This section describes the results, data analysis, and recommendations for the 2007-2008 Monitoring Program.

4.1 HYDROLOGY: PRECIPITATION AND FLOW

The monthly rainfall during the 2007-2008 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 11.10 inches during the 2007-2008 storm season in downtown Los Angeles was approximately 71.34 percent of the average annual rainfall. The average annual rainfall over 137 seasons at Station 716, Ducommun Street in downtown Los Angeles is approximately 15.56 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 2007-2008 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.

The Los Angeles County Flood Control District's (LACFCD) automated sampler flow data was used in those instances where the official record flow data Public Works' 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

Tables 4-2, 4-2a, and 4-3 include a composite and grab samples inventory taken for the chemical and biological analysis and toxicity analysis during the 2007-2008 monitoring season.

4.2.1 Mass Emission Analysis

This section provides a description of wet- and dry-weather mass emission results generated during the 2007-2008 monitoring season.

The Municipal Stormwater Permit specifically requires the LACFCD to assess the pollutant loading for the sampling events that were analyzed for the complete list of constituents following the 2007-2008 storm season. The Municipal Stormwater Permit also requires the identification and analysis of any long-term trends in stormwater or receiving water runoff. A correlation analysis 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 the Basin Plan for Los Angeles (Basin Plan) and the Criterion Maximum Concentration (CMC) of the California Toxics Rule (CTR) for mass emission monitoring was conducted as required by the Municipal Stormwater Permit.

The Basin Plan is designed to enhance water quality and protect the beneficial uses of all regional waters. The CMC of the CTR promulgates criteria for priority toxic pollutants in the State of California for inland surface waters and enclosed bays and estuaries. Constituents exceeding 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. Information about monitored storm events can be found in Appendix K.

The water quality objectives from the Ocean Plan are not applicable for comparison purposes because none of the samples were taken at or within the ocean or even in the tidal zones.

The water quality objectives from the Criterion Continuous Concentration of the CTR are not applicable for comparison purposes because none of the storm events lasted more than 2 consecutive days and none of the composite or grab samples was collected over a continuous 4-day period.

Based on the limited data collected during one year of monitoring, the following conclusions are presented. However, these conclusions may need to be refined or revised as additional data becomes available.

Wet Weather

The LACFCD met the Municipal Stormwater Permit requirement by monitoring at least three storms including the first storm event.

The permit requires a prioritization of results. Priorities were chosen to be those in which at least two out of three (approximately 67 percent) samples exceeded the most stringent applicable water quality standards. A general overview of the priorities is best presented using Table 1 below. An “X” indicates constituents for which at least 67 percent of samples exceeded applicable water quality standards in each watershed.

The results indicate that the abovementioned threshold was exceeded for the following constituents and at stated sites:

- Fecal Coliform throughout all watersheds, except Malibu Creek.
- Metals in all watersheds, except Malibu Creek.
- Ammonia in all watersheds, except Malibu Creek and San Gabriel River watersheds.
- Sulfate in Malibu Creek. Sulfate was also the only constituent for which at least 67 percent of samples exceeded the most stringent applicable water quality standards in this watershed during the 2007-2008 storm year.

Table 1. Priorities for each watershed based on mass emission monitoring results.

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

The results of Fecal Coliform exceedances and metals exceedances are in accordance with the Constituents of Concern identified in the LACFCD'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 a priority in any of the watersheds during this monitoring season. However, dissolved metals were identified as Constituents of Concern in Coyote Creek, Los Angeles River, Dominguez Channel, and Ballona Creek in the 1994-2005 Integrated Receiving Water Impacts Report.

- Cyanide was a priority in Ballona Creek, Coyote Creek, and Dominguez Channel only during the first storm season event (2007-08Event21) as opposed to all watersheds as reported in the 1994-2005 Integrated Receiving Water Impacts Report.

- Ammonia was not identified as a Constituent of Concern in the 1994-2005 Integrated Receiving Water Impacts Report, but Ammonia was a priority at all stations, except at Malibu Creek and San Gabriel River mass emission stations.

- Sulfate was not identified as a Constituent of Concern in the 1994-2005 Integrated Receiving Water Impacts Report, but Sulfate was a priority at Malibu Creek mass emission station.

Dry Weather

The LACFCD met the Municipal Stormwater Permit requirement for sampling two dry-weather samples at each monitoring station. A general overview of the priorities is best presented using Table 2 below. An "X" indicates constituents for which at least 67 percent of samples (2 of 2 events) exceeded the most stringent applicable water quality standards in each watershed.

Table 2. Priorities for each watershed based on mass emission monitoring results.

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

The results indicate that the abovementioned threshold was exceeded for the following constituents and at stated sites:

- Fecal coliform at Dominguez Channel

- Chloride at Santa Clara River

- Total Dissolved Solids (TDS) at Ballona Creek, Coyote Creek, and Dominguez Channel

Other observations:

- These results differed from those on the list of Constituents of Concern identified in the 1994-2005 Integrated Receiving Water Impacts Report.

- Only one exceedance of the water quality standards for Aluminum was found at San Gabriel River and another for Copper at Dominguez Channel during dry weather during this season.

- Cyanide exceedances were not found in any dry weather samples collected during this season, whereas it was a listed Constituent of Concern across all watersheds in the 1994-2005 Integrated Receiving Water Impacts Report.

- Chloride and TDS were not identified as Constituents of Concern in the 1994-2005 Integrated Receiving Water Impacts Report. However, all dry weather samples this year exceeded the water quality objective guidelines at Santa Clara River for Chloride; and Ballona Creek, Coyote Creek, and Dominguez Channel 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.

4.2.1.2 Loading and Trend Analysis

The LACFCD 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 TSS concentration for each storm is shown in Table 4-7 and the total TSS loading 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.

Pollutant loading at each mass emission station was analyzed to determine if there was any correlation between storm events and the amount of pollutant loading.

Figure 4-4 represents an analysis of trends in stormwater or receiving water quality. Some first flush phenomena were observed, primarily with pollutants associated with particulate matter, and storms with greater runoff volumes typically have larger pollutant loadings.

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.

The following conclusions were deduced from the loading analysis:

- First flush phenomenon was observed for most constituents whose concentrations came either from their insoluble or suspended form (i.e. TSS, oil and grease, etc…) or from a combination of their insoluble or suspended form and their dissolved form (i.e. total metals). This can be explained as 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 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 decrease with fluctuation over the season except at Malibu Creek, and concentrations in the San Gabriel Watershed varied largely by storm.

- TSS concentrations were usually higher during wet-weather than during dry-weather sampling events.

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

- Fecal Coliform and Ammonia were also observed at most mass emission stations during most events.

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:	2007-08Event21
Constituent:	Fluoride
Concentration:	0.391 mg/L
Runoff Volume:	2303.45 acre-ft (2222.80 acre-ft Runoff + 80.65 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 = (0.391 mg/L)(2303.45 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 = 2449.2 lbs.

Conversion factors

4.2.1.3 Correlation Study

A correlation analysis between metals and other constituents and TSS levels for 2 mass emission monitoring stations (San Gabriel River and Santa Clara River) and 1 tributary monitoring station (Upper San Jose Creek) was performed. Only constituents that had at least 3 detections during the 2007-2008 storm season were included in the analysis. Dry-weather data were not included in this correlation analysis as only 2 dry-weather events were conducted. At the Santa Clara River station, 20 of 30 constituents that met the above criteria (approximately 67 percent) had an R^2 value greater than 0.85, the selected minimum threshold value. Similarly, that number was 17 out of the 39 studied constituents (approximately 44 percent) at Upper San Jose Creek station. However, only 4 out of the total 34 qualified constituents (approximately 12 percent) had an R^2 value above 0.85 at the San Gabriel River station. Only those correlations with an R^2 value greater than 0.85 are presented in this report.

Background

The 1994-2005 Integrated Receiving Water Impacts Report presented a metals and TSS correlation analysis. That report found that there was poor correlation between TSS and metals in all watersheds except the Santa Clara River Watershed. It was suggested that the TSS correlation requirement be removed from the permit in order to free up resources for increased tributary monitoring. These suggestions were included in the 2006 Report on Waste Discharge. Thereafter, TSS correlation analysis was only conducted for the Santa Clara River Watershed, Ballona Creek Watershed and the Adams Drain Watershed in the 2005-2006 Stormwater Monitoring Report; and for the Santa Clara River Watershed, San Gabriel River Watershed and the Upper San Jose Creek Watershed in the 2006-2007 Stormwater Monitoring Report.

The LACFCD 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 was 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:

1. 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 LACFCD'S compliance with the Municipal Stormwater Permit. Laboratory analysis can vary greatly in cost and complexity. TSS testing is inexpensive and simple, while measuring metal or pesticide concentrations can be very costly and require complex equipment.

2. TSS correlation can help in identifying constituent sources and in selecting optimum Best Management Practices (BMPs). Strong correlation between a constituent and TSS may indicate that the constituent is found in particulate matter in that watershed. Examples include legacy 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 2007-2008 correlation study:

- The Santa Clara River Watershed, which the 1994-2005 Integrated Receiving Water Impacts Report indicated exhibited the largest number of correlations, had 20 constituents that correlated with TSS with an R^2 value greater than 0.85.

Constituent	R^2
Iron	1
Volatile Suspended Solids	0.99999
Chromium	0.99996
Arsenic	0.99984
Copper	0.99983
Aluminum	0.99971
Zinc	0.99964
Barium	0.99953
Nickel	0.99952
Lead	0.99832
Dissolved Oxygen	0.99384
Phosphorus- Total (as P)	0.99069
Kjeldahl-N	0.95179
Total Organic Carbon	0.95037
Dissolved Zinc	0.93644
Antimony	0.92445
Methylene Blue Active Substances (MBAS)	0.91272
Dissolved Barium	0.88964
Sulfate	0.87695
Dissolved Nickel	0.87268

  - Metals exhibited a strong correlation with TSS. Comparing the total concentrations and the dissolved concentrations of Iron, Chromium, Copper, Aluminum, Zinc, Barium, Nickel, and Lead revealed that the total concentrations of these metals comprised mostly of the insoluble form. An additional analysis of the correlation between the insoluble form of those metals and the TSS levels also showed very strong correlations. (Iron 1.00000, Chromium 0.99695, Copper 0.99741, Aluminum 0.99971, Zinc 0.99993, Barium 0.99846, Nickel 0.99749, and Lead 0.99832).

  - Appendix B 2007-2008 Sampling Results for Santa Clara River indicated that Copper and Zinc exceeded water quality objectives from the CMC of the CTR. However, their dissolved concentrations were well below the limits; thus the removal of TSS may help reduce Copper and Zinc levels in the water and possibly help achieve the water quality objectives set forth in the CMC of the CTR.

  - The results also indicated exceedances of Aluminum according to the Basin Plan. Dissolved Aluminum, however, was not detected in any of the stormwater samples, suggesting that Aluminum was mainly in its insoluble form. Thus, the removal of TSS may help reduce the level of Aluminum in the water and possibly help achieve the water quality objective set forth in the Basin Plan.

- The San Gabriel River Watershed had only 4 constituents with an R^2 value greater than 0.85. (Chloride 0.99991, Fluoride 0.97566, Volatile Suspended Solid 0.95543, Aluminum 0.91599).

  - o Aluminum is the only metal that showed a strong correlation with TSS in the San Gabriel watershed and Appendix B 2007-2008 Sampling Results for San Gabriel River indicated exceedances of Aluminum in accordance with the Basin Plan. Dissolved Aluminum was not detected in any of the stormwater samples collected during the 2007-2008 storm year. This suggests that Aluminum was mainly in its insoluble form; and therefore, the removal of TSS may help reduce the level of Aluminum in the water and possibly help achieve the water quality objective set forth in the Basin Plan.

- The Upper San Jose Creek Watershed had 17 constituents with an R^2 value greater than 0.85.

Constituent	R^2
Barium	0.99944
Lead	0.99941
Copper	0.99937
Iron	0.99867
Volatile Suspended Solids	0.9976
Aluminum	0.99611
Ammonia	0.99574
NH3-N	0.99568
Zinc	0.99217
Kjeldahl-N	0.9911
Dissolved Phosphorus	0.99097
Total Organic Carbon	0.97183
Arsenic	0.97165
Nickel	0.96615
Chemical Oxygen Demand	0.95825
Chromium	0.94692
Alkalinity as CaCO3	0.87868

  - o Metals displayed a strong correlation with TSS. Comparing the total concentrations and the dissolved concentrations of Barium, Lead, Copper, Iron, Aluminum, Zinc, Nickel, and Chromium revealed that the total concentrations of these metals comprised mostly of the insoluble form. An additional analysis of the correlation between the insoluble form of those metals and the TSS levels also showed very strong correlations. (Barium 0.99972, Lead 0.99913, Copper 0.99881, Iron 0.99876, Aluminum 0.99611, Zinc 0.98946, Nickel 0.97218, and Chromium 0.95262).

  - Appendix B 2007-2008 Sampling Results for Upper San Jose Creek indicated that Lead, Copper, and Zinc exceeded water quality objectives from the CMC of the CTR. However, their dissolved concentrations were well below the limits; thus the removal of TSS may help reduce Lead, Copper, and Zinc levels in the water and possibly help achieve the water quality objectives set forth in the CMC of the CTR.

  - The results also indicated that Aluminum exceeded the water quality objectives in accordance with the Basin Plan. Dissolved Aluminum, nevertheless, was not detected in any of the stormwater samples, suggesting that Aluminum was mainly in its insoluble form. The removal of TSS, therefore, may help reduce the level of Aluminum in the water and possibly help achieve the water quality objective set forth in the Basin Plan.

- Aluminum had a very strong correlation with TSS for San Gabriel River (major river) and Upper San Jose Creek (tributary merging into major river). This association of Aluminum with particulate matter should be considered when implementing source identification.

- TSS correlation may prove to be a useful tool in the selection of appropriate BMPs to remove sediment.

- Future more extensive TSS correlation efforts are possible using the newly created Integrated Water Quality Database. At this point in time, only data from the 2006-2007 and 2007-2008 storm years are 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 2007-2008 monitoring season.

The LACFCD met the Municipal Stormwater Permit requirement for tributary monitoring analysis by monitoring five 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. The hydrographs were generated using the flow rate software of our autosamplers as the LACFCD did not have official flow gages at the 6 tributary sites.

A comparison to the most stringent applicable water quality standards from the Basin Plan and the CMC of the CTR for tributary monitoring was conducted as required by the Municipal Stormwater Permit. 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 priorities 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 extended 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 year's monitoring results.

To be consistent with the analyses for mass emission stations, we used the same priority criteria. 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 the Mean Magnitude of Exceedance Ratios (MMER) per tributary was created for each of the constituents identified in tables 3 and 5, as applicable to each tributary grouping. The magnitude of exceedance ratio was calculated by dividing the strictest applicable water quality objective for a constituent into its reported value for each sampling event. The MMER then was the average magnitude of exceedance. An MMER value greater than 1 of a constituent indicates the degree by which on average that constituent exceeds the strictest applicable water quality objective. For example, if Aluminum has an MMER value of 2, then on average Aluminum exceeds the strictest applicable water quality objective by 100 percent. The confidence level for the mean concentration of a constituent in question to significantly exceed its water quality objective was also calculated in combination with analysis of variance and mean comparison analysis to help confirm the ranking order. The following conclusions and observations were drawn from the wet-weather tributary comparison study:

Table 3. Priorities 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)
Fecal Coliform	X	X	X	X	X	X
Ammonia	X	X	X	X	X	X
Total Aluminum	X	X	X	X	X	
Total Copper	X	X	X	X		X
Total Zinc	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 Integrated Receiving Water Impacts Report.

- The exceptions are that priorities were not found for Lead and Dissolved Lead, which were identified as Constituents of Concern in San Gabriel River and Coyote Creek in the 1994-2005 Integrated Receiving Water Impacts Report.

- Ammonia was not identified in that list of Constituents of Concern for San Gabriel River or Coyote Creek. Nevertheless, priorities for Ammonia were found at all tributary sites.

- Total Zinc was also not identified in the above list of Constituents of Concern for San Gabriel River or Coyote Creek, yet priorities for Total Zinc were found in Dalton/Walnut Creek, Puente Creek, Maplewood Channel, and SD21 monitoring sites.

- Total Aluminum was not a Constituent of Concern in Coyote Creek according to the 1994-2005 Integrated Receiving Water Impacts Report, yet it was a priority in both North Fork Coyote Creek and Maplewood Channel.

- Cyanide was not found to be a priority in any tributary. However, it was identified in the 1994-2005 Constituents of Concern list for both San Gabriel River and Coyote Creek.

Results from this past season's monitoring were analyzed and a ranking based upon MMER values and corresponding confidence levels per tributary were used to help focus management actions in the San Gabriel River and Coyote Creek Watersheds. Only those Constituents of Concern that were priorities this past year were considered and the results of that analysis for wet weather are presented in Table 4.

Table 4. Ranking of San Gabriel River and Coyote Creek Tributary Monitoring sites for management actions based on MMER per Constituent of Concern identified for respective watersheds in Table 3

Management Action Rank Order (SGR shaded)		Constituents of Concern					
		Fecal Coliform	Ammonia	Total Aluminum	Total Copper	Total Zinc	TDS
San Gabriel River Tributaries							
1	**Tributary**	Upper San Jose Creek	Puente Creek	Dalton/ Walnut Creek	Dalton/ Walnut Creek	Dalton/ Walnut Creek	N/A
	MMER	243.75	28.55	6.19	11.41	8.05	
	Confidence Level	87.0%	99.5%	92.0%	94.0%	95.0%	
2	**Tributary**	Puente Creek	Dalton/ Walnut Creek	Puente Creek	Puente Creek	Puente Creek	N/A
	MMER	130.63	33.49	5.64	8.7	7.79	
	Confidence Level	87.0%	98.0%	92.0%	90.0%	87.0%	
3	**Tributary**	Dalton/ Walnut Creek	Upper San Jose Creek	Upper San Jose Creek	Upper San Jose Creek	Upper San Jose Creek	N/A
	MMER	128.13	18.21	6.77	5.65	N/A	
	Confidence Level	85.0%	98.0%	86.0%	86.0%	N/A	
Coyote Creek Tributaries							
1	**Tributary**	North Fork Coyote Creek	Maplewood Channel	Maplewood Channel	Maplewood Channel	Maplewood Channel	N/A
	MMER	43.13	44.48	9.04	17.67	14.48	
	Confidence Level	95.0%	96.0%	95.0%	94.0%	95.0%	
2	**Tributary**	Maplewood Channel	SD 21	North Fork Coyote Creek	SD 21	SD 21	N/A
	MMER	69.63	93.53	5.9	8.31	4.18	
	Confidence Level	93.0%	87.0%	89.0%	93.0%	91.0%	
3	**Tributary**	SD 21	North Fork Coyote Creek	SD 21	North Fork Coyote Creek	North Fork Coyote Creek	N/A
	MMER	155.63	14.14	N/A	N/A	N/A	
	Confidence Level	91.0%	84.0%	N/A	N/A	N/A	

N/A = Not Applicable

The results from Table 4 suggest that during wet weather:

- The San Gabriel River watershed would benefit from focusing management actions on Dalton/Walnut Creek for Total Aluminum, Total Copper, and Total Zinc; on Upper San Jose Creek for Fecal Coliform; and on Puente Creek for Ammonia.

- The Coyote Creek Watershed would benefit from focusing management actions on Maplewood Channel for Ammonia, Total Aluminum, Total Copper, Total Zinc; and on North Fork Coyote Creek for Fecal Coliform.

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

Table 5. Priorities 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)
Fecal Coliform	X	X		X		X
TDS		X	X	X	X	
Ammonia		X	X			X
Total Copper	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.

- Of the 4 constituents in Table 5 above, only Fecal Coliform aligns with the list of Constituents of Concern for San Gabriel River and Coyote Creek in the 1994-2005 Integrated Receiving Water Impacts Report.

- Total Copper, which was identified as Constituent of Concern in both San Gabriel River and Coyote Creek in 1994-2005 Integrated Receiving Water Impacts Report, was a priority only in Dalton/Walnut Creek

- Priorities were not found for Dissolved Lead in the Coyote Creek tributaries, nor for Cyanide in either the San Gabriel River tributaries or the Coyote Creek tributaries.

- None of the tributary sites had priorities for Total Lead.

- Dry-weather samples indicated priorities for TDS in Puente Creek, Upper San Jose Creek, Maplewood Channel, and North Fork Coyote Creek. Note that there are no water body specific objectives for TDS in these tributaries. The effluent limit was based upon the guidelines in the Basin Plan, which would be protective of the potential MUN Beneficial Use.

- Dry-weather sample results indicated that Puente Creek, Upper San Jose Creek, and Artesia-Norwalk Storm Drain (SD 21) had priorities for Ammonia. Ammonia was not on the 1994-2005 list of Constituents of Concern for San Gabriel River or Coyote Creek.

Results from the past year's monitoring were analyzed and a ranking based upon MMER values and corresponding confidence levels per tributary was used to help focus management actions in the San Gabriel River and Coyote Creek Watersheds. Only those Constituents of Concern that were priorities this past year were considered and the results of that analysis for dry weather are presented in Table 6.

Table 6. Ranking of San Gabriel River and Coyote Creek Tributary Monitoring sites for management actions based on MMER per constituent identified for respective watersheds in Table 5

Management Action Rank Order (SGR shaded)		Constituents of Concern					
		Fecal Coliform	Ammonia	Total Aluminum	Total Copper	Total Zinc	TDS
San Gabriel River Tributaries							
1	**Tributary**	Dalton/ Walnut Creek	Upper San Jose Creek	N/A	Dalton/ Walnut Creek	N/A	Puente Creek
	MMER	41.25	2.25		1.14		1.92
	Confidence Level	77.0%	79.0%		77.0%		82.0%
2	**Tributary**	Puente Creek	Puente Creek	N/A	Puente Creek	N/A	Upper San Jose Creek
	MMER	21	1.61		N/A		1.2
	Confidence Level	75.0%	76.0%		N/A		80.0%
3	**Tributary**	Upper San Jose Creek	Dalton/ Walnut Creek	N/A	Upper San Jose Creek	N/A	Dalton/ Walnut Creek
	MMER	N/A	N/A		N/A		N/A
	Confidence Level	N/A	N/A		N/A		N/A
Coyote Creek Tributaries							
1	**Tributary**	SD 21	SD 21	N/A	Maplewood Channel	N/A	North Fork Coyote Creek
	MMER	5	1.42		N/A		1.97
	Confidence Level	76.0%	88.0%		N/A		92.0%
2	**Tributary**	Maplewood Channel	Maplewood Channel	N/A	North Fork Coyote Creek	N/A	Maplewood Channel
	MMER	628.5	N/A		N/A		1.44
	Confidence Level	75.0%	N/A		N/A		87.0%
3	**Tributary**	North Fork Coyote Creek	North Fork Coyote Creek	N/A	SD 21	N/A	SD 21
	MMER	N/A	N/A		N/A		N/A
	Confidence Level	N/A	N/A		N/A		N/A

N/A = Not Applicable

The results from Table 6 suggest that during dry weather:

- The San Gabriel River watershed would benefit from focusing management actions on Dalton/Walnut Creek for Fecal Coliform and Total Copper; on Upper San Jose Creek for Ammonia; and on Puente Creek for TDS.

- The Coyote Creek Watershed would benefit from focusing management actions on SD 21 for Fecal Coliform and Ammonia; and on North Fork Coyote Creek for TDS.

4.2.3 Water Column Toxicity Analysis

This section describes the water column toxicity results generated during the 2007-2008 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. Dry-weather samples were collected on November 28, 2007 (2007-08Event27), and April 9, 2008 (2007-08Event47); and wet-weather samples were collected during the first rain event of the season on September 22, 2007 (2007-08Event21), and during the second rain event of the season on November 30, 2007 (2007-08Event30), at all mass emission sites. The results obtained from these samples are found in Table 4-6a and Table 4-6b respectively.

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 significantly affected by exposure to the dry-weather sample collected from Los Angeles River mass emission site on April 9, 2008. That sample had TU values equal to 2.91 (survival) and 2.26 (reproduction). The TU values 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 only significantly affected by exposure to the dry-weather sample collected from the Ballona Creek mass emission site on November 28, 2007. That sample had TU value equal to 2.64. 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.

- Ceriodaphnia dubia survival and reproduction were significantly affected by exposure to the wet-weather sample collected from Malibu Creek mass emission site on September 22, 2007. That sample had TU values equal to 3.20 (survival) and 2.90 (reproduction). The TU values 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 four mass emission sites (Malibu Creek, San Gabriel River, Dominguez Channel, and Santa Clara River) on September 22, 2007. These samples had TU values equal to 1.33, 2.05, 1.25, and 3.13, 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 Santa Clara River mass emission site on November 30, 2007. That sample had TU value equal to 1.24. 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 Storm Water Permit requires a minimum of one 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.

Ballona Creek Watershed and Los Angeles River Watershed Trash Compliance Monitoring Reports can be found in Appendices I and J respectively.

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 2007-2008 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.*

The primary stationary sources that have reported emissions of aluminum compounds in California are crushed and broken stone mining, metal working machinery, and national security systems (ARB, 1997b). In California, aluminum phosphide and aluminum tris(O-ethyl phosphate) are registered pesticides. Aluminum phosphide is registered as a insecticide. It is used to control stored product insects and is registered for use for fumigating raw agricultural commodities, animal feed ingredients, processed foods (sugar, flour, etc.), tobacco, wood, paper, leather, human and animal hair, feathers, etc. It is also registered for vertebrate control (rats, mice, squirrels, gophers etc.) in and around mills, food processing plants, warehouses and silos, and in rail cars, ships, and shipping containers (DPR, 1996). Aluminum tris(O-ethyl phosphate) (Fosetyl-Al) is registered as a fungicide. It is used for the control and prevention of plant diseases on citrus, avocado, almonds and other nut crops. It may also be applied to small fruit crops (blackberry, boysenberry), and to a variety of leafy vegetable (spinach, lettuce, collard greens) and to cole crops (cabbage, broccoli) (DPR, 1996).

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.

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.

Ammonia exists naturally in the environment and is also an important commercial and industrial chemical, according to the New York Department of Health (http://www.health.state.ny.us/environmental/emergency/chemical_terrorism/ammonia_tech.htm). 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.

4.2.6 Recommendations

The core monitoring program as prescribed in the Permit is designed to achieve the objectives in Section 1.1. However, in actuality data gathered by the program are insufficient for use in identifying pollution sources, making management decisions with respect to BMP implementation, and evaluating the effectiveness of existing control measures. Answering these questions would require more targeted, and possibly more localized, monitoring programs. The beginning of such a program is under development by the LACFCD as described in its Receiving Waters Limitations Compliance Report submitted to the Regional Board on October 15, 2007.

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 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 sampling for these constituents one time per year during the first storm event.

There appears to be some correlation between sediments and certain constituents. Further analysis is recommended.

The Permit is unclear with regard to which water quality standards to be applied to each of the monitoring programs. To reduce any uncertainty, we request that the Los Angeles RWQCB provide a current compilation of applicable water quality standards.

Best Management Practices Implementation

Priorities found at various sites during this monitoring year included Aluminum, Copper, Zinc, TDS, Sulfate, Chloride, Fecal Coliform, and Ammonia. Discussion of BMP implementation is not possible in this Annual Monitoring Report. Long term trends will need to be determined and analyzed prior to making any management decisions regarding BMP implementation.

P:\wmpub\DATA MANAGEMENT\Monitoring\0708 MS4 Monitoring Data\Write-up\Draft 07-08 Section 4_fg.doc