5.1 OBJECTIVES ACHIEVED

Since 1994, the goal of the Monitoring Program has been to develop information to support effective watershed stormwater quality management programs. The primary objectives of the Monitoring Program, as outlined in the Permit and Section 1 of this report, follow.

5.1.1 Track Water Quality Status, Pollutant Trends and Pollutant Loads, and Identify Pollutants of Concern

Water quality status and pollutant trends and loads were successfully addressed by all of the major monitoring program elements: the Santa Monica Bay receiving waters impact study, the mass emission monitoring element, the land use monitoring element, and the critical source monitoring element.

The Santa Monica Bay receiving waters impact study extended from the 1996-97 through the 1998-99 storm seasons and focused on discharge from Ballona and Malibu Creeks.

The five mass emission stations located on major tributaries to the Pacific Ocean sampled runoff from 1220 of 2086 square miles of the Los Angeles coastal basin. The only major watershed not monitored for mass emissions was the largely undeveloped Santa Clara River watershed in the northwest part of the permit area. The mass emission data was also used to identify pollutants of concern and to calculate seasonal loads. Since January 1995, 212 station events have been sampled. Generally, sampling activities were conducted according to plan, and attempts were made to capture as many storms as possible. Initial mechanical difficulties with the sampling equipment were overcome over the years of use.

The siting of these stations was dictated in large part by accessibility and the availability of public right of way. All five mass emission stations were set up in existing Department of Public Works stream gauge shelters. Two of the mass emission stations, Ballona Creek and Malibu Creek, have the longest record, sampling since January 1995, and the balance of the mass emission stations have been sampling since the 1995-96 storm season. The automated equipment also provided the collection of flow-weighted composite samples, which reflect and allow for varying constituent concentrations throughout the storm event.

The sampling of runoff from land use specific drainage areas also began in January 1995 with the installation of automated equipment in the Santa Monica Pier drain (retail/commercial). By the 1995-96 season, four more of the current land use monitoring stations were installed (high density SFR, vacant, light industrial, and transportation). When the current permit came into effect in July, 1996, two more land use stations were installed (multifamily residential and educational). The final land use monitoring station (mixed residential) was installed by the 1997-98 storm season. Similar flow-weighted compositing was accomplished through the use of automated equipment for sampling runoff from land use-specific drainage areas.

In contrast to the mass emission stations, land use monitoring stations are largely located in underground drains. Their siting was therefore more complicated, requiring the identification of locations where the drainage area was the predominant land use, where there was a manhole near available power in available right-of-way, where the drain was not surcharged in a moderate storm, and where personnel would be relatively safe. Since 1995, 396 station events have been sampled.

The land use monitoring was successful at characterizing runoff from land use specific drainage areas and developing seasonal mean concentrations. Seasonal mean concentrations (also called Event Mean Concentrations) were used for calculating loading from unmonitored watersheds. It was found that seasonal mean concentrations were below the 25% error rate in 77% of circumstances.

Monitoring at the land use stations and mass emission stations included a broad constituent suite including bacteria, metals, organics, major ions, and nutrients. The laboratory analytical efforts achieved detection limits (DL) as required by the Permit for all constituents, and achieved DLs that were lower than Permit requirements for many analytes, particularly for constituents of concern.

5.1.2 Monitor and Assess Pollutant Loads from Specific Land Uses and Watershed Areas

The mass emission and land use monitoring elements were successful at assessing loading. Loading was first reported in the 1994-95 Los Angeles County Stormwater Monitoring Report. Subsequent loading based on both observed and modeled data was also reported in the 1998-99 and 1999-2000 Reports. The County's GIS Loading Model has been recognized as an innovative solution to estimating loading in unmonitored watersheds.

5.1.3 Identify, Monitor, and Assess Significant Water Quality Problems Related to Stormwater Discharges Within the Watershed

The monitoring program was successful at identifying significant water quality problems associated with stormwater discharge. First, the Santa Monica Bay receiving waters impacts study identified zinc and copper from Ballona Creek discharge as being toxic to the fertilization rate of simple marine animals. Toxicity testing of dry and wet weather flow in the Los Angeles and San Gabriel Rivers also identified toxicity problems. The extent and severity of bacterial indicators was better understood through wet weather mass emission sampling and ad hoc dry weather sampling.

5.1.4 Identify Sources of Pollutants in Stormwater Runoff

All of the major monitoring program elements were used successfully to identify stormwater pollutant sources. The Santa Monica Bay receiving waters study identified Ballona Ck., and not Malibu Ck., as a contributor of stormwater toxicity. Further, it identified zinc and copper as two metals contributing to the toxicity. The mass emission monitoring identified the Los Angeles River as consistently contributing the most zinc, copper, and suspended solids.

The land use monitoring identified light industrial, transportation, and retail/commercial land uses as developing the highest median concentrations for total and dissolved zinc. Light industrial and transportation land uses displayed the highest median concentrations for total and dissolved copper, and light industrial produced the highest concentrations of suspended solids.

Finally, the critical source monitoring program identified fabricated metal businesses as producing the highest median concentrations for zinc, copper, and suspended solids.

5.1.5 Identify and Eliminate Illicit Discharges

Each Permittee has a program to identify and eliminate illicit connections to the storm drain system to the maximum extent practicable. One of the programs developed for the elimination of illicit connections is open channel and underground storm drain inspections.

Most Permittees perform random area surveillance during dry and wet weather to inspect for potential illegal discharges. The Permittees also conduct educational site visits at businesses. During these visits, flyers with information on Best Management Practices (BMPs) applicable to that business are distributed.

The County, maintaining the majority of the storm drains within Los Angeles County, conducts routine inspections of the storm drain system for illicit connections/illicit discharges. Maps and connection inventory reports for 1,304 storm drains have been prepared to facilitate these inspections, which have resulted in the discovery of 1,993 undocumented connections as of July of 1999. These connections are either removed or permitted.

A toll free number 1-888-CleanLA was created for the public to report observed illicit connections/illicit discharges to the storm drain system.

It is recommended that the IC/ID model program approved by the Regional Board on March 23, 1999, be continued.

5.1.6 Evaluate the Effectiveness of Management Programs including Pollutant Reductions Achieved by Implementation of Best Management Practices (BMPs)

The Critical Source element of the monitoring program was successful at examining the potential effectiveness of good housekeeping and preventive types of voluntary Best Management Practices at one critical source industry. While two of the industries showed no significant improvement as the result of implementing BMPs, the fabricated metal industry showed significant improvement for total and dissolved copper.

5.1.7 Assess the Impacts of Stormwater Runoff on Receiving Waters

The receiving waters impact study, one of the first to assess stormwater impacts on the marine environment, was very successful at assessing stormwater impacts on Santa Monica Bay. The study was performed by the Southern California Coastal Waters Research Project, the University of Southern California, and the University of California Santa Barbara. The plume study found that freshwater plumes extended for a number of miles out to sea and often persisted for a number of days after a storm. The toxicity study found that the stormwater discharge from Ballona Creek was toxic to sea urchin fertilization and that dissolved zinc and copper were contributors to the toxicity. The study also found that sediments offshore of Ballona Creek generally had higher concentrations of urban contaminants, including common stormwater constituents such as lead and zinc.

5.2 WIDE CHANNEL PILOT STUDY

The purpose of the wide channel pilot study (Woodward-Clyde et al, 1996) was to evaluate the accuracy of a single point water quality intake in representing the water quality in wide channels. Ballona Creek, Los Angeles River, San Gabriel River, and Coyote Creek can be considered wide

channels. The pilot study found the water homogenous through the depth and the width of the channel. Thus, the single point intake produces a representative sample, and no adjustments were made to the monitoring stations. A complete report of this pilot study may be found in Appendix E.

Additional analysis was conducted in 1998 confirming that vertical mixing was achieved.

5.3 LOW FLOW PILOT STUDY

The purpose of the low flow pilot study (Woodward-Clyde et al, 1996) was to assess the feasibility of modifying the automated sampling equipment at land use stations in order to sample storms as small as 0.1 inch rainfall. The pilot study concluded that: operational effectiveness of automated equipment dropped significantly for storms as low as 0.1" rainfall, the feasibility and effectiveness of sample retrieval and transport became very difficult for such storms, and the ability to program and maintain low flow settings at other automated samplers could only be accomplished through large investments in telemetry. A complete report of this pilot study may be found in Appendix D.

Further analysis was conducted in 1998 that concluded 94 percent of total runoff volumes are monitored using the 0.25 inch threshold. Therefore, monitoring continued unaltered.

5.4 FUTURE MONITORING RECOMMENDATIONS

The following recommendations include monitoring, research, and studies that should be considered or undertaken to advance the understanding of stormwater quality science and support future TMDL development. Because of their scope, such studies should be undertaken by various entities, such as the Regional Water Quality Control Board, NPDES permittees, or by collaborative efforts between private and public organizations.

5.4.1 Mass Emission Element

Because the Pacific Ocean is a primary resource to Southern California, it is recommended that mass emission monitoring continue at the five existing sites for up to five storm events per season.

Non-Detection Test: The Permit states that if a given constituent is not detected in at least 25% of the samples taken in ten consecutive storm events at a given station, then that constituent may qualify for removal from the analytical suite for the associated station. For mass emission stations, several constituents met this criterion (see Table 4-7). Carbonate, the majority of heavy metals (24 of the 38), and all of the pesticides met the criteria in each of the mass emission sites. All of the semi-volatile constituents that had more than 10 samples met the criteria in each mass emission site as well. (Due to the change in detection limits of many SVOCs, there were fewer than 10 samples tested under the new limit.) Cyanide, total phenols, MBAS, dissolved aluminum, dissolved nickel, and total lead had less than 25% detection in four of the five sites. It is recommended that these constituents be removed from the analytical suite for the associated stations.

5.4.2 Land Use Element

One of the goals of the land use monitoring element was to develop Event Mean Concentrations (EMCs) for constituents of concern. The EMCs are used in the County's GIS Loading Model to calculate seasonal loading from unmonitored watersheds.

EMC Test: The Permit allows the discontinuation of monitoring at a land use station for specific constituents once the event mean concentration (EMC) is derived with an error rate of 25% or less. We used the mean standard error as a substitute for error rate as mutually agreed upon with the RWQCB (Swamikannu, 1999). Nitrate-Nitrogen achieved the 25% error rate at each of the land use monitoring sites. Total kjeldahl nitrogen (TKN) and total phosphorus met the criteria at seven of the eight land use sites. Dissolved copper, total zinc, dissolved zinc, ammonia-nitrogen, nitrate, and dissolved phosphorus met the criteria at six of the eight sites.

Of 115 station-constituents under investigation, 26 of them had an EMC with a mean standard error higher than 25% (Table 4-14). In other words, there were 26 station-constituents which had a standard error (standard deviation of the mean) larger than 25% of their corresponding mean concentrations. Carbonate, the majority of heavy metals (24 of the 38), and all of the pesticides met the criteria in each of the land use sites. All of the semi-volatile constituents that had more than 10 samples met the criteria in each land use site as well. (Due to the change in detection limits of many SVOCs, there were fewer than 10 samples tested under the new limit.) Flouride, MBAS, dissolved aluminum, and total lead had less than 25% detection in seven of the eight sites.

Given the findings of both the non-detect test and the EMC test, it is recommended that the following land use stations monitor the following constituents only:

Constituents for Future Land Use Monitoring

LAND USE STATION	DRAINAGE SYSTEM	FUTURE MONITORING
Retail/Commercial	Santa Monica Pier Drain	Ammonia, total and dissolved copper, nitrate, total lead, TSS, PAH, diazinon, chlorpyrifos.
Vacant	Sawpit Wash	TKN, TSS, PAH, diazinon, chlorpyrifos.
High Density Single Family Residential	Bond Issue Project 620	Total Lead, PAH, diazinon, chlorpyrifos.
Transportation	Dominguez Channel	PAH, diazinon, chlorpyrifos.
Light Industrial	Bond Issue Project 1202	Total Copper, PAH, diazinon, chlorpyrifos.
Education	Bond Issue Project 474	Total Copper, Total Zinc, TSS, PAH, diazinon, chlorpyrifos.
Multifamily Residential	Bond Issue Project 404	Ammonia, Ammonia Nitrogen, Nitrite Nitrogen, TSS, PAH, diazinon, chlorpyrifos.
Mixed Residential	Bond Issue Project 156	Ammonia, Nitrate, Total Zinc, PAH, diazinon, chlorpyrifos.

Note that the retail/commercial site was removed in 1999 for construction of the City of Santa Monica's stormwater treatment plant. Future monitoring at this site may be in jeopardy.

5.4.3 Critical Source Element

Limited success was achieved in evaluating BMP effectiveness for two of the first three industries. The reasons for no discernable differences in concentrations before and after BMP implementation at the two industries are not obvious, but may include the voluntary nature of the BMP usage. However, valuable baseline data has been collected to date, and success was seen at one critical source industry. Therefore, it is recommended that the critical source program continue as described in the 1996 Municipal Stormwater Permit until eight critical industries are studied.

5.4.4 TMDLs in Los Angeles County

By March, 2006, at least 22 impaired water bodies in Los Angeles County will come under Total Maximum Daily Load (TMDL) regulation due to the recent Consent Decree (Los Angeles Regional Water Quality Control Board et al, 1999). The pollutants claimed to be causing impairment include trash, nutrients, coliform, nitrogen, metal, PCBs, pesticides, and chlordane. It is recommended that receiving water impact studies be performed on significant impaired water bodies to identify impacts due to stormwater. Such impact studies could include assessments of bioassessment.

5.4.5 Constituents of Concern

The following recommendations are based on the observation of problems identified by the monitoring program, namely: dry and wet weather bacteria indicators, zinc and copper toxicity in Ballona Ck., suspended solids linked to contaminated sediments, and toxicity in the Los Angeles and San Gabriel Rivers. These recommendations also recognize the concerns regarding possible stormwater impairment to water bodies under the forthcoming TMDL regulations.

5.4.5.1 Bacteria

Wet weather observations suggest that peak coliform levels may be related to regional hydrologic conditions. In an effort to characterize the presence and persistence of indicator bacteria in dry and wet weather, the Southern California Coastal Waters Research Project is conducting research and calibrating water quality models. Participation in these studies is recommended. It is further recommended that similar studies be initiated for other parts of the County where indicator bacteria impair beneficial uses.

5.4.5.2 Contaminated Sediments

Because contaminated sediments can be linked to suspended solids in stormwater, participation in the Corps of Engineers' Sediment Control Management Plan and the Coastal Commission Sediment Task Force is recommended. It is further recommended that receiving water impacts due to aerial deposition studies be conducted on inland watersheds.

5.4.5.3 Stormwater Toxicity

With the identification of zinc and copper in Ballona Creek stormwater discharge, it is recommended that major tributaries to Ballona Creek be surveyed to find possible contributing areas and sources.

It is recommended that two dry weather and two wet weather Toxicity Identification Evaluations be conducted for a full range of constituents on freshwater species on the L. A. River and Dominguez Channel.

It is recommended that two wet weather Toxicity Identification Evaluations be conducted for a full range of constituents on freshwater species on the San Gabriel River.

5.4.6 Receiving Waters Impacts

It is recommended that follow-up studies be conducted in Santa Monica Bay that address the persistence of stormwater plumes following storm events, the toxicity of stormwater on species other than sea urchins, and the fate of sediments in the Bay.

It is further recommended that a study be conducted assessing the impacts due to stormwater on San Pedro Bay.

5.4.7 Other Monitoring Activities

Participation and cooperation with local and regional monitoring programs is recommended, including but not limited to the Santa Monica Bay Restoration Project, the City of Long Beach, and the developing Southern California Regional Stormwater Monitoring Coalition.

It is also recommended that Best Management Practices and impacts be formally evaluated. Examples would include the City of Santa Clarita demonstration projects, catch basin inserts and deflectors, groundwater impacts due to stormwater infiltration, the Department of Public Works' parking lot retrofit, and storm drain low flow diversions.