EXECUTIVE SUMMARY

The Terminal Island Treatment Plant (TITP) 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 throughout the Outer Harbor was required to determine impacts, if any, from the discharged effluent from TITP.

The Terminal Island Treatment 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 tertiary treatment without disinfection through chlorination in December 1996. TITP 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 Treatment 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, TITP has worked to improve the treatment processes. The Advanced Wastewater Treatment Facility (AWTF) at TITP, a joint venture with the Los Angeles Department of Water and Power, was essentially completed in 2002. Currently, AWTF treats approximately 5 MGD of tertiary effluent through micro-filtration (MF) and reverse osmosis (RO) processes. Beginning March 2006 (after the period covered in this report), the effluent from the AWTF process began being used in the Dominguez Gap Barrier Project for groundwater recharge and 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 landfill 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. Activities associated with this project have slowed recently, but the work is not completed. Additional dredging for this project is anticipated to recommence in early 2007 (Kathryn Curtis, Port of Los Angeles, personal communication). The project, which increased depths to accommodate deeper container vessels, has impacted the area near the TITP outfall through the Pier 400 Submerged Storage Site (P400 SSS). This site, constructed adjacent to the existing TITP 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 TITP outfall could continue to mask or alter the effects of the TITP 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 created by the dredging and landfill operations allowing for a more accurate assessment of the potential impacts of the TITP 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, landfill, or other disruptions to the Outer Harbor sediments occurs.

The following are the summarized information collected from January 2004 through December 2005 and general conclusions of this biennial assessment report.

Effluent Quality

In 2004, TITP discharged an average of 15.6 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, 0.2 mg/L.

In 2005, TITP discharge into the Outer Los Angeles Harbor increased slightly to an average of 16.0 MGD of tertiary-treated wastewater. 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, 0.4 mg/L.

The annual average removal efficiencies of these key constituents remained high. During both 2004 and 2005, the average percent removals were 92% for oil and grease, 97% for ammonia, 99% for BOD, and greater than 99% removal of both suspended and settleable solids. Throughout 2004 and 2005, the Terminal Island Treatment Plant discharge was in complete compliance with NPDES permit limitations for all effluent constituents except chronic toxicity. The cause of the toxicity exceedance is under investigation.

Up to 5 MGD of the tertiary effluent discharged to the Harbor received further treatment through microfiltration and reverse osmosis at the plant's Advanced Water Treatment Facility (AWTF) in 2004 and 2005. The AWTF underwent further testing and optimization during this time period to gain operational experience and achieve the discharge limits of the potable and non-potable permits for the City's Harbor Water Recycling Project (HWRP). As stated above, TITP began delivering advanced tertiary effluent from the AWTF facility to the City's HWRP in March 2006.

Microbiology

Microbiological data indicates the TITP discharge has only a small to moderate impact on the receiving waters of the Los Angeles Harbor. Densities of indicator bacteria (i.e., total coliforms, fecal coliforms/*E. coli*, and enterococci) are low near the outfall and decrease with distance from it, indicating that the discharge is quickly dispersed and any impact to the shoreline is negligible or non-existent. Bacterial densities tend to increase at the Los Angeles Harbor Main Ship Channel and at the entrance to the Cabrillo Marina; both of these areas are subject to influences from storm drains. All Harbor stations, both those monitored weekly and monthly, were in compliance with REC-1 standards for indicator bacteria, and they had lower bacterial counts than the shoreline stations; thereby indicating, that the discharge had little to no impact on the shoreline. Due to construction of the P400 SSS, data from three monthly Water Quality Plume Tracking Survey stations could not be collected during 2004-2005. Prior to the construction of the P400 SSS, these three stations exhibited low bacterial counts and did not appear to be significantly impacted by the TITP discharge. These three stations are not included in the new permit and are not being sampled currently.

Generally, high concentrations of indicator bacteria occur within the swimming area of Inner Cabrillo Beach. Since the TITP discharge does not appear to impact the Inner Cabrillo Beach shoreline (located well beyond the TITP outfall area), other possible sources of pollution are more likely the cause of the higher counts and non-compliance at these shoreline stations. The persistence of high bacterial indicator counts at Inner Cabrillo Beach and the Los Angeles Harbor Main Ship Channel resulted in these areas being included on the 2002 Clean Water Act 303 (d) list. 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 washdowns, 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 became effective March 9, 2005. Mitigation measures to improve water quality, include, but are not limited to, extending or altering the bird exclusion structure, cleaning or replacing the sand, increasing the number of trash cans at the beach, repairing the sanitary sewer lines and storm drains, and educational and service programs at Inner Cabrillo Beach. These and possibly other mitigation efforts are 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 receiving water sampling is required quarterly for ammonia and both acute and chronic toxicity, and biannually for dioxin. A one- year monthly study for ammonia, metals, dieldrin, dioxin (TCDD), cyanide, and MBAS is required also.

The location of the wastewater field in Los Angeles Harbor was detected as areas of low salinity. The Terminal Island Treatment Plant wastewater outfall produces a small, dilute wastewater field in the Outer Harbor. It typically was detected at a few stations located within 0.5 km of the outfall 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. A probability analysis indicated that the wastewater field is present up to 45% of the time along the causeway. The salinity anomaly and bacterial data show that within the area of special concern, the Shallow Water Habitat, these parameters are at background levels as predicted.

Toxicity exceedences in Harbor receiving waters were rare. When they did occur, the toxicity appears to have resulted from ambient conditions, such as a harmful algal bloom (specifically a red tide), rather than TITP effluent.

Sediment Chemistry

Sediments in Los Angeles Harbor are heterogeneous, being comprised of various levels of sand, silt, and clay. Silt and clay are predominant at all inner harbor stations, but mainly sand is found at the station (HM13) outside the breakwater. Cyanide, dissolved sulfide, TOC, and TOX were all detected in the 2004 summer survey; however, cyanide and dissolved sulfide were not detected during the 2005 survey.

Eight out of nine priority metals, silver being the exception, were detected at all stations in the 2004 and 2005 summer surveys. Silver was detected at six stations in 2004 but only at two stations in 2005. The highest concentration of total metals was measured at station HM3 (outfall) in 2004 and station HM13 (outer breakwater) in 2005.

The only DDT derivative repeatedly detected at all stations in both the 2004 and 2005 summer surveys was p,p'-DDE. The highest concentration of total DDT was measured at HM13 and the lowest at HM4 in 2004 and 2005. No PCBs were found at any station in either summer survey.

Total metals and DDT concentrations over the past five years generally were lower at HM3 (outfall) than at HM13 (outer breakwater of the Harbor) . Exceptions to this occurred in 2002 and 2004, when metal concentrations were higher at HM13 than at HM3. These results suggest that the pollutant accumulations at the station outside the harbor (HM13) are not due to TITP effluent being discharged into the Los Angeles Harbor, but rather to another source.

Macrofauna

Many analytical methods were applied to macrofauna data this year. Parsimony analyses of the stations revealed station groupings that underscore 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.

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 sand, zinc, toxicity, and the number of ERL exceedances as the highest correlating combination of variables ($r = 0.649$). Plotting various principal component analyses with different sets of abiotic variables onto the infauna-derived PAE cladogram resulted in groupings relatively congruent with the topology of the cladogram. The PCA of sediment granulometry with sediment fractions mapped onto the cladogram mirrored the biotic pattern the closest. The PCA from the sediment's contaminant constituents and subsequent variable mapping showed that the general pattern of higher toxicity values and metal concentrations occurred within the Harbor. The final PCA derived from the entire suite of diversity and phylodiversity indices 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 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. Even with the completion of dredging and fill activity in the Outer Los Angeles Harbor for Pier 400, a continuing impact on the Post-Pier 400 monitoring stations around the TITP outfall is being noted, most notably from P400 SSS activity. This impact upon the Outer Los Angeles Harbor continues to affect the distribution of species, their behavior, and composition of the macrofaunal community collected by the City of Los Angeles' Post-Pier 400 Monitoring Program. 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 continues to be garbled and altered, and thus not fully informative relative to the objective of the Post-Pier 400 Monitoring Program, which is to investigate the potential effects of the effluent discharged from the TITP on the surrounding infaunal communities in Outer Los Angeles Harbor.

Trawling

The results of the trawl-caught megainvertebrates and fish assessment, like those of the macrofaunal assessment, were difficult to discern. No pattern seemed lucid enough to be associated with the TITP Outfall, but rather with a schedule of dredge and fill activities for the P400 SSS. However, the parsimony analysis of endemicity (PAE) cladogram groupings that emerged, primarily outside versus inside the Harbor, suggest community patterns are a result of station location (the distinct grouping of samples from HT5 outside of the harbor) overlaid by seasonal patterns as shown by the station clades with samples predominantly from a given season or sampling period. The remaining sampling events are relatively indistinct, and the sampling events that constitute the inside grouping (or clade) do not show any emergent patterns with respect to one another. This suggests that any impact caused by the discharged effluent is either negligible or indistinguishable from the lingering widespread effects caused by the previous construction activities of Pier 400 and P400 SSS occurring in the Harbor.

Adult fish populations in Los Angeles Harbor have been studied in the past using otter trawls, gill nets, purse seines, and diver observations. The sampling devices most frequently used were otter trawls of various sizes, and it has been shown that catch efficiency of otter trawls is highly variable (8-52%) depending on trawl size, fish size, and fish species. Hence, it is difficult to assess how quantitatively comparable previous reports are with our results reported herein. The aforementioned variability reported from our community parameters over the last few years continue to bear testimony to this concept.

Within the 37 sampling events (19 in 2004 and 18 in 2005) over the 2004-2005 biennium, the same small group of fish and invertebrate species that typically dominate sampling period after sampling period were recorded. Sampling year 2004 showed a marked increase in fish biodiversity according to species richness with 34 compared to recent years. However, biodiversity declined slightly to 28 species in 2005. Fish species had variable abundances punctuated at several sampling events driven by a few species. The dominant species were, once again, *Genyonemus lineatus* (white croaker), *Seriphus politus* (queenfish), *Citharichthys stigmaeus* (speckled sanddab), and *Symphurus atricaudus* (California tonguefish). However, in contrast to years prior to 2003, *Paralichthyes californicus* (California halibut) 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, and seven out of 18 events in 2005. Megainvertebrates were moderately biodiverse with 26 taxa in 2004 and 27 taxa in 2005, but noticeably decreased from 40 taxa out of only 11 sampling events in 2003.

Tissue Chemistry

The new TITP NPDES permit added annual analyses of liver samples from *Genyonemus lineatus* (white croaker) to the muscle tissue analyses previously required on this species. Additionally, annual muscle tissue analyses on a sport fish other than white croaker were added to the tissue bioaccumulation trend survey.

Five white croaker in 2004 and ten in 2005 were collected by trawling at station HT7 (located at the terminus of the TITP outfall). Ten sport fish, queenfish (*Seriphus politus*), samples were collected at station HT12 (near TITP outfall) in 2005 for the seafood safety study. Sampling for white croaker was conducted at station HT5 (reference site outside of the breakwater) during 2004 and 2005 as required by the NPDES permit, but no white croaker were collected.

Arsenic, copper, mercury, and zinc were detected in all white croaker muscle tissue samples collected in 2004 and 2005. Mercury concentrations, ranging from 0.017 to 0.11 mg/kg in muscle samples, were well below the "action levels" of 1.0 mg/kg for fish consumption set by the Food and Drug Administration (FDA) and 0.3 mg/kg for the Human Health Consumption level set by USEPA. Among the detected organics, p,p'-DDE was detected in all samples with an average of 0.11 mg/kg, which is above the 0.1 mg/kg limit set by OEHHA.

Arsenic, copper, and mercury were detected in queenfish muscle tissue, but their averages were lower than those found in muscle tissue of white croaker collected in 2004 and 2005. Two DDT derivatives and two PCB derivatives were detected in queenfish muscle tissue in 2005. Total DDT was above the recommended limit of 0.1 mg/kg.

All metals except chromium were detected at higher levels in two composite samples of white croaker liver tissue than were found in white croaker muscle tissue. The average of p,p'-DDE in liver tissue was more than 4 times the average in muscle tissue. PCBs also were found at significantly higher concentrations in liver tissue.

No clear temporal pattern was observed for selected pollutants (arsenic, copper, mercury, zinc, DDTs, and PCBs) and percent lipid from 2000 to 2005 in white croaker collected at the outfall (HT7). Based on previous spatial and temporal patterns of the pollutants in fish tissue and the relationship with sediment pollutants, the TITP wastewater discharge appears to have very little impact on the pollutant burden of white croaker in the Harbor.

The total DDT levels in both white croaker and queenfish tissues exceeded the recommended 0.1 mg/kg limit. The total PCB level in muscle tissue of queenfish also exceeded the 0.1 mg/kg limit.