Harbor. It generally was detected at a few stations located within the vicinity of the outfall (Figure 4-1, page 57), and generally distributed northward along the Pier 400 causeway to the west or east with occasional southward movement. This pattern of wastewater dispersion has been consistent since completion of the current Pier 400 configuration. The salinity and bacterial data show that within the area of special concern, the Shallow Water Habitat, these parameters are at background levels as predicted.

No acute toxicity was found at the required receiving water stations (HW23 and HW33) for the period sampled. Only the August samples exceeded in chronic toxicity during 2006. The chronic toxicity found in the first half of 2007 that triggered accelerated sampling is thought to be due to improper sampling (i.e., the use of a metal sampler). Once this was remedied, the samples achieved the receiving water permit required TUc of 1.0. However, late 2007 yielded yet another string of exceedences for both stations HW24 and HW43. In the months of November and December, HW24 exceeded three out of four sampling events, while HW43 exceeded all four times. Concurrent samples of TIWRP effluent in the months of November and December met the effluent permit requirements of <1.67 TUc. This leads to the conclusion that the effluent did not contribute to the chronic toxicity in the receiving water. Sampling personnel did not observe signs of a harmful algal bloom during those months, but other ambient conditions may have contributed to the chronic toxicity. Exactly what is causing the chronic toxicity is unknown at this time. The Los Angeles Harbor is a highly impacted body of water. Therefore, causes of chronic toxicity may be multiple, including a non-point source.

SEDIMENT CHEMISTRY

The Los Angeles Harbor sediment is comprised of various levels of sand, silt, and clay. Silt and clay are predominant at all inner harbor stations (Figure 5-1, page 84), but mainly sand was found at station HM13 outside the breakwater. Total organic carbon (TOC) was detected at all stations in 2006 and 2007 summer surveys. TOX and dissolved sulfide were not detected at any stations in 2006. Cyanide was detected at one station only. Total organic halides (TOX), dissolved sulfide, and cyanide were not analyzed in 2007.

Eight out of 13 priority metals were found in 2006 and 2007. Silver was not detected in 2006, but was detected in 2007. The most polluted sediment was found at station HM13 outside the breakwater in 2006, and at HM12 in 2007.

Out of the 26 pesticides and PCBs tested in the surveys, only six were detected in 2006 and four of the six in 2007. The only DDT derivative repeatedly detected at all stations in the two summer surveys was p,p'-DDE. PCBs were detected at two monitoring stations in 2006 and not detected in any stations in 2007.

Over the five-year period ending in 2007, total DDT was more prominent at HM13 outside the Harbor than at the HM3 TIWRP outfall, except in 2007 when pollutants were not normalized against the fine-grain fraction. These results suggest that the pollutant accumulations at the station outside the Harbor (HM13) are not due to TIWRP effluent being discharged into the Los Angeles Harbor, but rather to another source.

MACROFAUNA

Many analytical methods were applied to the data set this year. Parsimony analyses of the stations (Figure 6-1, page 100) revealed station groupings underscoring the distinct species assemblages found outside of the Harbor relative to those within. Traditional diversity indices, as well as newly developed phylodiversity indices capturing the phylogenetic and trophic structure of the communities, revealed higher values at station HM13 outside the Harbor relative to those sampled within. The two samples from Station HM3, the closest station to the Terminal Island Water Reclamation Plant (TIWRP) Outfall, by not grouping together and by having near average values of taxa, abundance, and diversity indices, in concert with reference condition Benthic Response Index (BRI) scores further suggests the effluent from TIWRP is having little to no observable effect on the benthic community.

Non-metric multidimensional scaling derived from the cladogram's branch lengths and subsequent multivariate analyses matching this biotic pattern to the abiotic variables identified percent silt, sand, nickel, and depth as the highest correlating combination of variables (r=0.730). These results complement the aforementioned pairwise Independent Contrasts (Pearson Product-Moment Correlations) of the sediment variables through the cladogram that resulted in clay and silt being highly correlated with an r-value of 0.71 and with TOC most highly correlated with silt with an r-value of 0.53.

Independent contrasts between TOC and nickel, copper, chromium, zinc, and mercury were highly correlated with r-values of 0.96, 0.94, 0.94, 0.93, and 0.84, respectively, and all with highly significant two-tailed p-values. Conducting various principal component analyses with different sets of abiotic variables onto the infauna-derived parsimony analysis of endemicity (PAE) cladogram resulted in groupings relatively congruent with the topology of the cladogram. The principal components analysis (PCA) of all abiotic variables with sediment fractions mapped onto the cladogram mirrored the biotic pattern the closest. The final PCA derived from the entire suite of diversity and phylodiversity indices (not shown herein) generally grouped the samples from station HM13 outside the breakwater away from the stations within the Harbor, with the

highest values from the diversity indices recorded from the samples collected at station HM13.

Hence, the array of analyses applied to the data all lead to similar conclusions, namely, that the species assemblage or community pattern represented by the cladogram, was structured from a combination or interplay of sediment granulometry, depth, and the chemical constituents found therein.

Extensive re-suspension and subsequent sedimentation has occurred in the Outer Los Angeles Harbor with similar past construction events. With the completion of dredging and filling activity in the Outer Los Angeles Harbor for Pier 400, a continuing impact on the Post-Pier 400 monitoring stations around the TIWRP outfall is still being noted, most notably from P400 SSS activity. Despite these intermittent impacts, the composition of the macrofaunal community collected appears to be stabilizing with a healthy number of 236 taxa reported for the biennium despite the slightly reduced number of species reported in 2006 (179) and 2007 (199). With recovery from the impacts caused by the construction activities related to Pier 300/400 continuing to progress, coupled to current P400 SSS activity resulting in the actual loss or exclusion of near-outfall stations HM1 and HM5, the message or signal that has been obtained from the most recent data analysis may only represent an intermittent improvement in time and may degrade with future construction activity. Hence, these results may not be fully informative relative to the objective of the Post-Pier 400 Monitoring Program: to investigate the potential effects of the effluent discharged from the TIWRP on the surrounding infaunal communities in Outer Los Angeles Harbor.

TRAWLING

Within the 24 sampling events (Figure 7-1, page 123) over the 2006-2007 biennium, the same small group of fish and invertebrate species that typically dominate sampling period after sampling period were recorded. Fish species had variable abundances punctuated at several sampling events driven by a few species. The dominant species were, once again, *Genyonemus lineatus*, *Seriphus politus*, *Citharichthys stigmaeus*, *Synodus lucioceps,* and *Symphurus atricaudus*. However, in contrast to years prior to 2003, *Paralichthys californicus* appears to be emerging as a prominent species as it occurred in 11 out of 11 events in 2003, 15 out of 19 events in 2004, 7 out of 18 events in 2005, and 17 out of 24 events over the 2006-2007 bienniumn.

For megainvertebrates, *Crangon nigromaculata* followed by *Philine auriformis* have dominated the catch both in abundance and occurrence in previous years. This co-occurring pair remained the most widely occurring in 2006-2007. However, by far the most abundant megainvertebrate was *Sicyonia ingentis* with 228 individuals, primarily at HT12. This species' abundance pattern was challenged by that of *C. nigromaculata* (137 individuals) for the biennium, suggesting an equitable niche for these species. In general, megainvertebrates occurred in low numbers of species and abundances relative to other nearshore soft-bottom habitats and to previous years. Additionally, megainvertebrate taxa tend to fluctuate more dramatically in Los Angeles Harbor from year to year in the overall context of their historical master species list as seen between 2006 and 2007.

In summary, the results of the trawl-caught fish and megainvertebrate program for the 2006-2007 biennium suggests a somewhat diverse community of fish and megainvertebrates exists with many samples recording the number of taxa collected in the mid- to high-teens. Although, the progression of deposition of dredged Los Angeles Harbor sediments and removal of these stored sediments as fill material for continuing Los Angeles Harbor construction projects continues, more pattern was discernible in this biennial report than the previous report. The cladogram of the combined fish and megainvertebrate community data grouped like-station samples together, such as all HT10 samples, all HT5 samples, three of the four HT13, and three of the four HT12 samples. This grouping of like stations is an indication of species-site fidelity and

suggests the possible recovery of the environment from previous perturbation. Additionally, there also was evidence of grouping by season in the cladogram, further suggesting the environment is having a larger role in structuring the local community than the constant construction within the Harbor over the previous years. Additionally, although the Terminal Island Water Reclamation Plant's Outfall Station HT7 had highly variable species richness with values of 8, 12, 17, and 18, it should be noted that the taxa counts of 17 and 18 represent some of the most diverse samples collected during the biennium. Indeed, the Winter sample from 2007 scored the highest phylogenetic diversity value for the entire biennium.

Although Pier 400 construction is complete, current activities including proximate dredging and filling of spoils remain (i.e., Pier 400 Submerged Storage Site). This, combined with the previous construction, dredging, and fill activities, appear to constitute a lasting effect upon the behavior and, therefore, the distribution of species often captured in our monitoring program. Hence, any message obtained from the data analysis tends to still be a bit garbled, altered, and not informative relative to the objective of the Los Angeles Harbor Monitoring Program: to investigate potential effects of the effluent discharged from the Terminal Island Water Reclamation Plant's outfall on the biological communities (i.e., benthic infauna, trawled fish and invertebrates, and sportfish) in the Los Angeles Harbor. Hence, we must continue to recommend that the results from the trawling program be viewed with extreme caution until the Los Angeles Harbor environment becomes more stabilized.

TISSUE CHEMISTRY

This two-year survey is designed to assess how safe it is to eat sport fish caught from the vicinity of the TIWRP outfall in Los Angeles Harbor, and if the level of contaminants in these fish tissues are correlated to contaminants in the sediment that may result from the discharge of treated effluent from TIWRP into the Harbor (Figure 8-1, page 144). Ten white croaker and eight white surfperch samples were collected in 2006 and ten white croaker samples and ten queenfish samples were collected in 2007. The liver tissue from five white croakers were composited into one liver sample thus a total of two liver composite samples were collected.

All muscle and liver tissue samples were analyzed for total DDT, six DDT derivatives (o,p'DDE, p,p'DDE, o,p'DDD, p,p'DDD, o,p'DDT, and p,p'DDT), total PCB, seven PCB Aroclors (1016, 1221, 1232, 1242, 1248, 1254, and 1260), and percent lipid.

In 2006, none of the white croaker muscle samples exceeded the EPA's DDT screening value (SV) of 0.560 mg/kg, while PCB 1254 and PCB 1260 concentrations of one white surfperch muscle sample exceeded the OEHHA fish consumption advisory value of 0.1 mg/kg. In 2007, one white croaker muscle sample contained p,p'-DDE in a concentration that exceeds the DDT SV of 0.1 mg/kg.

During 2006 and 2007, the liver tissue concentrations of p,p'-DDE and PCB 1260 in white croaker exceeded their respective EPA screening and OEHHA fish consumption advisory values in all samples tested. In addition, in 2006 the PCB 1254 concentrations of both liver samples exceeded the fish consumption advisory value.

To assess the potential of sediment as a source of pollution on the targeted fishes, the pollutant concentrations in muscle tissues of white croaker collected at the outfall are compared with the pollutant concentrations in sediments near the outfall during 2006 and 2007 surveys. This two-year survey reveals no apparent relationship between the DDT and PCB levels in fish tissue and in sediment. Percent lipid levels were relatively stable during this survey period.