Introduction

1.1 Background

National Pollutant Discharge Elimination System (NPDES) permitting requirements are mandated by the Federal Clean Water Act (CWA). In 1987, the CWA was amended by the Water Quality Act to require the U.S. Environmental Protection Agency (EPA) to develop discharge permits under the NPDES program. In California, the municipal permit program is overseen by the State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards (RWQCB) in accordance with the November 1990 Federal Regulations (40 CFR Part 122) and the Porter-Cologne Act. These regulations require all municipal separate storm sewer systems (MS4s) that serve populations over 100,000 to obtain coverage under an NPDES discharge permit. In the San Diego area, the San Diego Regional Water Quality Control Board (RWQCB) oversees the NPDES permit program.

The County of San Diego, the City of San Diego, the San Diego Unified Port District, the San Diego Regional Airport Authority and 17 other cities (collectively referred to as Copermittees) are covered under a municipal NPDES permit for discharge of urban runoff to waters of the United States. The participating Copermittees share the costs of monitoring required for compliance with this permit. Copermittees include:

Cities:	Carlsbad	Chula Vista	Coronado
	Del Mar	El Cajon	Encinitas
	Escondido	Imperial Beach	La Mesa
	Lemon Grove	National City	Oceanside
	Poway	San Diego	San Marcos
	Santee	Solana Beach	Vista

County: Unincorporated areas of San Diego County within the Urban Limit Line
Other: San Diego Unified Port District
San Diego Regional Airport Authority (added as a Copermittee on August 13, 2003 under Addendum No. 1 to Order 2001-01)

This report provides a summary of the 2004-2005 Receiving Waters Monitoring Program for the Copermittees identified as dischargers of urban runoff in Order No. 2001-01 (the permit) of the RWQCB, and fulfills the requirements of Order No. 2001-01 Attachment B, IV, *Submittal of Receiving Waters Monitoring Requirements*.

Order No. 2001-01 requires the implementation of a countywide or watershed-based Receiving Waters Monitoring Program that includes the following components:

- Urban Stream Bioassessment Monitoring
- Long-term Mass Loading Monitoring
- Coastal Storm Drain Outfall Monitoring
- Ambient Bay, Lagoon, and Coastal Receiving Water Monitoring
- Toxic Hot Spots Monitoring in San Diego Bay.

Introduction

SECTION 1

The Core Receiving Waters Monitoring Program was developed by the Copermittee Monitoring Workgroup and described in the *Previous Monitoring and Future Recommendations Report* (MEC 2001) required by the permit.

The three elements of the recommended monitoring framework include:

Regional Monitoring Programs that provide baseline datasets for comparing information from local monitoring programs. These programs encompass a large spatial area (e.g., San Diego Region, entire southern California bight), and look at many elements potentially impacted by storm water runoff. This type of monitoring takes a long-term view of the ultimate receiving waters, the coastal bays, lagoons, and the ocean. Regional monitoring is designed to answer questions concerning the ecological health of a large geographic region and encompass numerous components, including water and sediment quality, fish, benthos, birds, etc. An example of regional monitoring is the Southern California Coastal Waters Research Project (SCCWRP) Bight Monitoring that is conducted every five years.

Core Monitoring is long-term monitoring with the objective of tracking compliance with regulatory requirements or limits, or to track trends over time. Core monitoring programs typically involve sampling at fixed stations that are sampled routinely through time. Individual monitoring components are designed to evaluate the long-term changes in water quality and mass loading to MS4 and receiving waters. Assessing concentrations of chemical constituents, toxicity to test organisms, and benthic assemblages provides indications of long-term trends and effects between and within watersheds.

Special Studies supplement both the Core Monitoring and the Regional Monitoring. Special Studies are focused evaluations designed to answer specific questions. These are typically short-term efforts intended to answer specific questions that may be raised during assessment of core monitoring results. Some examples of Special Studies include evaluation of the link between storm water discharges and Toxic Hot Spots, conducting DNA-ribotyping for bacterial source identification in a watershed, and source identification studies used for the development of Total Maximum Daily Loads (TMDLs) for 303(d) listed impaired waterbodies.

This report summarizes the results of monitoring activities that took place in 2004-2005. The primary short-term objectives of the Core Receiving Waters Monitoring Program activities are to:

- Determine the ecological health of receiving waters in the county based on chemical, physical, and biological evidence.
- Assess compliance with RWQCB order No. 2001-01.

The long-term objectives include:

- Predict short- and long-term impacts to receiving waters that result from changes in land-use within each watershed, and provide data that can be analyzed to develop pollutant reduction strategies for those impacts.
- Measure the effectiveness of Urban Runoff Management Plans (URMPs) and other potential pollutant reduction strategies.
- Develop and implement a program that integrates with other regional programs involved in assessing the overall health of receiving waters in San Diego County and Southern California.

1.2 Monitoring Program History

The San Diego Regional Storm Water Monitoring Program was first mandated by the RWQCB under Order No. 90-42, NPDES Permit CA 0108758 issued on July 16, 1990 and implemented in 1993-1994. This permit was scheduled to expire on July 15, 1995; however, coverage was extended pending the issuance of a new permit. To facilitate continuation of monitoring activities, revised monitoring requirements were published on October 31, 1995 under the RWQCB Monitoring and Reporting Program Order No. 95-76. Alterations to Order No. 95-76 were made through Technical Change Order No. 1, published in January 1996. Changes to the program implemented during wet-weather season 1998/99 were authorized under Technical Change Order No. 2, dated December 3, 1998. Technical Change Order No. 3 addressed changes to the program during the 1998/1999 wet-weather season. Technical Change Order No. 4 documents program changes for the 1999/2000 wet-weather monitoring effort. On February 21, 2001 the RWQCB adopted a new permit for the region, Order No. 2001-01.

The following is a chronological summary of storm water monitoring programs in the San Diego region over the past ten years from the *Previous Storm Water Monitoring and Future Recommendations* Report (MEC 2001). Emphasis is placed on reviewing the progression of monitoring objectives and methodologies.

1.2.1 1993-1994 Objectives and Key Elements

The primary objective of this program was to measure pollutant concentrations and provide preliminary estimates of pollutant loads for use in establishing storm water management program priorities (Kinnetic Laboratories 1994).

The first year's monitoring program was designed by a task force of the Copermittees, and approved by the RWQCB. Storm water monitoring in the 1993-1994 season was performed at 15 sites. Each of these sites utilized flow-composited storm water monitoring stations. Six sites with relatively small catchments and one dominant land use per drainage were classified as land use stations. Different land uses that were evaluated include residential, commercial, industrial, and construction. The purpose of these land use stations was to identify the concentration of constituents of concern (COC) that result from the net effect of activities within each different land use type. Two construction sites and seven mass loading stations (MLS) were also monitored in the 1993-1994 season. These MLS were selected to directly measure pollutant loading for typical storm events from major watersheds. Criteria for selecting which watersheds would be monitored included choosing those with more populated urban portions of the region and those jurisdictions that discharge into the bays and coastal ocean waters.

Land use sampling station sites included:

- Residential Sites – Jeremy and Park
- Commercial Sites – Wal-Mart and Yuma
- Industrial Sites – Vernon and Yarrow
- Construction Sites – Top Gun and Proctor

Mass loading sites included:

- Carroll
- Rose
- Tecolote

- San Diego River
- Switzer
- Chollas
- Otay

The primary variable used to assess COC concentrations from storm water data collected during the 1993-1994 season was the event mean concentration (EMC). The EMC was defined as the total pollutant load divided by the total runoff volume per storm event. EMC estimates were directly assessed by measurement of COC concentrations in the flow-weighted composite samples, which is a mechanical technique of obtaining the values. The 1993-1994 monitoring program mandated collection of two storm events at each of the 15 sites.

The storm water data collected in the 1993-1994 season was compared against the Nationwide Urban Runoff Program (NURP) data (EPA 1983), land use water quality data from other regional studies in California, and water quality objectives adopted in the *Water Quality Control Plan for the Inland Surface Waters of California* (ISWP). The results of the land use monitoring in San Diego County showed:

- Lead concentrations in San Diego County were lower than NURP estimates, while the concentration of most other metals was comparable to the results of NURP sites.

- San Diego County nutrient data was elevated compared to similar regional sites.

- Concentrations of bacterial indicators were high, but in line with NURP data.

1.2.2 1994-1995 Objectives and Key Elements

The RWQCB issued a new Monitoring and Reporting Program on June 30, 1994 for the second year of the San Diego Regional Storm Water Monitoring Program. This program was similar to the first year's program, but included additional land use stations and eliminated some of the previous mass loading stations. Toxicity testing and sampling and testing of sediments in Chollas Creek and the nearby San Diego Bay sediments were also added. Construction site monitoring was also eliminated.

The primary objectives of the storm water monitoring program for the 1994-1995 season (Kinnetic Laboratories 1995) were:

- Directly measure pollutant loadings during typical storm events from highly urbanized San Diego area watersheds that discharge directly into important bay and stream receiving waters. The purpose of these stations was to evaluate area-wide contributions of storm water pollutant loadings to receiving waters.

- Characterize storm water runoff discharges from small, relatively homogeneous drainages identified as representative of residential, commercial, and industrial land use activities within San Diego County. The purpose of gathering these data was to identify and monitor the effectiveness of specific best management practices (BMPs) associated with land use activities (however, these specific BMPs are not addressed in the final report).

- Investigate receiving water impacts by measuring aquatic toxicity of storm water runoff and sediments in San Diego Bay at the discharge area of one of the urban creeks (Chollas Creek).

While the 1993-1994 monitoring program mandated collection of two storm events at each of the 15 sites, the 1994-1995 monitoring program required three storm events at each of the 12 locations chosen for monitoring. Flow-weighted composites were taken and discharge volumes for each storm event were recorded. Grab samples were collected for measuring pollutant constituents in storm water not amenable to composite sampling techniques. EMC were calculated for each COC.

Similar to the 1993-1994 season, data from the 1994-1995 season were compared against NURP data, land use water quality data from other regions, and water quality objectives. In addition, sediment samples from four locations within Chollas Creek and in San Diego Bay at the mouth of Chollas Creek were evaluated for physical, chemical, and toxicity attributes. New land use sites included Landis (residential), Bramson (commercial), and Crosby (industrial).

The findings of the land use monitoring were similar to those in 1993-1994 with the addition that mean EMC data from San Diego County for copper were lower than NURP values. Nitrogen concentrations that were slightly elevated in 1993-1994 were reduced and consistent with NURP data in 1994-1995.

1.2.3 1995-1996 Objectives and Key Elements

Storm water monitoring requirements for the 1995-1996 season were published on October 31, 1995 under tentative RWQCB Order No. 95-76. The objective of the monitoring and reporting program was to characterize storm water pollutant loading and concentrations, including long-term trends during the wet-weather season, which was defined as October 1 to April 30 of each year (Woodward-Clyde 1996).

The 1995-1996 monitoring program consisted of sampling three storm events at 12 stations. Stations included nine land use and three MLS sites. The nine land use sites were clustered in three geographic areas including North County, South County, and a heavily populated urban area of the City of San Diego. MLS were located at Tecolote, Switzer, and Chollas Creeks. The list of analytes specified in Order No. 95-76 included many of those chemicals listed under 40 CFR 122, Appendix D, Table II and III, as well as pollutant indicators listed in 40 CFR 122.26(d)(2)(iii)(A)(3). Those analytical parameters are listed in Table 1-1. For this wet-weather season, Technical Change Order No. 1 authorized the analysis for Total Recoverable Metals instead of Dissolved Metals.

Pre- and post-wet season sediment samples were taken upstream of the MLS location in Chollas Creek and at the mouth of Chollas Creek in San Diego Bay to evaluate storm water effects on the receiving water environment by assessing bottom sediments. Samples were collected within the two-week periods prior to October 1, 1995 and after April 30, 1996 in accordance with tentative RWQCB Order No 95-76. Physical, chemical, and toxicity analyses were performed on the sediment samples as specified in the RWQCB Order.

Table 1-1. Analytical requirements for each type of monitoring site as specified in RWQCB Order 95-76 (Woodward-Clyde 1998).

Constituent	Monitored Station Designation		
	Land Use	Mass Loading	Creek and Bay Sediments
General Physical and Inorganic Non-Metals	●	●	
Total Dissolved Solids (TDS)	●	●	
Total Suspended Solids (TSS)	●	●	
Turbidity	●	●	
Total Hardness	●	●	
pH	●	●	
Specific Conductance	●	●	
Temperature	●	●	
Total Phosphorus	●	●	
Dissolved Phosphorus	●	●	
Nitrate and Nitrite	●	●	
Total Kjeldahl Nitrogen (TKN)	●	●	
Ammonia	●	●	
Total Cyanide	●	●	
Biological Oxygen Demand, 5-day	●	●	
Chemical Oxygen Demand	●	●	
Percent Solids			●
Grain Size			●
Organics			
Total Petroleum Hydrocarbons	●		●
Oil and Grease	●	●	
Total Phenols	●	●	
Acid/Base/Neutral Extractable Compounds	●	●	●
Chlorinated Pesticides	●	●	●
Methylene Blue Active Substances	●	●	
Total Organic Carbon			●
Metals, Total Recoverable			
Antimony	●	●	
Arsenic	●	●	●
Beryllium	●	●	
Cadmium	●	●	●
Chromium	●	●	●
Copper	●	●	●
Lead	●	●	●
Mercury	●	●	●
Nickel	●	●	●
Selenium	●	●	
Silver	●	●	●
Thallium	●	●	
Zinc	●	●	●
Bacteriological			
Total Coliform	●	●	
Fecal Coliform	●	●	
Fecal Streptococcus	●	●	
Toxicity			
Ceriodaphnia dubia		●	
Pimephales promelas		●	
Eohaustorius estuarius			●

1.2.4 1996 – 2000 Objectives and Key Elements

The objectives of the Copermittee storm water monitoring program did not change significantly from those defined for the 1995-1996 permit year over the period covering 1996 through 2000. Changes in the administration of the program from 1996 through 2000 are summarized below.

- In 1996-1997, storm water monitoring was conducted at the previous nine land use stations and four MLS. Two of the MLS were monitored in the previous years. A new MLS on Chollas Creek replaced one that was tidally influenced, and new MLS were added at California Creek and Los Peñasquitos Creek at Sorrento Valley at the request of the RWQCB. The Switzer Creek location was eliminated because it was tidally influenced. Polycyclic aromatic hydrocarbons (PAH) were analyzed using ultra-low detection limits during the 1996-1997 wet-weather monitoring season as a one-time study to quantify the levels present in storm water runoff. The levels were generally one order of magnitude lower than those measured by the U.S. Navy in Paleta Creek and the Sweetwater River. The ultra-low detection limit PAH analysis was discontinued in subsequent years primarily because it was intended as a special study and the results did not warrant its continuation.

- The 1997-1998 monitoring program consisted of pre- and post-season sediment sampling at two locations and storm water sampling during rain events at 12 locations in San Diego County. The eight land use stations and four MLS monitored in 1997-1998 were the same stations monitored in 1996-1997.

- In 1998-1999, the scope of the storm water monitoring program was changed significantly based on discussions and research by a Storm Water Monitoring Working Group of Copermittees that met during September and October in 1998 and again in the fall of 1999. The Storm Water Monitoring Program Working Group evaluated new ways to obtain useful data by conducting focused monitoring for wet-weather season 1999-2000. Recommendations from the group and documented in Technical Change Order Nos. 2 and 3 included:

  - Elimination of eight land use stations from the program, as the previous five years of monitoring data were determined to be adequate for modeling purposes. Monitoring was conducted at the four MLS monitored in the previous year. A fifth MLS (AH1 – Agua Hedionda), which also served as a bacteria monitoring station, and four other bacteria monitoring stations were added to the program for a focused monitoring study in the Agua Hedionda watershed to determine sources of fecal contamination in runoff.
  - Elimination of constituents that were non-detect in 90 percent or more of the samples analyzed (included most semivolatile organic compounds, all organochlorine pesticides and polychlorinated biphenyls (PCBs), total cyanide, total beryllium, silver, mercury, and thallium).
  - Addition of Diazinon and Chlorpyrifos as new parameters.
  - The amphipod *Hyalella azteca* was used when performing toxicity tests in lieu of the fish *Pimephales promelas*.

- For the 1999-2000 wet-weather season, the RWQCB approved the proposed program in Technical Change Order No. 4 to the Monitoring and Reporting Order 95-76 dated November 5, 1999. This provided for additional studies of Diazinon usage in San Diego County and follow-up bacterial source tracking studies in Agua Hedionda Lagoon and Watershed.

1.2.5 2000-2001 Objectives and Key Elements

The storm water monitoring conducted in the 2000-2001 storm season was conducted under Order 95-76; however, Order 2001-01 was imminent and the Copermittees had several coordination meetings with the RWQCB to discuss the monitoring scope for the wet season. The Copermittees proposed a historical and statistical review of all prior years' monitoring results. This review was to include recommendations for the design of the next five years of monitoring (refer to *San Diego Region Previous Storm Water Monitoring Review and Future Recommendations, Final Report*, submitted August 20, 2001).

Until results of the historical review and design of the next five years of monitoring were completed, the MLS wet-weather monitoring sites were retained at the same five MLS as the prior year. The RWQCB requested the addition of stream health indicator studies at 23 stations pursuant to the California Department of Fish and Game (CDFG) Rapid Stream Bioassessment (RSB) Monitoring Program to supplement on-going monitoring in other areas of the County by the CDFG.

Sediment sampling at Chollas Creek both upstream and in San Diego Bay was conducted in October prior to the wet season. Post-wet season sampling in Chollas Creek and San Diego Bay was not conducted in order to allow Copermittees to provide sampling in support of the San Diego Bay Toxic Hot Spot Working Group (THSWG). The group was working on a monitoring study design to be conducted by SCCWRP and the US Navy. The RWQCB agreed to allow the Copermittees to direct resources at providing supplemental monitoring to the THSWG in lieu of monitoring post-wet season in 2001. The Copermittee monitoring support to the THSWG consisted of the collection of fine grain accumulated sediments within upstream reaches of Chollas and Paleta Creeks to assess contaminants available for discharge to the Bay during storm events.

1.2.6 2001-2002 Objectives and Key Elements

Order 2001-01 was adopted in February 2001 and the 2001-2002 monitoring season was conducted under this document. The Copermittee's activities in the 2001-2002 monitoring year included the following activities. Details of each activity are provided in the following pages.

- Chemical and toxicity testing of storm water runoff from 12 MLS located within major watersheds of the County of San Diego.
- Rapid stream bioassessments at 23 stations in Fall 2001 and Spring 2002.
- Development of an ambient bay and lagoon monitoring program using information from other bay and lagoon monitoring studies performed in southern California.
- Coastal outfall monitoring.
- Toxic hot spot monitoring.

The primary objective of this monitoring program was to determine the ecological health of receiving waters in the region based on chemical, physical, and biological evidence.

1.2.6.1 Water Quality Monitoring at the Mass Loading Stations

Twelve MLS were monitored during the wet-weather season over three separate viable storm events. A storm event was considered viable with a minimum of 0.1 inch of rainfall. Per RWQCB guidance, each storm of at least 0.1 inch of rainfall was separated by a minimum of 72 hours of rainfall, and the forecasted storm volume was within ±50% of the average storm volume and duration for the region. The 12 MLS are located within the following streams:

Santa Margarita River	Tecolote Creek
San Luis Rey River	San Diego River
Agua Hedionda Creek	Chollas Creek
Escondido Creek	Sweetwater River
San Dieguito River	Otay River
Peñasquitos Creek	Tijuana River

The monitoring at Santa Margarita River was performed by the Navy Public Works Center under the supervision of Storm Water/Solid Waste Branch Head, Camp Pendleton Marine Corps Base for security reasons.

The MLS at Otay River did not receive any runoff during 2001-2002, therefore this site was not sampled.

All sampling and analyses conducted at MLS were in accordance with applicable USEPA regulations and RWQCB guidance. One flow-weighted composite was collected along with one grab sample at each station during each storm. Grab samples were generally taken after the first hour of increased flow during the storm.

The Santa Margarita and San Diego River monitoring stations were co-located with United States Geological Survey (USGS) flow measuring stations. Flow rates at the other stations were monitored using an American Sigma flow meter with an ultrasonic sensor and/or a submerged pressure transducer. The sensor continuously measured stage and relayed that information to the flow meter. The flow meter continually calculated flow rates by inserting the stage information into the preprogrammed discharge equation.

Field crews measured the flow rate of streams at stations not rated using USGS stream profiling guidelines prior to the beginning of the storm season and periodically throughout the storm season. This was accomplished by manual rating techniques using a hand-held flow meter. The resulting discharge rates were used to calculate a discharge equation, which was utilized by the flow monitoring equipment at some stations. Other stations utilized velocity/stage measurements to calculate discharge rates.

The flow-weighted composite water samples were analyzed for the following parameters:

Inorganic chemicals – Ammonia, chemical oxygen demand (COD), total and dissolved phosphorus, nitrate, nitrite, total hardness, Total Kjeldahl Nitrogen (TKN), total dissolved solids (TDS), total suspended solids (TSS), turbidity, and methylene blue active substances (MBAS);

Metals (Total and Dissolved) – Antimony, arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc;

Organophosphate pesticides – Diazinon and Chlorpyrifos;

Toxicity Testing - At each station using *Ceriodaphnia dubia*, *Selenastrum capricornutum*, and *Hyalella azteca*.

Grab samples were analyzed for the following parameters:

Temperature, pH, specific conductance, oil and grease, biological oxygen demand (BOD), total coliform, fecal coliform, and enterococcus.

1.2.6.2 Ambient Bay, Lagoon, and Coastal Receiving Water Monitoring

The objective of 2001-2002 ambient bay, lagoon, and coastal receiving water monitoring program was to design a program that would be implemented in the 2002-2003 monitoring year to assess the conditions in the receiving waters. The 2001-2002 effort focused on reviewing results from other studies conducted in lagoons and bays in southern California. This review provided initial information regarding monitoring methods and statistical designs to develop an effective monitoring program for the Copermittee Storm Water Program.

1.2.6.3 Rapid Stream Bioassessment Monitoring

This task monitored stream health pursuant to California Department of Fish and Game (CDFG) Rapid Stream Bioassessment Monitoring (RSB) procedures.

Sampling and analysis of substrate samples for benthic infauna from each of 20 bioassessment monitoring stations and three reference stations (established in 2001) were conducted. Field measurements included pH, temperature, dissolved oxygen (DO), conductivity, flow rate, percent gradient, sampling area physiography, and overall assessment of physical habitat (e.g., vegetative cover and bank stability) at each station. Samples were analyzed in the MEC taxonomy laboratory pursuant to the CDFG procedure. A 10% quality assurance check was performed on taxonomic identification by the CDFG laboratory.

Sample data from all RSB Monitoring stations on the receiving waters within the jurisdictions of the Copermittees were analyzed. Multivariate assemblage analyses were conducted to simultaneously evaluate all the populations of benthic invertebrates to provide a relative assessment of ecological health.

1.2.6.4 Toxic Hot Spot Monitoring in San Diego Bay

The California Bay Protection and Toxic Cleanup Program (BPTCP) 1996 report identified areas of sediment contamination, benthic community impairment and toxicity to marine organisms in San Diego Bay. Based upon findings in the report, five specific areas in San Diego Bay were designated as toxic hot spots. Most of the areas lie at the outlets of creeks or storm drains, suggesting urban runoff is contributing to sediment toxicity at the toxic hot spots. Subsequently, four of the five sites were placed on the State's 303(d) list as impaired water bodies, leading to formal requirements for the establishment of TMDLs for those sites. In 1999, the U.S. Navy, the San Diego Unified Port District, and the City of San Diego formed a partnership, the Toxic Hot Spot Work Group (THSWG), to begin addressing these areas of concern. Monitoring for those sites was designed to support the development of TMDLs. For program consistency and to avoid duplicative efforts, the monitoring required by the permit was conducted within the context of and included the active involvement of the THSWG.

The THSWG, working with the RWQCB and SCCWRP, developed a workplan to study two of the five toxic hotspots beginning in July 2001. This work was conducted by the U.S. Navy and SCCWRP and

focused on evaluating sediment chemistry, sediment toxicity, and benthic communities at the discharges of Paleta and Chollas Creeks.

To augment the THSWG study, the Copermittees re-allocated monitoring efforts from the 2000-2001 wet-weather program's sediment monitoring of Chollas Creek. In lieu of conducting the second sediment sampling at the mouth of Chollas Creek in San Diego Bay, sampling upstream at two locations in Paleta Creek and three upstream locations in Chollas Creek was performed. The sediment samples were collected upstream of tidal influence and just below main tributaries to provide initial screening information about potential sources of bedload sediment contamination available for transport downstream to San Diego Bay. Sediment samples were analyzed for the same chemical parameters as proposed in the U.S. Navy/SCCWRP work. The study performed by the Copermittees provides supplementary information useful to the SCCWRP/Navy investigation at both Chollas and Paleta Creeks in San Diego Bay. The THSWG will utilize the results of this initial Copermittee monitoring program to design the next phase of investigation in San Diego Bay. The THSWG monitoring process is designed to be adaptive and based upon questions and answers elucidated from the results of this initial study.

1.2.6.5 Coastal Outfall Monitoring

Coastal Outfall Monitoring was conducted and reported by coastal jurisdictions.

1.2.7 2002 – 2003 Objectives and Key Elements

The monitoring conducted in 2002-2003 continues the monitoring program initiated in the 2001-2002 storm season.

1.2.7.1 Water Quality Monitoring at the Mass Loading Stations

Water quality monitoring at the MLS during the 2002-2003 wet-season was conducted following the methods described in Order 2001-01 and established during the 2001-2002 monitoring season. As indicated in the 2001-2002 Urban Runoff Monitoring Report, the MLS at Otay River never received any runoff; therefore, this station was removed from the 2002-2003 monitoring program. The Navy Public Works Center continued to perform monitoring on the Santa Margarita River. The 2002-2003 MLS were:

- Santa Margarita River (Navy Site)
- San Luis Rey River
- Agua Hedionda Creek
- Escondido Creek
- San Dieguito River
- Peñasquitos Creek
- Tecolote Creek
- San Diego River
- Chollas Creek
- Sweetwater River
- Tijuana River

Total organic carbon (TOC) and dissolved organic carbon (DOC) were added to the analytical requirements for each sample. All other testing and analyses were similar to those performed in 2001-2002 and were conducted in accordance with applicable USEPA regulations and RWQCB guidance.

1.2.7.2 Ambient Bay, Lagoon and Coastal Receiving Water Monitoring

The 2002-2003 monitoring season was the second year of this program, but the first year for sample collection, analysis and reporting. The program was designed to monitor the greatest potential water quality impact from urban runoff in a bay or lagoon (embayment). Based on a literature review, areas with the smallest sediment grain size and greatest TOC were most likely to reveal the water quality

impacts to the receiving water. Due to spatial and temporal variability, these areas are not permanently fixed. Therefore an embayment was most effectively monitored with a two-phase sampling program. In Phase I the embayment was stratified and sampled randomly within strata. These samples were analyzed and ranked based on grain size and TOC concentrations. In Phase II three sites representing areas of finest grain size and highest TOC were selected and resampled. These samples were subjected to toxicological testing and chemical and biological analyses. The selected smaller suite of samples were then tested individually or as a single composite.

Twelve coastal embayments were monitored. These included:

Santa Margarita River Estuary	San Elijo Lagoon
Oceanside Harbor	San Dieguito Lagoon
San Luis Rey River Estuary	Los Peñasquitos Lagoon
Buena Vista Lagoon	Mission Bay
Agua Hedionda Creek	Sweetwater River Estuary
Batiquitos Lagoon	Tijuana River Estuary

1.2.7.3 Rapid Stream Bioassessment Monitoring

During the 2002-2003 monitoring season, the methods for the rapid stream bioassessment monitoring program remained the same as the previous year, with minor changes. First, the monitoring sites were re-located to be correlated with the mass loading stations. This was performed in order to sample two sites of the water body within each hydrologic unit that had a mass loading station. One site was located as far downstream as possible, and the other site was located as far upstream as possible and still be located within an urban runoff receiving area. In 2001-2002, the sites were co-located with sites previously monitored by CDFG.

Data analysis was performed utilizing the San Diego Index of Biotic Integrity (IBI) score. This score provided a quantitative ranking of sites based on expected reference conditions. Originally, sites were relatively compared to each other utilizing the Benthic Macroinvertebrate Index (BMI).

1.2.7.4 Toxic Hot Spot Monitoring in San Diego Bay

Toxic Hot Spot Monitoring was conducted outside of this monitoring program by the RWQCB, the Port of San Diego, and the City of San Diego in collaboration with SCCWRP and the US Navy.

1.2.7.5 Coastal Outfall Monitoring

The individual coastal jurisdictions performed and reported on the monitoring efforts.

1.2.8 2003 – 2004 Objectives and Key Elements

The monitoring conducted in 2003-2004 continued the monitoring program initiated in the 2001-2002 storm season.

1.2.8.1 Water Quality Monitoring at the Mass Loading Stations

Water quality monitoring at the MLS during the 2003-2004 wet-season was conducted following the methods described in Order 2001-01 and established during the 2001-2002 monitoring season. As indicated in the 2001-2002 Urban Runoff Monitoring Report, the MLS at Otay River never received any

runoff; therefore, this station was removed during the 2002-2003 monitoring program. The Navy Public Works Center continued to perform monitoring on the Santa Margarita River. The 2003-2004 MLS were:

- Santa Margarita River (Navy Site)
- San Luis Rey River
- Agua Hedionda Creek
- Escondido Creek
- San Dieguito River
- Peñasquitos Creek
- Tecolote Creek
- San Diego River
- Chollas Creek
- Sweetwater River
- Tijuana River

All testing and analyses were similar to those performed in 2002-2003 and were conducted in accordance with applicable USEPA regulations and RWQCB guidance.

1.2.8.2 Ambient Bay, Lagoon, and Coastal Receiving Water Monitoring

The 2003-2004 monitoring season was the third year of this program, and the second year for sample collection, analysis and reporting. The program was designed to monitor the greatest potential water quality impact from urban runoff in a bay or lagoon (embayment). Based on a literature review, areas with the smallest sediment grain size and greatest TOC were most likely to reveal the water quality impacts to the receiving water. Due to spatial and temporal variability, these areas are not permanently fixed. Therefore an embayment was most effectively monitored with a two-phase sampling program. In Phase I, the embayment was stratified and sampled randomly within strata. These samples were analyzed and ranked based on grain size and TOC concentrations. In Phase II, three sites representing areas of finest grain size and highest TOC were selected and resampled. These samples were subjected to toxicological testing and chemical and biological analyses. The selected smaller suite of samples was then tested individually or as a single composite.

Twelve coastal embayments were monitored. These included:

- Santa Margarita River Estuary
- Oceanside Harbor
- San Luis Rey River Estuary
- Buena Vista Lagoon
- Agua Hedionda Creek
- Batiquitos Lagoon
- San Elijo Lagoon
- San Dieguito Lagoon
- Los Peñasquitos Lagoon
- Mission Bay
- Sweetwater River Estuary
- Tijuana River Estuary

1.2.8.3 Rapid Stream Bioassessment Monitoring

During the 2003-2004 monitoring season, the methods for the rapid stream bioassessment monitoring program remained the same as the previous year, with minor changes. A couple of the monitoring sites were relocated due to dry conditions. In addition, the San Diego Index of Biotic Integrity (IBI) was replaced by a more comprehensive Southern California IBI (Ode et al. 2005). The new IBI rating system covers a geographic range from southern Monterey County to the Mexican Border and inland to the eastern extent of the southern Coast Ranges. The new IBI is also tiered to account for elevation effects on benthic communities. The biological metrics used in the new IBI are different, and show a better response to watershed scale and stream reach scale disturbance gradients.

1.2.8.4 Toxic Hot Spot Monitoring in San Diego Bay

Toxic Hot Spot Monitoring was conducted outside of this monitoring program by the RWQCB, the Port of San Diego, and the City of San Diego in collaboration with SCCWRP and the US Navy.

1.2.8.5 Coastal Outfall Monitoring

The individual coastal jurisdictions performed and reported on the monitoring efforts.

1.3 2004-2005 Scope of Work

The monitoring conducted in 2004-2005 continues the monitoring program initiated in the 2001-2002 storm season. A summary of the wet-weather monitoring program stations from 1993 through 2005 is provided in Table 1-2, and the station locations are shown on Figure 1-1.

1.3.1.1 Water Quality Monitoring at the Mass Loading Stations

Water quality monitoring at the MLS during the 2004-2005 wet-season was conducted following the methods described in Order 2001-01 and established during the 2001-2002 monitoring season. The Navy Public Works Center did not perform monitoring on the Santa Margarita River during the 2004-2005 season due to sampling equipment being lost in flooding during the first rain event. The Navy indicated they would not sample during the remainder of the 2004-2005 wet-season. The 2004-2005 MLS were:

San Luis Rey River	Tecolote Creek
Agua Hedionda Creek	San Diego River
Escondido Creek	Chollas Creek
San Dieguito River	Sweetwater River
Peñasquitos Creek	Tijuana River

All testing and analyses were similar to those performed in 2003-2004 with the exception that the analysis for Chlorpyrifos and Diazinon by ELISA methodology was discontinued. Low level Chlorpyrifos and Diazinon analysis by EPA Method 625 (GC/MS) was continued as in the previous year which allows for monitoring of additional organophosphate pesticides. All tests and analyses were conducted in accordance with applicable USEPA regulations and RWQCB guidance. Table 1-3 presents a listing of all constituents **required** to be analyzed and the analytical methods utilized. Table 1-4 presents a listing of additional constituents **not required** by the permit, but are included as part of the methodology used during the determination of Chlorpyrifos and Diazinon.

For the 2004-2005 monitoring season, one toxicity identification evaluation (TIE) was performed at the Tijuana River site where toxicity was present.

Table 1-2. Wet-weather monitoring stations 1993-1994 through 2004-2005.

Site Name	Type	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05
NC1-Yuma	Commercial	●	●	●	●	●							
NC2-Park	Residential	●	●	●	●	●							
NC3-Yarrow	Industrial	●	●	●	●	●							
SC1-Jeremy	Residential	●	●	●	●	●							
SC2-Vernon	Industrial	●	●	●	●	●							
SC3-Walmart	Commercial	●	●	●	●	●							
SD1-Top Gun	Construction	●											
SD2-Proctor	Construction	●											
SD3-Carroll	Mass loading	●											
SD4-Rose	Mass loading	●											
SD5-Tecolote	Mass loading	●	●	●	●	●	●	●	●	●	●	●	●
SD6-San Diego River	Mass loading	●											
SD7-Switzer	Mass loading	●	●	●	●	●							
SD8-Chollas	Mass loading	●	●	●	●	●	●	●	●	●	●	●	●
SD9-Otay*	Mass loading												
SD10-Bramson	Commercial		●	●	●	●							
SD11-Crosby	Industrial		●	●	●	●							
SD12-Landis	Residential		●	●									
SD13-California	Mass loading				●	●	●	●	●				
SV1-Sorrento Valley	Mass loading				●	●	●	●	●				
AH1-Agua Hedionda	Mass loading						●	●	●	●	●	●	●
AH-Re-Residential	Bacteria						●	●					
AH-Co-Commercial	Bacteria						●	●					
AH-Os-Open Space	Bacteria						●						
AH-L-Lagoon	Bacteria						●	●					
AH-Lc-Lagoon	Bacteria							●					
AH-Lm-Lagoon	Bacteria							●					
AH-Rec-Residential	Bacteria							●					
AH-Coc-Commercial	Bacteria							●					
SMR-Santa Margarita River **	Mass loading									●	●	●	
SLR-San Luis Rey River	Mass loading									●	●	●	●
EC-Escondido Creek	Mass loading									●	●	●	●
SDC-San Dieguito Creek	Mass loading									●	●	●	●
PC-Peñasquitos Creek	Mass loading									●	●	●	●
SDR-San Diego River	Mass loading									●	●	●	●
SR-Sweetwater River	Mass loading									●	●	●	●
OR-Otay River***	Mass loading									●			
TJR-Tijuana River	Mass loading									●	●	●	●

*This station was established in the 1993/94 wet-weather monitoring season, but was vandalized before any sampling was performed.

**This station was not sampled by the Navy DPW in 2004/05 due to equipment loss during the first rain event.

***This station was decommissioned at the end of the 2001/02 season. No flow was ever recorded at this site.

Figure 1-1. Wet-weather monitoring stations for 1993 through 2005.

Table 1-3. Analytical requirements for Mass Loading Stations 2004-2005.

Constituent	Volume Required	Method	Reporting Limit	Units	Holding Time
General Physical and Inorganic Non-Metals					
Total Dissolved Solids (TDS)	100 mL	SM 2540 C	20	mg/L	7D
Total Suspended Solids (TSS)	100 mL	SM 2540 D	40	mg/L	7D
Turbidity	100 mL	SM 2130 A-B	0.1	NTU	48H
Total Hardness	150 mL	EPA 200.7	10	mg $CaCO_3$/L	6M
pH	In field	EPA 150.1	0.1	S.U.	I
Specific Conductance	In field	SM 2510 B	1.0	umhos/cm	28D
Temperature	In field				I
Dissolved Phosphorus	250 mL	SM 4500 B,E	0.05	mg/L	48H
Total Phosphorus	250 mL	SM 4500 B,E	0.10	mg/L	28D
Nitrite as N	200 mL	SM 4500 NO2 B	0.05	mg/L	48H
Nitrate as N	200 mL	SM 4500 NO3 E	0.1	mg/L	48H
Total Kjeldahl Nitrogen (TKN)	500 mL	SM 4500N C	0.5	mg/L	28D
Ammonia as N	250 mL	SM 4500 NH3B,C	0.1	mg/L	28D
Biological Oxygen Demand, 5-day (BOD)	1000 mL	SM 5210 B	2	mg/L	48H
Chemical Oxygen Demand (COD)	25 mL	EPA 410.4	25	mg/L	28D
Dissolved Organic Carbon (DOC)	200 mL	EPA 415.1	1.0	mg/L	
Total Organic Carbon (TOC)	200 mL	EPA 415.1	1.0	mg/L	
Methylene Blue Active Substances (MBAS)	250 mL	SM 5540 C	0.5	mg/L	48H
Organics					
Oil and Grease (O&G)	500 mL	EPA 413.2	1.0	mg/L	14D
Diazinon	1 L	EPA 625	0.05	µg/L	14D
Chlorpyrifos	1 L	EPA 625	0.05	µg/L	14D
Metals, Dissolved					
Antimony (Sb)	75 mL	EPA 200.8	0.006	mg/L	6M
Arsenic (As)	75 mL	EPA 200.8	0.002	mg/L	6M
Cadmium (Cd)	75 mL	EPA 200.8	0.001	mg/L	6M
Chromium (Cr)	75 mL	EPA 200.8	0.005	mg/L	6M
Copper (Cu)	75 mL	EPA 200.8	0.010	mg/L	6M
Lead (Pb)	75 mL	EPA 200.8	0.005	mg/L	6M
Nickel (Ni)	75 mL	EPA 200.8	0.005	mg/L	6M
Selenium (Se)	75 mL	EPA 200.8	0.005	mg/L	6M
Zinc (Zn)	75 mL	EPA 200.8	0.02	mg/L	6M
Metals, Total					
Antimony (Sb)	75 mL	EPA 200.8	0.006	mg/L	6M
Arsenic (As)	75 mL	EPA 200.8	0.002	mg/L	6M
Cadmium (Cd)	75 mL	EPA 200.8	0.001	mg/L	6M
Chromium (Cr)	75 mL	EPA 200.8	0.005	mg/L	6M
Copper (Cu)	75 mL	EPA 200.8	0.010	mg/L	6M
Lead (Pb)	75 mL	EPA 200.8	0.005	mg/L	6M
Nickel (Ni)	75 mL	EPA 200.8	0.005	mg/L	6M
Selenium (Se)	75 mL	EPA 200.8	0.005	mg/L	6M
Zinc (Zn)	75 mL	EPA 200.8	0.02	mg/L	6M
Bacteriological					
Total Coliform	200 mL	SM 9221 B	*	MPN/100 mL	6H
Fecal Coliform	200 mL	SM 9221 E	*	MPN/100 mL	6H
Enterococcus	200 mL	SM 9230	*	MPN/100 mL	6H
Toxicity	20 L				
7-day chronic test with the cladoceran *Ceriodaphnia dubia*					
Chronic test with the freshwater algae *Selenastrum capricornutum*					
Acute survival test with the amphipod *Hyalella azteca*.					

* Bacteriological methods are quantified from 20-16,000,000 MPN/100 mL

Table 1-4. Additional constituents analyzed for Mass Loading Stations 2004-2005.

Constituent	Volume Required	Method	MDL	Units	Holding Time
Organophosphorus Pesticides					
Bolstar	1 L	EPA 625	0.010	µg/L	14D
Coumaphos	1 L	EPA 625	0.010	µg/L	14D
Demeton (Total)	1 L	EPA 625	0.010	µg/L	14D
Dichlorvos	1 L	EPA 625	0.010	µg/L	14D
Disulfoton	1 L	EPA 625	0.010	µg/L	14D
Ethoprop	1 L	EPA 625	0.010	µg/L	14D
Fensulfothion	1 L	EPA 625	0.010	µg/L	14D
Fenthion	1 L	EPA 625	0.010	µg/L	14D
Guthion	1 L	EPA 625	0.010	µg/L	14D
Malathion	1 L	EPA 625	0.005	µg/L	14D
Merphos	1 L	EPA 625	0.010	µg/L	14D
Mevinphos	1 L	EPA 625	0.010	µg/L	14D
Parathion, methyl	1 L	EPA 625	0.010	µg/L	14D
Phorate	1 L	EPA 625	0.010	µg/L	14D
Ronnel	1 L	EPA 625	0.010	µg/L	14D
Stirofos	1 L	EPA 625	0.010	µg/L	14D
Tokuthion	1 L	EPA 625	0.010	µg/L	14D
Trichloronate	1 L	EPA 625	0.010	µg/L	14D

1.3.1.2 Ambient Bay, Lagoon, and Coastal Receiving Water Monitoring

The 2004-2005 monitoring season was the fourth year of this program, and the third year for sample collection, analysis, and reporting. The methods for the ambient bay, lagoon and coastal receiving water monitoring program remained the same as the previous year.

Twelve coastal embayments were monitored. These included:

Santa Margarita River Estuary
Oceanside Harbor
San Luis Rey River Estuary
Buena Vista Lagoon
Agua Hedionda Creek
Batiquitos Lagoon
San Elijo Lagoon
San Dieguito Lagoon
Los Peñasquitos Lagoon
Rose and Tecolote Creek deltas
Sweetwater River Estuary
Tijuana River Estuary

This report contains the results for the Phase II sampling conducted during the 2003-2004 monitoring season, and station location information and results for the Phase I sampling conducted during the 2004-2005 monitoring season.

1.3.1.3 Rapid Stream Bioassessment Monitoring

During the 2004-2005 monitoring season, the methods for the rapid stream bioassessment monitoring program remained the same as the previous year. Rapid stream bioassessment sampling occurred in October 2004 and May 2005. Rapid stream bioassessments were performed following the Southern California IBI rating system (Ode et al. 2005).

1.3.1.4 Toxic Hot Spot Monitoring in San Diego Bay

Toxic Hot Spot Monitoring was conducted outside of this monitoring program by the RWQCB, the Port of San Diego, and the City of San Diego in collaboration with SCCWRP and the US Navy.

1.3.1.5 Coastal Outfall Monitoring

The individual coastal jurisdictions continued to perform and report on the monitoring efforts. These data were analyzed and utilized in this report during the process of conducting the watershed management area assessments.

1.4 Report Organization

This report is organized to represent a watershed approach to reviewing the results. The methods for the storm water monitoring, rapid stream bioassessments, ambient bay and lagoon monitoring, and the WMA assessments are combined into a single section (Section 3). Sections 4 – 12 each represent a single WMA and results for each of the monitoring programs and watershed assessments specific to each WMA are presented together. Similar to previous years, a cross watershed comparison follows the watershed management area results. Table 1-5 provides a brief layout of this year's report organization:

Table 1-5. Report Organization.

Section	Description
2	Describes the study area on a regional and watershed scale.
3	Provides methods for the storm water monitoring, rapid stream bioassessment, and ambient bay and lagoon monitoring programs, and watershed management area assessments.
4	Santa Margarita River WMA results, including monitoring site descriptions, storm water monitoring (not performed at this site in 2004-2005), stream bioassessment, and ambient bay and lagoon monitoring. Results of each program are combined and an assessment of the watershed management area is presented.
5	San Luis Rey River WMA results, presented in a similar fashion as Section 4.
6	Carlsbad WMA results, presented in a similar fashion as Section 4.
7	San Dieguito River WMA results, presented in a similar fashion as Section 4.
8	Los Peñasquitos River WMA results, presented in a similar fashion as Section 4.
9	Mission Bay WMA results, presented in a similar fashion as Section 4.
10	San Diego River WMA results, presented in a similar fashion as Section 4.
11	San Diego Bay WMA results, presented in a similar fashion as Section 4.
12	Tijuana River WMA results, presented in a similar fashion as Section 4.
13	Provides a regional overview of findings and a statistical comparison of the region's watersheds.
14	Provides conclusions and recommendations for the 2005-2006 Receiving Waters Monitoring Program.
15	References
Appendix	Appendices A through I