This section describes the results, data analysis, and recommendations for the 2006-07 Monitoring Program.

4.1 HYDROLOGY: PRECIPITATION AND FLOW

The monthly rainfall during the 2006-07 storm season was compared to the long-term pattern of rainfall in Figure 4-1. Figure 4-2 illustrates that the total annual rainfall of 2.48 inches during the 2006-07 storm season in downtown Los Angeles was just 15 percent of the average annual rainfall. The average annual rainfall over 136 seasons at Station 716, Ducommun Street in downtown Los Angeles is about 15.51 inches. Table 4-1 summarizes the hydrologic and meteorological conditions of each station-event monitored during this storm season.

Appendix A contains hydrographs for each fully-monitored storm of the 2006-07 season. Each hydrograph includes the time of the first and last composite sample aliquot collection, the sample volume interval, runoff volume, and the percent of storm sampled.

Public Works' Water Resources Division has been operating the Santa Clara River runoff gaging station since the end of 2005, avoiding discharge record issues encountered last season. However, issues did come up at other sites over the course of the monitoring period. Public Works' Watershed Management Division's automated sampler flow data was used in those instances where the official record discharge data from Water Resources Division was not available or had technical issues. Instances where this occurred are indicated in the hydrographs in Appendix A.

4.2 STORMWATER QUALITY

An inventory of the composite and grab samples taken for the chemical and biological analysis and toxicity analysis during the 2006-07 monitoring season is included in Tables 4-2, 4-2a, and 4-3.

4.2.1 Mass Emission Analysis

This section provides a description of wet- and dry-weather mass emission results generated during the 2006-07 monitoring season.

Public Works analyzes an extensive number of individual water quality constituents, the results of which are included in Appendix B. A comparison was made between mass emission water quality results and the most stringent water quality objectives amongst the Ocean Plan, the Basin Plan, and the CTR. The freshwater final acute criteria set by the California Department of Fish and Game was also used to provide water quality standards for chlorpyrifos and diazinon.

The Municipal Stormwater Permit specifically requires the Los Angeles County Flood Control District to assess the pollutant loading for the sampling events that are analyzed for the complete list of constituents following the 2006-07 storm season. In addition, the Municipal Stormwater Permit requires the identification and analysis of any long-term trends in stormwater or receiving water runoff. An analysis of the correlation between pollutants of concern and Total Suspended Solids (TSS) loadings for the sampling events was also performed.

4.2.1.1 Comparison Study

A comparison to the most stringent applicable water quality standards from among the Basin Plan, the Ocean Plan, or the CTR for mass emission monitoring was conducted as required by the Municipal Stormwater Permit. The California Department of Fish and Game provided freshwater final acute criteria water quality standards for chlorpyrifos and diazinon.

The Basin Plan is designed to enhance water quality and protect the beneficial uses of all regional waters. The Ocean Plan is applicable to point source discharges to the ocean. The CTR promulgates criteria for priority toxic pollutants in the State of California for inland surface waters and enclosed bays and estuaries. Constituents that exceeded the most stringent applicable water quality standards are highlighted in Appendix B and Table 4-4. Table 4-4 and Figure 4-3 summarize this comparison analysis.

The following conclusions were drawn from the mass emission comparison study:

Wet Weather

Public Works met the Municipal Stormwater Permit requirement by monitoring at least three storms including the first one. Typically, Public Works monitors one additional storm each season, but this was impossible due to the very dry storm season. Also, many of the storms were sporadic and localized, leading to inconsistencies in the dates of monitored storms across the watersheds. Some storms were slightly under the NPDES Municipal Stormwater Permit 0.25 inches total rainfall requirement.

Monitoring at Dominguez Channel and Santa Clara River stations were the exception. Dominguez Channel was fully monitored four times, and the last event was to capture results to coincide with the Permit required second wet-weather toxicity test. Santa Clara River was fully monitored five times as the rainfall was more consistent in that higher elevation and manual sampling precluded any technical difficulties associated with automated samplers.

Results at issue were chosen to be those in which at least 75 percent of samples exceeded applicable water quality standards. This is similar to the pollutant investigation threshold of three exceedances of four sampling events in the Tributary Monitoring Program. A general overview of the results at issue is best presented using Table 1 below. An x indicates constituents for which at least 75 percent of samples exceeded applicable water quality standards in each watershed.

Table 1. Constituents for which at least 75 percent of samples exceeded applicable water quality standards for each watershed based on mass emission monitoring results.

Constituents	Watershed						
	San Gabriel River	Coyote Creek	Los Angeles River	Dominguez Channel	Ballona Creek	Malibu Creek	Santa Clara River
Enterococcus	X	X	X	X	X	X	X
Fecal Coliform	X	X	X	X	X	X	X
Total Coliform	X	X	X	X	X		X
Total Aluminum	X	X	X	X	X	X	X
Total Copper	X	X	X	X	X	X	X
Total Lead		X	X	X	X		
Total Zinc		X	X	X	X		
Ammonia		X		X	X	X	X
Cyanide			X	X			

The results show that:

- Bacteria exceedances were an issue throughout all of the watersheds during wet weather.
- Consistent metals exceedances were also an issue among all watersheds.

The results are in accord with the Constituents of Concern identified in the Department's 1994-2005 Integrated Receiving Water Impacts Report (Table 1, Executive Summary, page 5). The Constituents of Concern considered both wet- and dry-weather monitoring results, using yearly mean constituent values and applicable water quality standards to calculate the frequency and magnitude of exceedances.

Notable differences between this year's results and the 1994-2005 list of Constituents of Concern included:

- None of the dissolved metals were found to be an issue in any of the watersheds during this monitoring season. Dissolved metals are a Constituent of Concern in Coyote Creek, Los Angeles, River, Dominguez Channel, and Ballona Creek.

- Exceedances of the standard for Cyanide were only found in Los Angeles River and Dominguez Channel as opposed to all watersheds as reported in the 1994-2005 Integrated Receiving Water Impacts Report.
- Diazinon is a Constituent of Concern in Dominguez Channel and Santa Clara River, but only one exceedance was found (Coyote Creek dry-weather event) during this monitoring year.
- Ammonia was not identified as a Constituent of Concern in the 1994-2005 Integrated Receiving Water Impacts Report, but consistent exceedances for Ammonia were found in samples taken at all stations, except at Los Angeles River.

Dry Weather

Public Works met the Municipal Stormwater Permit requirement for sampling two dry-weather samples at each monitoring station. A general overview of the results at issue is best presented using Table 2 below. An x indicates constituents for which at least 75 percent of samples (2 of 2 events) exceeded applicable water quality standards in each watershed.

Table 2. Constituents for which at least 75 percent of samples exceeded applicable water quality standards for each watershed based on mass emission monitoring results.

Constituents	Watershed						
	San Gabriel River	Coyote Creek	Los Angeles River	Dominguez Channel	Ballona Creek	Malibu Creek	Santa Clara River
Enterococcus	X			X	X		X
Fecal Coliform	X				X		
Total Copper	X	X	X	X	X	X	X
Cyanide		X	X				
Chloride							X
Ammonia	X	X	X	X			
Sulfate						X	
Total Dissolved Solids		X			X		

The results show:

- As with the wet-weather results, these results were in general agreement with those on the list of Constituents of Concern identified in the 1994-2005 Integrated Receiving Water Impacts Report. The strongest exceptions were that no dissolved metals or Diazinon exceedances were found.

- Consistent Enterococcus indicator bacteria exceedances were found in the San Gabriel River, Dominguez Channel, Ballona Creek, and Santa Clara River during dry weather.

- Fecal Coliform was also an issue for Ballona Creek and San Gabriel River. Malibu Creek had no exceedances of the water quality standards for Enterococcus and Fecal Coliform during dry weather during this season.

- Consistent Total Copper exceedances were found in all watersheds as was indicated above during wet-weather events.

- Cyanide exceedances crossed the 75 percent exceedances parameter only at the Coyote Creek and Los Angeles River, whereas it is a listed Constituent of Concern across all watersheds.

- Chloride and Total Dissolved Solids (TDS) were not identified as Constituents of Concern. However, all dry weather samples exceeded the water quality objective guidelines at Santa Clara River for Chloride; and Ballona Creek and Coyote Creek for TDS.

- Note that there are no water body specific objectives for TDS at Ballona Creek, Coyote Creek, and Dominguez Channel. The effluent limit was based upon the guidelines in the Basin Plan, which would be protective of the potential MUN Beneficial Use.

- Sulfate and Ammonia exceedances were found to be an issue during dry weather. Those two constituents are not on the list of Constituents of Concern identified in the 1994-2005 Integrated Receiving Water Impacts Report. Sulfate was an issue in Malibu Creek, and Ammonia was an issue in San Gabriel River, Coyote Creek, Los Angeles River, and Dominguez Channel during dry weather.

Loading and Trend Analysis

Public Works met the Municipal Stormwater Permit requirement to collect and analyze TSS samples at all mass emission stations equipped with automated samplers for storm events of at least 0.25 inches of rainfall. The concentrations for TSS for each storm is shown in Table 4-7 and the total loading for TSS for each mass emission station is shown in Table 4-8. An estimate of the total pollutant loads for each mass emission station is shown in Table 4-9, representative of stormwater and urban runoff.

It is possible to see if there is any correlation between storm events and the amount of pollutant loading, by analyzing the pollutant loading at each mass emission station,.

Figure 4-4 represents an analysis of trends in stormwater or receiving water quality. Some first flush phenomena are observed, primarily with pollutants associated with particulate matter, and storms with greater runoff volumes typically have larger pollutant loadings. It may be possible to analyze the loading as it relates to total precipitation or precipitation intensity, although an analysis of loading versus time yields little useful information in the short term.

Long term temporal trends cannot be found by analyzing one year's worth of data and an analysis of historical long term temporal trends can be found in the 1994-2005 Integrated Receiving Water Impacts Report. Additional long term trend analysis will be conducted for the next Integrated Receiving Water Impacts Report.

Public Works has recently developed an Integrated Water Quality Database. Trend analysis can be conducted with less effort, once previously collected data is entered into the system.

The following conclusions were deduced from the loading analysis:

- The extremely low amount of rain created an unusual combination of modest pollutant loads and high concentrations. This can be explained as a first flush phenomenon. Pollutants accumulate during the dry season and wash off during the first storm event(s) of the year.

- The total runoff volume and pollutant loading at the Los Angeles River Monitoring Station was usually higher than at the other monitoring stations. Los Angeles River has approximately two to twenty-five times the surface area of the other watersheds. This creates more potential for surface runoff pollution and likely explains, in part, the increased loading of constituents at the Los Angeles River Monitoring Station when compared to the other monitoring stations.

- The storm on December 9, 2006, produced the single largest TSS load of the season at the Los Angeles River with a load 6,650 tons. The Los Angeles River is the largest contributor of TSS out of the seven mass emission stations monitored, although other watersheds sometimes contribute larger loads during particular storm events.

- Five of the seven mass emissions stations exhibited first flush phenomena for TSS. TSS concentrations tended to increase over the season at Coyote Creek, and concentrations in the Santa Clara Watershed varied largely by storm.

- TSS concentrations were usually much higher during wet weather than during dry sampling events. However, the first dry-weather sampling event at San Gabriel River was higher than any measured wet-weather events at the same location.

- High levels of Aluminum, bacteria, Copper, Lead, Nickel and Zinc were observed at most mass emission stations during most events, and the metals levels tended to decline through the storm season.

- MBAS loading, which indicates the presence of surfactants, was generally higher in the more urbanized watersheds. MBASs tended to exhibit first flush phenomena in more rural watersheds, but tended to be present at fairly constant levels in the more urbanized watersheds. This suggests continuous sources in the urbanized areas, while the more rural watersheds may have periodic or seasonal sources.

- In general, TDS loads and loads from individual dissolved constituents increased during the storm season, most likely due to the presence of water in the watersheds after the first storm. This water collected dissolved materials and was then flushed into the MS4 system by additional rainfall. However, other dissolved constituents were observed mainly during the first storm, suggesting that they are present on the surface rather than in the ground.

Pollutant Loading Example

At the request of the Regional Water Quality Control Board, below is an example of the pollutant loading calculation:

Site: Ballona Creek Mass Emission Station

Storm event: 12/25/2003

Constituent: Nitrate

Concentration: 4.75mg/L

Runoff Volume: 481.8 acre-ft (440 acre-ft Runoff + 41.8 acre-ft Base Flow)
1lb = 454 g
1g = 1,000 mg
1L = 0.03531467 ft^3
1 ft^3 = 2.2957 x 10^{-5} acre-ft

Pollutant Loading = (Pollutant Concentration)(Runoff Volume)

Pollutant Load = (4.75 mg/L)(481.8 acre-ft)(1g/1,000 mg)(1 lb/454g)(1 ft^3/2.2957 x 10^{-5} acre-ft)(1L/0.03531467 ft^3)
Pollutant Load = 6223 lbs.

Conversion factors

4.1.2.3 Correlation Study

An analysis of the correlation between metals and other constituents and TSS levels for two mass emission and one tributary monitoring stations was performed. Not all constituents had a sufficient number of detections to be correlated and the correlation between most constituents and TSS levels was poor. Only those correlations with an R^2 value greater than 0.4 are presented.

Background

The 1994-2005 Integrated Receiving Water Impacts Report presented an analyses of the metals and TSS correlation. This report found that there was poor correlation between TSS and metals in all watersheds besides the Santa Clara River Watershed. It was suggested to remove the TSS correlation requirement from the permit in order to free up resources for increased tributary monitoring. These suggestions were included in the 2006 Report on Waste Discharge. In anticipation of the Regional Water Quality Control Board's concurrence, TSS correlation analysis was only conducted for the Santa Clara River Watershed, Ballona Creek Watershed and the Adams Drain Watershed in the 2005-06 Stormwater Monitoring Report.

Public Works continued the reduced TSS correlation efforts recommended in the 2006 Report of Waste Discharge as we did not receive any communication from the Regional Water Quality Control Board directing otherwise. TSS correlations were prepared for the Santa Clara River, the San Gabriel River and Upper San Jose Creek, once previously collected data is entered into the system,.

Current Efforts

A trend line was projected on each of the constituent-versus-TSS plots and the coefficient of determination (R^2) was calculated to see if there was any correlation between the concentrations for each constituent and TSS (Figure 4-5). The closer the value of R^2 is to the number one, the stronger the correlation of the two variables.

TSS correlation can serve at least two purposes in a Stormwater Monitoring Program:

- TSS testing alone could be substituted for an array of more costly tests, if strong correlations could be found between constituents of concern and TSS,. TSS correlation would result in an ability to redirect limited resources away from laboratory analysis and towards other aspects of the Public Works' compliance with the Municipal Stormwater Permit. Laboratory analysis can vary greatly in cost and complexity. Determination of TSS is an inexpensive and simple test, while measuring metal or pesticide concentrations can be very costly and require complex equipment.

- A second purpose that TSS correlation can play is in determining the origin and Best Management Practices (BMPs) for constituents. Strong correlation between a constituent and TSS may indicate that the constituent is found in particulate matter in that watershed. Examples include heritage pesticides associated with erosion or metal dust associated with brake pads and tires. Addressing pollution caused by particulate matter will have different challenges and require different techniques than pollution caused by liquids or gases.

The following conclusions were deduced from the correlation study analysis:

- The Santa Clara River Watershed, which the 1994-2005 Integrated Receiving Water Impacts Report indicated exhibited the largest number of correlations, had only six constituents what correlated with TSS with an R^2 value greater than 0.4. (Ammonia 0.71, Nitrate (N) 0.68, Nitrate (NO3) 0.67, Total Selenium 0.49, Total Cadmium 0.48, Total Organic Carbon 0.41).

- Three of the correlations were a form of Nitrogen, possibly suggestive of fertilizer runoff from landscaped areas or agriculture.

- The San Gabriel River Watershed had 19 constituents with a R^2 value greater than 0.4. (Alkalinity 0.49, Total Antimony 0.70, Dissolved Antimony 0.70, Total Arsenic 0.58, Total Barium 0.58, Dissolved Barium 0.65, Total Chromium 0.86, Dissolved Chromium 0.61, Total Copper 0.54, Dissolved Copper 0.74, Cyanide 0.80, Hardness as CaCO3 0.52, Ammonia (N) 0.70, Total Nickel 0.47, Nitrate-N 0.65, pH 0.43, Specific Conductance 0.43, Sulfate 0.49, Total Coliform 0.47).

- The highest R^2 value in the San Gabriel River Watershed was 0.86 for Total Chromium. This association of Chromium with particulate matter should be considered when implementing source identification and enforcement activities.

- The Upper San Jose Creek Watershed had 17 constituents with a R^2 value greater than 0.4. (Total Aluminum 0.96, Ammonia 0.50, Total Antimony 0.89, Total Arsenic 0.90, Total Barium 0.94, BOD 0.75, Total Cadmium 0.68, Total Chromium 0.95, Total Chromium VI 0.55, Total Copper 0.80, Dissolved Chromium VI 0.55, Total Iron 0.94, Dissolved Lead 0.80, Dissolved Nickel 0.44, Total Nickel 0.93, Dissolved Phosphorus 0.55, Dissolved Zinc 0.54).

- The highest R^2 value in the Upper San Jose Creek Watershed was 0.96 for Total Aluminum. This association of Aluminum with particulate matter should be considered when implementing source identification and enforcement activities. Also of note is that the second highest correlation in the Upper San Jose Watershed (tributary to the San Gabriel River Watershed) was for Total Chromium with an R^2 value of 0.95.

- San Gabriel River Watershed and Upper San Jose Creek Watershed had six metals in common that correlated to TSS with a R^2 value greater than 0.4. They were Antimony, Arsenic, Barium, Chromium, Copper, and Nickel.

- The Upper San Jose Creek Watershed exhibits correlations with R^2 values greater than 0.8 for 9 metals. They are Aluminum, Antimony, Arsenic, Barium, Chromium, Copper, Iron, Lead, and Nickel.

- The relatively strong correlation between some metals and TSS in the Upper San Jose Creek Watershed and the continued correlation of these metals in the San Gabriel River Watershed should be used to prioritize BMPs and investigative/enforcement actions for those metals.

- Correlation of TSS and constituent concentrations is poor in large watersheds with multiple sources. Correlations are better in smaller watersheds, most likely due to the relatively larger degree of homogeneity in sources.

- TSS correlation should be discontinued in the Mass Emissions Monitoring Program, but may prove to be a useful tool in the Tributary Monitoring Program.

- Use of the newly created Integrated Water Quality Database will allow for more extensive TSS correlation efforts in the future. At this point in time only the present year's data is available, but efforts are underway to import historical water quality records.

4.2.2 Tributary Monitoring Analysis

This section provides a description and analysis of wet- and dry-weather tributary results generated during the 2006-07 monitoring season.

Public Works met the Municipal Stormwater Permit requirement for tributary monitoring analysis by monitoring at least four storms, including the first storm of the season. Tributary monitoring analysis included all of the water quality constituents monitored under the mass emission monitoring program, Though only a requirement for the first storm of the season. The results are included in Appendix B. Flow was also measured and is reported as hydrographs, which can be found in Appendix A. A comparison was made between tributary water quality results and the most stringent water quality objectives amongst the Ocean Plan, the Basin Plan, and the CTR, in order to identify the subwatersheds where stormwater discharges are causing or contributing to exceedances of water quality standards. The freshwater final acute criteria set by the California Department of Fish and Game was also used to provide water quality standards for Chlorpyrifos and Diazinon.

Since the tributary monitoring stations collect samples from subwatersheds within the San Gabriel River Watershed, the results from the San Gabriel River and Coyote Creek Mass Emission stations were also used in the analysis. The Big Dalton Wash/Walnut Creek, Puente Creek, and Upper San Jose Creek stations are upstream of the

San Gabriel River Mass Emission Station. The North Fork Coyote Creek and Storm Drain 21 (Artesia-Norwalk Drain) stations are upstream of the Coyote Creek Mass Emission station. The Maplewood Channel station is situated below the San Gabriel Mass Emission station. Maplewood Channel results were analyzed in comparison with those from the Coyote Creek Mass Emission station due to their relatively close proximity.

It was not possible to accurately identify any problems based on dry weather results as only two samples were taken at each tributary monitoring station in compliance with the Municipal Stormwater Permit as modified by the Los Angeles Regional Water Quality Control Board. Nevertheless, efforts were expanded to analyze data from the two dry-weather events.

Constituents that exceeded the applicable water quality standards are highlighted in Appendix B and Table 4-5. Table 4-5 and Figure 4-3 summarize this comparison analysis. Tables 3 and 5 below provide a summary of findings based upon this monitoring year's results, using the three exceedances out of four sampling events (or 75 percent of samples) pollutant investigation threshold parameter in the NPDES Municipal Stormwater Permit. Tables 4 and 6 provide a ranked list of sites for consideration of management actions based upon monitoring conducted at the tributary monitoring sites this past year. A ranking based upon loading rates per area was created for each of the Constituents of Concern identified in the 1994-2005 Integrated Receiving Water Impacts Report for San Gabriel River and Coyote Creek Mass Emission sites, as applicable to each tributary grouping.

The following conclusions were drawn from the wet-weather tributary comparison study:

Table 3. Constituents for which at least 75 percent of samples exceeded applicable water quality standards for each watershed based on San Gabriel River Watershed Tributary site monitoring results.

Constituents	Watershed					
	Dalton/Walnut Creek (SGR)	**Puente Creek (SGR)**	**Upper San Jose Creek (SGR)**	Maplewood Channel (CC)	North Fork Coyote Creek (CC)	SD 21 (Artesia-Norwalk Drain) (CC)
Enterococcus	X	X	X	X	X	X
Fecal Coliform	X	X	X	X	X	X
Total Coliform	X	X	X	X	X	X
Total Aluminum	X	X	X	X	X	X
Total Copper	X	X	X	X	X	X
Total Lead		X		X	X	X
Total Zinc		X	X	X	X	X
Ammonia		X		X	X	X

Note that the drains in the dark shaded cells above are tributary to the San Gabriel Mass Emission station. The drains in the unshaded cells are and/or were analyzed as if they were tributary to the Coyote Creek Mass Emission station.

- These results align generally with the Constituents of Concern for San Gabriel River and Coyote Creek Mass Emission stations, respectively, identified in the 1994-2005 Integrate Receiving Water Impacts Report.

- The exceptions are that no consistent exceedances were found for Dissolved Lead, one of the Constituents of Concern in Coyote Creek.

- Ammonia exceedances in excess of the 75 percent parameter were found at some of the sites. That constituent was not identified in the list of Constituents of Concern for San Gabriel River and Coyote Creek.

- Total Zinc was not identified in the list of Constituents of Concern for San Gabriel River or Coyote Creek, yet significant exceedances were found in all tributaries except for the Big Dalton Wash/Walnut Creek site.

- Total Aluminum was not identified as a Constituent of Concern in Coyote Creek, yet consistent exceedances were found in both of its tributaries.

- Cyanide was not found to be an issue exceedance in any tributary, contrary to the Constituent of Concern list for both San Gabriel River and Coyote Creek.

Results from this past season's monitoring were analyzed and a loading per area metric was used to prioritize pollutant reduction activities, in order to help focus management actions in the San Gabriel River and Coyote Creek Watersheds. Only those Constituents of Concern that had consistent exceedances this past year were considered. Below are the results of that analysis for wet weather:

Table 4. Ranking of San Gabriel River and Coyote Creek Tributary Monitoring sites for management actions per Constituent of Concern identified for the respective watersheds in the 1994-2005 Integrated Receiving Water Impacts Report.

Management Action Rank Order (SGR shaded)	Constituents of Concern					
	Entero-coccus (MPN/ hectare)	Fecal Coliform (MPN/ hectare)	Total Coliform (MPN/ Hectare)	Total Aluminum (kg/ hectare)	Total Copper (kg/ hectare)	Total Lead (kg/ hectare)
San Gabriel River Tributaries						
1	Dalton/ Walnut Creek 2.72505 E+11	Dalton/ Walnut Creek 3.65771 E+11	Dalton/ Walnut Creek 1.56237 E+12	Dalton/ Walnut Creek 2.53 E-02	Dalton/ Walnut Creek 4.47 E-04	Dalton/ Walnut Creek 2.04 E-03
2	Upper San Jose Creek 1.9733 E+11	Upper San Jose Creek 2.498 E+10	Puente Creek 1.517 E+11	Upper San Jose Creek 2.15 E-02	Upper San Jose Creek 3.27 E-04	Upper San Jose Creek 1.33 E-04
3	Puente Creek 3.216E+10	Puente Creek 2.176E+10	Upper San Jose Creek 1.24734E+11	Puente Creek 5.50E-03	Puente Creek 9.17E-05	Puente Creek 3.21E-05
Coyote Creek Tributaries						
1	SD 21 6.4383 E+12	SD21 6.4696 E+11	SD21 1.1617 E+13	NA	SD21 1.23 E-02	SD21 1.02 E-02
2	Maple-Wood Channel 5.364 E+12	Maple-Wood Channel 1.477 E+11	Maple-Wood Channel 7.405 E+12	NA	Maple-wood Channel 7.91 E-03	Maple-wood Channel 4.47 E-03
3	North Fork Coyote Creek 5.4322 E+11	North Fork Coyote Creek 8.3362 E+10	North Fork Coyote Creek 5.4199 E+11	NA	North Fork Coyote Creek 5.84 E-04	North Fork Coyote Creek 1.64 E-03

NA = Not Analyzed

The results in Table 4 indicate that:

- The San Gabriel River Watershed would benefit from focusing management actions in the order of Dalton/Walnut Creek, Upper San Jose Creek, and Puente Creek, for all of the above Constituents of Concern.

- The Coyote Creek Watershed would benefit from focusing management actions in the order of SD 21 (Artesia-Norwalk Drain), Maplewood Channel, and North Fork Coyote Creek.

The following conclusions were drawn from the dry-weather tributary comparison study:

Table 5. Constituents for which at least 75 percent of samples exceeded applicable water quality standards for each watershed based on San Gabriel River Watershed Tributary Site monitoring results.

Constituents	Watershed					
	Dalton/Walnut Creek (SGR)	**Puente Creek (SGR)**	**Upper San Jose Creek (SGR)**	Maplewood Channel (CC)	North Fork Coyote Creek (CC)	SD 21 (Artesia-Norwalk Drain) (CC)
Enterococcus	X	X		X		
Fecal Coliform		X		X		X
Total Coliform		X		X		X
Total Copper	X	X	X	X	X	X
Ammonia	X	X	X		X	X
Cyanide					X	
Total Dissolved Solids					X	X

Note that the drains in the dark shaded cells above are tributary to the San Gabriel Mass Emission station. The drains in the unshaded cells are and/or were analyzed as if they were tributary to the Coyote Creek Mass Emission station.

- These results align generally with the Constituents of Concern for San Gabriel River and Coyote Creek mentioned above.

- The exceptions are that no consistent exceedances were found for Dissolved Lead in the Coyote Creek tributaries, nor for Cyanide in the San Gabriel River tributaries.

- Total Lead exceedances did not surpass the 75 percent threshold at any of the sites.

- Interestingly, dry-weather samples consistently exceeded the water quality objective guidelines for TDS in North Fork Coyote Creek and SD 21 (Artesia-Norwalk Drain). Note that there are no water body specific objectives for TDS in the Coyote Creek Watershed. The effluent limit was based upon the guidelines in the Basin Plan, which would be protective of the potential MUN Beneficial Use.

Results from the past year's monitoring were analyzed and a loading per area metric was used to prioritize pollutant reduction activities, in order to help focus management actions in the San Gabriel River and Coyote Creek Watersheds. Only those Constituents of Concern that had consistent exceedances this past year were considered. Below are the results of that analysis for dry weather:

Table 6. Ranking of San Gabriel River and Coyote Creek Tributary Monitoring sites for management actions per Constituent of Concern identified for the respective watersheds in the 1994-2005 Integrated Receiving Water Impacts Report.

Management Action Rank Order (SGR shaded)	Constituents of Concern				
	Enterococcus (MPN/ hectare)	Fecal Coliform (MPN/ hectare)	Total Coliform (MPN/ Hectare)	Total Copper (kg/ hectare)	Cyanide (kg/ hectare)
San Gabriel River Tributaries					
1	Dalton/ Walnut Creek 6.08 E+09	Dalton/ Walnut Creek 2.93 E+10	Upper San Jose Creek 6.03 E+10	Upper San Jose Creek 7.08 E-04	Dalton/ Walnut Creek 7.79 E-03
2	Upper San Jose Creek 2.76 E+09	Upper San Jose Creek 1.08 E+10	Dalton/ Walnut Creek 4.61 E+10	Dalton/ Walnut Creek 3.34 E-05	Upper San Jose Creek 1.49 E-04
3	Puente Creek 1.52 E+09	Puente Creek 6.0 E+08	Puente Creek 3.96 E+09	Puente Creek 8.1 E+06	Puente Creek 1.09 E-06
Coyote Creek Tributaries					
1	Maple-Wood Channel 1.2 E+11	SD 21 1.61 E+11	SD 21 8.81 E+12	Maple-wood Channel 3.36 E-04	Maple-Wood Channel 5.84 E-05
2	SD 21 1.29 E+09	Maple-Wood Channel 1.33 E+10	Maple-Wood Channel 6.0 E+12	SD 21 2.93 E-04	SD 21 5.03 E-05
3	North Fork Coyote Creek 7.73 E+07	North Fork Coyote Creek 2.88 E+08	North Fork Coyote Creek 4.36 E+09	North Fork Coyote Creek 2.01E-05	North Fork Coyote Creek 1.55 E-05

The results above indicate that:

- The San Gabriel River Watershed would benefit from focusing management actions in the order of Dalton/Walnut Creek, Upper San Jose Creek, and Puente Creek tributaries for all of the above Constituents of Concern.

- The Coyote Creek Watershed would be beneficial to focus management actions in the order of Maplewood Channel, SD 21, and North Fork Coyote Creek tributaries for all of the above Constituents of Concern.

4.2.3 Water Column Toxicity Analysis

This section describes the water column toxicity results generated during the 2006-07 storm season. Water column toxicity monitoring was performed at all mass emission sites in accordance with the Municipal Stormwater Permit. In total, four samples were analyzed for toxicity at each site. An additional event was taken at the San Gabriel and Santa Clara River sites. Dry-weather samples were collected on October 31, 2006, and April 2, 2007, at the Santa Clara River mass emission site, and on November 1, 2006 and April 2, 2007, at the other six mass emission sites.

The results obtained from these samples are found in Table 4-8a. Wet-weather samples were collected during the first rain event of the season on December 9, 2006, (at all seven mass emission sites), on February 10, 2007 (at Ballona Creek, San Gabriel River, and Coyote Creek mass emission sites), on February 19, 2007 (at Santa Clara River mass emission site), on February 22, 2007 (at Malibu Creek, Los Angeles River, San Gabriel River, and Santa Clara River mass emission sites) and on April 20, 2007 (at the Dominguez Channel mass emission site). The results obtained from these samples are found in Table 4-8b.

A minimum of one freshwater and one marine species was used for toxicity testing, specifically Ceriodaphnia dubia (water flea) seven-day reproduction/survival and Strongylocentrotus purpuratus (sea urchin) fertilization. Results calculated from the Ceriodaphnia dubia and Strongylocentrotus purpuratus tests included the No Observed Effect Concentration (NOEC), 50 percent Effective Concentration (EC50), 50 percent Lethal Concentration (LC50), and toxicity unit (TU). NOEC is the highest concentration of toxicant that would cause no observable adverse effects on the test organisms, which means the values for the observed responses statistically are insignificantly different from the controls. EC50 is the toxicant concentration that would cause an observable adverse effect on a quantal response (such as death, fertilization, germination, or development) in 50 percent of the test population.

A quantal response is an all-or-none response. For example, death is a quantal response because a test organism can only be either dead or alive after being exposed to the toxicant concentration in the test sample. When the observable effect is death or immobility, the term Lethal Concentration or LC is used in place of the term Effective Concentration or EC. Therefore, LC50 is the concentration that produces a 50 percent reduction in survival. TU is defined in the permit as 100/(LC50 or EC50). A TU value greater than or equal to 1.00 is considered substantially toxic and requires a TIE.

The following conclusions were deduced from the water column toxicity testing:

- Ceriodaphnia dubia survival and reproduction were not significantly affected by exposure to the wet- or dry-weather samples collected from all sites during this past monitoring season.

- Sea urchin fertilization was significantly affected by exposure to the dry-weather sample collected only from the Ballona Creek mass emission site on April 2, 2007. That sample had TU value equal to 1.004. The TU value triggered a TIE study in accordance with the Permit. The baseline test conducted on the sample did not detect any toxicity, indicating no purpose to continue with further TIE manipulations. The fact that a very slight amount of toxicity was observed in the initial chronic test, indicated that the toxicant was most likely associated with volatile compound(s). The compound(s) apparently dissipated to nontoxic levels between the time of the initial toxicity tests and initiation of the baseline toxicity testing.

- Sea urchin fertilization was significantly affected by exposure to the wet-weather samples collected from all the mass emission stations (Ballona Creek, Malibu Creek, Los Angeles River, Coyote Creek, San Gabriel River, Dominguez Channel, and Santa Clara River) on December 9, 2006. These samples had TU values equal to 1.26, 1.34, 1.42, 1.40, 1.36, 1.36, and 1.36, respectively. In accordance with the Permit, TIEs were attempted on these samples and toxicity was not observed during the baseline toxicity testing, indicating no purpose for furtherance of the TIE analysis. The fact that a slight amount of toxicity was observed in the initial chronic tests, indicated that the toxicant was most likely associated with volatile compound(s). The compound(s) apparently dissipated to nontoxic levels between the time of the initial toxicity tests and initiation of the baseline toxicity testing.

- Sea urchin fertilization was significantly affected by exposure to the wet-weather sample collected from the Dominguez Channel mass emission site on April 20, 2007. That sample had TU value equal to 1.60. The TU value triggered a TIE study in accordance with the Permit. The baseline test conducted on the sample did not detect any toxicity, indicating no purpose to continue with further TIE manipulations. The fact that a very slight amount of toxicity was observed in the initial chronic test, indicated that the toxicant was most likely associated with volatile compound(s). The compound(s) apparently dissipated to nontoxic levels between the time of the initial toxicity tests and initiation of the baseline toxicity testing.

4.2.4 Trash Monitoring Analysis

The Municipal Stormwater Permit requires a minimum of one trash photograph at each mass emission station after the first storm event and three additional storm events per year. Pictures can be found in Appendix C.

This section also summarizes the trash monitoring results generated during the 2006-07 season. The completed Baseline Monitoring Study installed almost 600 catch basin inserts and four CDS units in various land uses, including commercial, high density single family residential, industrial, low density single family residential, and open space/parks, across the Los Angeles River and Ballona Creek Watersheds for monitoring trash discharge rates. The trash collected from each device was separated into two categories: Anthropogenic and Sediment/Vegetation. The trash collected was then weighed and recorded, after separating into these categories. One dry-weather cleaning event was conducted in each watershed during this season, completing the contract. Table 4-12a and Table 4-12b summarize the trash collection results for the cleaning events per land use.

The following conclusions were drawn from the trash monitoring results for Anthropogenic trash in Los Angeles River and Ballona Creek Watersheds:

Los Angeles River Watershed

- The rate of collected trash to tributary area in the Los Angeles River Watershed from one cleaning event for 2006-07 season was 0.49 lbs/acre.

- The industrial land use was the largest trash contributor with a rate of 1.03 lbs/acre. The second highest contributor was the High Density Single Family Residential land use with a rate of 0.86 lbs/acre. It was followed by the commercial, Open Space/Parks, and Low Density Single Family Residential land uses with rates of 0.72 lbs/acre, 0.07 lbs/acre, and 0.0 lbs/acre, respectively.

Ballona Creek Watershed

- The rate of collected trash to tributary area in the Ballona Creek Watershed from one cleaning event for 2006-07 season was 2.23 lbs/acre.

- The commercial land use was the largest contributor of a rate of 7.44 lbs/acre. The second largest trash generated rate was from the Open Space/Parks land use with 2.77 lbs/acre. It was followed by industrial with 1.72 lbs/acre and High Density Single Family Residential with 0.78 lbs/acre. Finally, the lowest contributor was the Low Density Single Family Residential land use with 0.57 lbs/acre.

Trash compliance monitoring for the Ballona Creek Watershed is included in Appendix I.

4.2.5 Identification of Possible Sources

This section describes the possible sources of the constituents that did not meet the water quality standards during the 2006-07 monitoring season in all or most of the watersheds, as discussed above in Section 4.2.1 and 4.2.2.

The source of bacteria is hard to pinpoint. According to the *Draft Total Maximum Daily Load to Reduce Bacterial Indicator Densities at Santa Monica Bay Beaches* published on November 8, 2001, by the California Regional Water Quality Control Board, Los Angeles Region, urban runoff from the storm drain system may have elevated levels of bacterial indicators due to sanitary sewer leaks and spills, illicit connections of sanitary lines to the storm drain system, runoff from homeless encampments, illegal discharges from recreational vehicle holding tanks, and malfunctioning septic tanks among other things. Fecal matter from animals and birds can also elevate bacteria levels. A July 2007 report by ENSR International for USEPA New England Region 1, *Mitigation Measure to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Manual for Massachusetts*, reiterated the above-mentioned sources.

An article titled *Residential Sources of Contamination* on EPA's website states that elevated levels of chloride may be a result of fertilizers, animal waste, industrial wastes, minerals, or seawater. It also indicates that many metals, such as Aluminum, Silver, Iron, and Zinc, could be a result of natural deposits.

According to the report *Regulating Copper in Urban Stormwater Runoff* by G. Fred Lee, Ph.D. and Anne Jones-Lee, Ph.D., Copper can come from brake pads or industrial (such as the textile industry) and mining sources. A metals source study is discussed in the article *Loadings of Lead, Copper, Cadmium, and Zinc in Urban Runoff from Specific Sources* by A.P. Davis, M. Shokouhian, and S. Ni. The study concludes that significant levels of metals were found from urban areas, especially in highway runoff. The abstract identifies important sources, such as building siding for Lead, Copper, Cadmium, and Zinc, vehicle brake emissions for Copper and tire wear for Zinc. Atmospheric deposition was also identified as an important source of Cadmium, Copper, and Lead. Details behind those findings can be found in the May 2005 Technical Report from SCCWRP entitled, *Contributions of Trace Metals From Atmospheric Deposition to Stormwater Runoff in a Small Impervious Urban Catchment.*

A 2005 online article by Scorecard, The Pollution Information Site, *Aluminum and Compounds*, indicated that Aluminum is one of the most abundant metals in the earth's crust. It does not exist as pure Aluminum, but forms compounds primarily with silica, oxygen, and fluorine. Natural sources include bauxite and alum. The mostly urbanized

Los Angeles Basin has, at best, only trace amounts of Aluminum compounds in its soil. The most likely sources of Aluminum in stormwater would be alum in water treatment plants, bentonite in water purification systems, metal working industries, and some pesticides.

The Agency for Toxic Substances and Disease Registry, Division of Toxicology, in Atlanta, Georgia prepared a *Public Health Statement, Cyanide*. In it, a few of the major sources of cyanides included vehicle exhaust and cyanide-containing pesticides.

Large quantities of greenish rock with amphiboles and sediment are found near the Mass Emission station in the Malibu Creek Watershed. The hillside is mainly composed of what appears to be very decomposed, somewhat grainy, greenish marine or lagoonal sediment/glauconite and less decomposed, greenish-brown shale with clear fossils and embedded detritus. These sediments are known to be sulfur bearing. Representative field samples gathered initially had a distinct moderate sulfur (musty, rotten eggs) odor. Sulfate concentrations can be largely attributable to the presence of eroded sulfur-rich sediment. Fungal and bacterial processes within the creek and surrounding areas may facilitate the release of sediment bound sulfur into the water column.

Another sulfur source may be effluent from the nearby Tapia Wastewater Treatment Plant, found just upstream from the sampling site. Sulfur is used in wastewater processes such as flocculation. However, other sampling stations close to wastewater treatment plants did not show highly elevated sulfur concentrations. Tests and/or a review of effluent reports would be necessary to determine if the Plant's effluent was a significant contributor to the raised sulfur concentrations of these waters.

One significant exceedance of oil and grease was found at the Dalton/Walnut Creek tributary site during this monitoring period. Sources of oil and grease included oil and other lubricating agents leaking from vehicles and being washed during storms from roads, parking lots, gasoline stations and other areas of intense automobile use as reported in an article on *Pollutants and Stormwater Runoff* by J. A. Arnold, S.W. Coffey, D.E. Line, J. Spooner, Extension Biological and Agricultural Engineer Specialists, and D.W. Moody, U.S. Geological Survey, included in a paper titled *Urban Integrated Pest Management* for the North Carolina Cooperative Extension Service, College of Agriculture and Life Sciences, North Carolina State University.

According to the New York Department of Health (http://www.health.state.ny.us/environmental/emergency/chemical_terrorism/ammonia_tech.htm), Ammonia exists naturally in the environment and is also an important commercial and industrial chemical. It is used in agriculture (fertilizers), as a refrigerant, in water treatment processes, in cleaning products and in the manufacture of many products including other chemicals, plastics, textiles, explosives and pesticides. Ammonia is produced by the decomposition of organic matter. One particular ammonia source of interest is wastewater treatment plants. According to *Water Supply and Pollution Control*, by Warren Viessman, Jr. and Mark J. Hammer, there is an average of 24 mg/L of Ammonia-Nitrogen (NH3-N) in biologically treated domestic wastewater that has not undergone denitrification.

As mentioned in the Basin Plan, the watersheds with excessive TDS exceedances are often impaired (by high levels of minerals) and there is not sufficient historic data to designate objectives based on natural background conditions. The effluent limits applied in those watersheds were based upon guidelines in the Basin Plan that are intended to be protective of the MUN Beneficial Use. Site-specific objectives have not yet been determined.

Effectiveness of Existing Control Measures

Existing control measures throughout the basin can at least partially be credited with reductions in significant exceedances for some constituents at some sites this monitoring year, compared to the previous one, 2005-06. Constituents that were not an issue during wet weather this year included Total Coliform and Sulfate at Malibu Creek, and Dissolved Copper at Los Angeles River and Dominguez Channel. Constituents that were not an issue during dry weather this year included Enterococcus at Coyote Creek and Los Angeles River, Fecal Coliform at Coyote Creek, Los Angeles River, and Dominguez Channel, Total Coliform at all mass emission sites (except Malibu Creek), and TDS at Dominguez Channel. It should also be noted that Toxic Unit exceedances were not an issue during dry weather this monitoring year, compared to the previous year (2005-06), for Ceriodaphnia Dubia (water flea) for Survival and Reproduction at Dominguez Channel and Malibu Creek, and the Strongylocentrotus Purpuratus (sea urchin) for Fertilization at Los Angeles River.

4.2.6 Recommendations

Monitoring components conducted during the 2006-07 monitoring season included collecting two dry-weather samples at each of the tributary monitoring stations as recommended in the 2002-03 monitoring report. In addition, all required samples were taken, including dry weather and toxicity samples. Below are some recommendations that were identified based on results of monitoring in the 2006-07 monitoring season.

Many of the polychlorinated biphenyls, SOVs, and chlorinated pesticides cannot be compared to the water quality standards because there are no standards listed in the Basin Plan, Ocean Plan, or CTR. However, even if there were water quality standards, all of these constituents were not detected at any of the mass emission or tributary monitoring stations. We recommend discontinuing sampling for these constituents, except during the first storm event of every year. We also request that the Los Angeles RWQCB provide a current compilation of applicable water quality standards in an easily viewable table on their website.

Some constituents sampled at the tributary stations, particularly Total Copper and Total Aluminum showed consistent exceedances of water quality standards during this year of monitoring. The Municipal Stormwater Permit requires the initiation of a focused effort to identify sources of pollutant within that subwatershed when a constituent exceeds a water quality standard in three out of four samples. To identify the possible sources of these pollutants, Public Works compared them with the water quality data collected from the land-use monitoring stations.

The land use of all tributary monitoring stations is predominantly high density single family residential. The land-use monitoring water quality data indicate that Total Copper and Total Aluminum were also typically found from the same land use, high density single family residential.

Based upon just one year of monitoring at the San Gabriel River Watershed Tributary Monitoring sites, it is recommended that management actions be focused first upon the Constituents of Concern in the Dalton/Walnut Creek and Storm Drain 21 (Artesia-Norwalk Drain) watersheds for wet weather, and Dalton/Walnut Creek and Maplewood Channel for dry weather.

Just one season has been spent gathering data in the San Gabriel River Watershed tributary monitoring sites. Therefore, to verify results, it is recommended that tributary monitoring be continued there for the 2007-08 season.

The role of bacterial populations resident in sediment should be investigated as an alternative to current MS4 sources. The role that tides play in enterococci levels should also be checked. While storm drains are recognized as an important conveyance of bacteria, other sources also exist and should be thoroughly examined.

Efforts on source identification and implementation of BMP strategies should take TSS correlation into consideration. Pollutants with strong correlations may be treated with filtration technologies, and may have relatively localized sources. Conversely, they may also be widespread through aerial deposition, which also provides hints towards source identification.

Compliance with the Municipal Stormwater Permit should be prioritized across all portions of County government. The Los Angeles County Flood Control District and Public Works have limits upon their scopes of operations, and require the cooperation of other County agencies such as the District Attorney's Office and Sheriff's Department to fully implement effective source control measures. Compliance by other Permittees should also be encouraged through cooperative efforts.

It is recommended that mass emission monitoring, toxicity monitoring, trash monitoring, and tributary monitoring be continued in the future in addition to the regional monitoring and special studies, in order to identify and better understand the source(s) of pollution.

Best Management Practices Implementation

Newly arisen pollutants at issue at various sites during this monitoring year included Aluminum, Copper, Lead, Zinc, Fecal Coliform, Ammonia, and Cyanide. Best Management Practices (BMP) implementation measures for identifying and addressing the possible sources of those pollutants include infiltration, suspended solids reduction, and other runoff/volume reduction BMPs for metals. Source control, e.g. correct usage/application of pesticides, is recommended for Ammonia and Cyanide. Source control BMPs are also recommended for Fecal Coliform, such as checking septic systems for leaks and proper disposal of pet waste.

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