4.0 SAN GABRIEL RIVER WATERSHED MANAGEMENT AREA

4.1 Watershed Description

4.1.1 Watershed Land Use, Percent Impervious, and Population

Land use in the San Gabriel River Watershed Management Area is approximately half vacant land and half urban (Figure 4-1). The urban area is concentrated in the lower elevation area in the south (Figure 4-2). Commercial, industrial, and transportation categories make up a large percentage of the developed area (cumulatively, 18%).

The average impervious area of the San Gabriel River Watershed is estimated to be 29% based on assumptions of impervious areas in each land use type.

The San Gabriel River Watershed Management Area if divided into three segments: the upper third of the San Gabriel WMA has a very low population density; the middle third, monitored by the San Gabriel River mass emission station "S14", has a moderately high density; and the lower third, monitored by the Coyote Creek mass emission station "S13", has a slightly lower population density than the middle section (Figure 4-3).

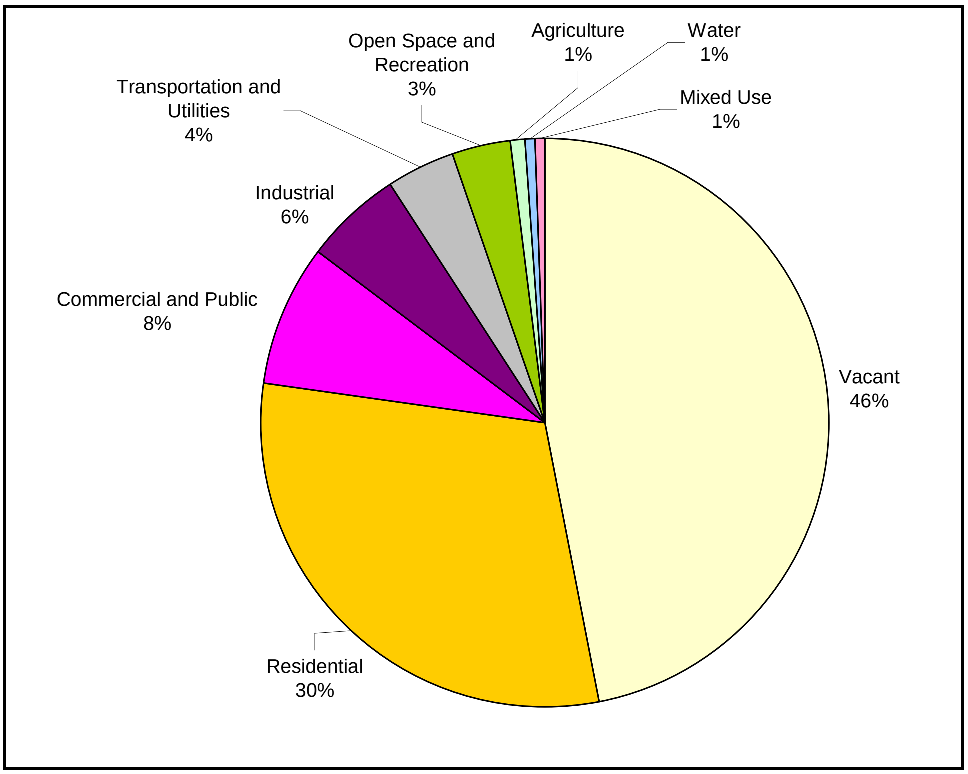

Figure 4-1. Land Use Percentages in the San Gabriel River WMA.

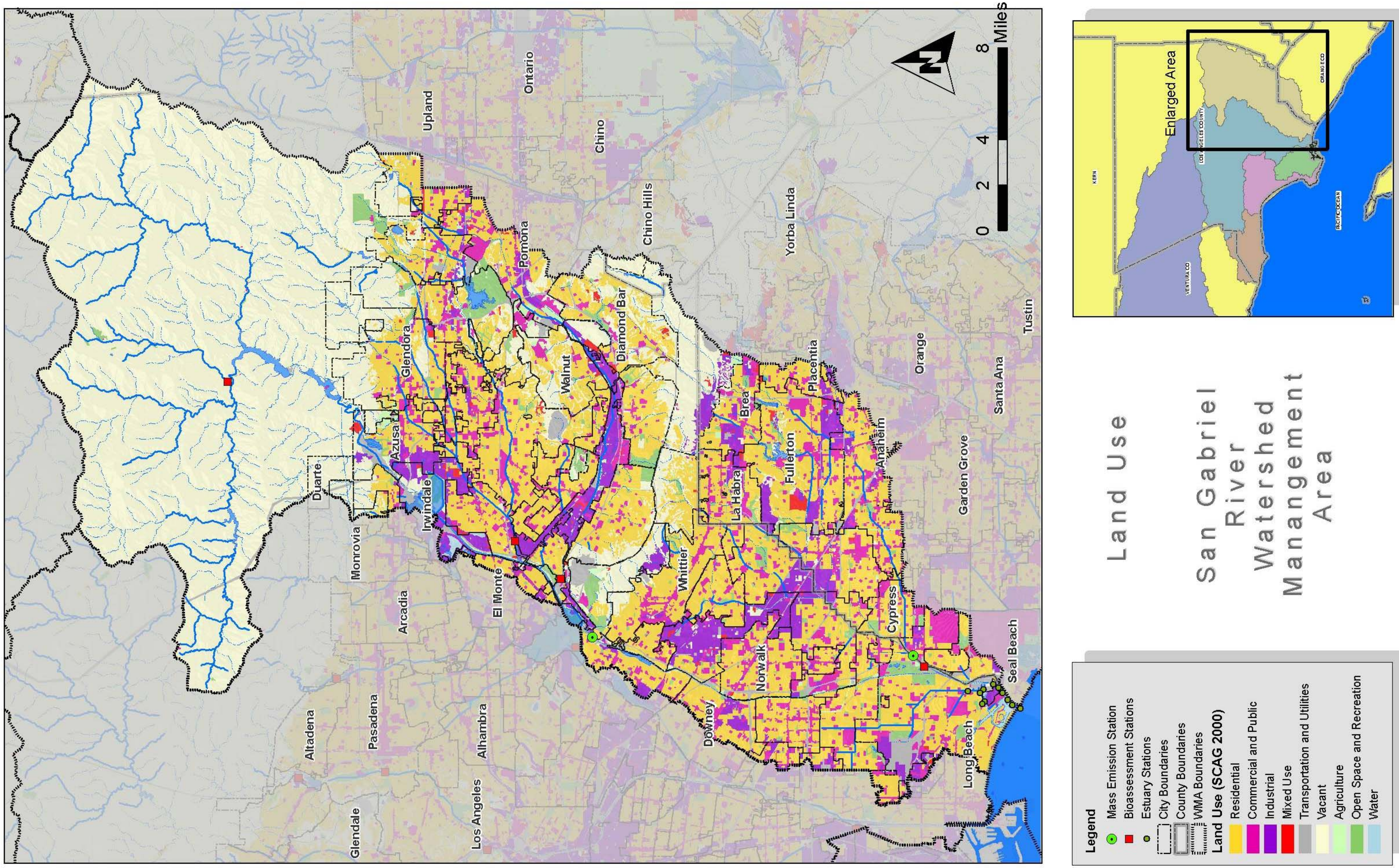

Figure 4-2. Land Use Distribution in the San Gabriel River WMA.

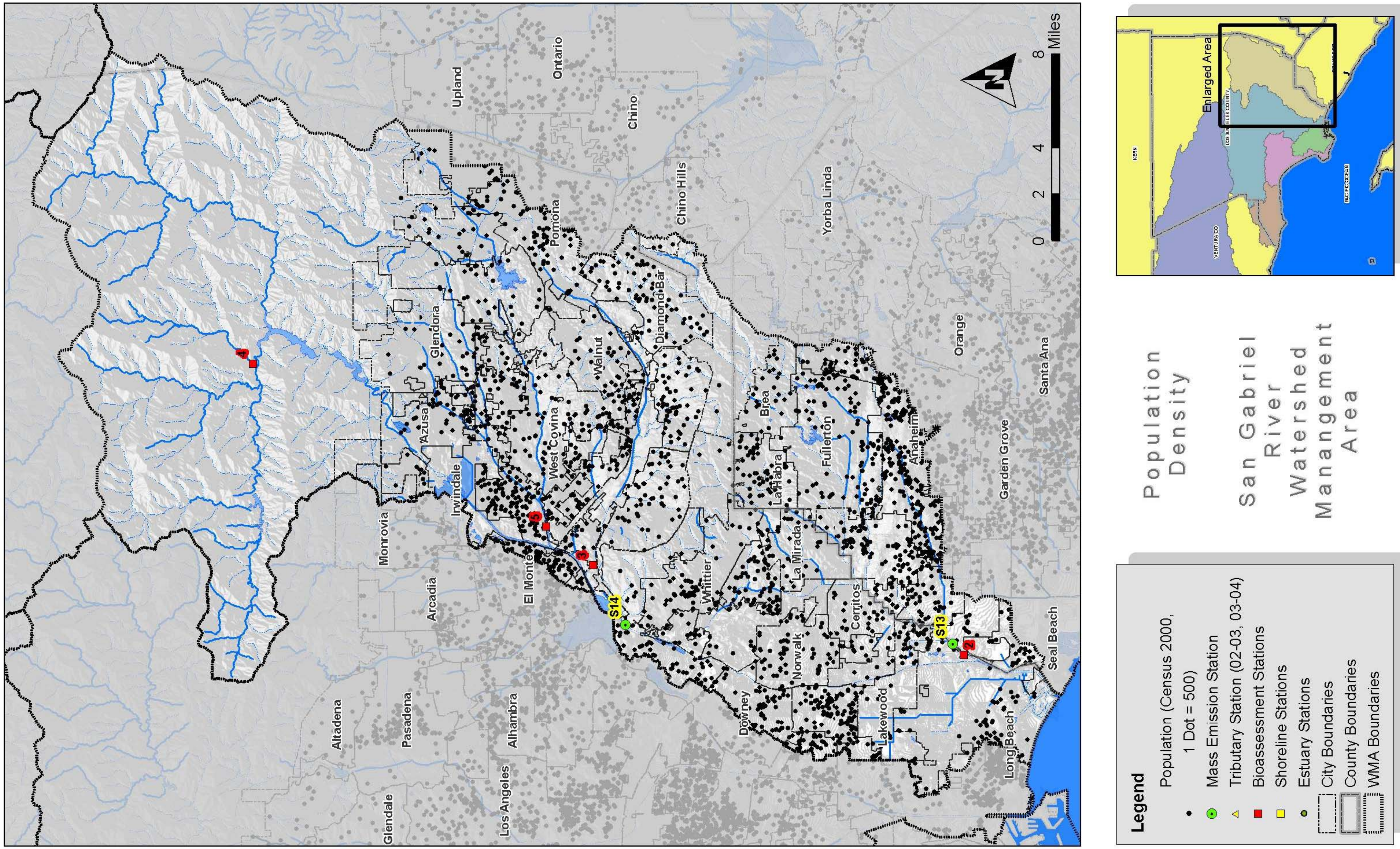

Figure 4-3. Population Density in the San Gabriel River WMA.

4.1.2 Hydrology and Monitoring Stations

The San Gabriel River receives drainage from a large area of eastern Los Angeles County. Its headwaters originate in the San Gabriel Mountains (Figure 4-4). The watershed consists of extensive areas of undisturbed riparian and woodland habitats in its upper reaches. The lower part of the river flows through a concrete-lined channel in a heavily urbanized portion of the county before becoming a soft bottom channel once again in the City of Long Beach. A major tributary in the lower reach of the river is Coyote Creek. The San Gabriel River ultimately flows into Long Beach Harbor.

The Coyote Creek Watershed drains approximately 150 square miles in southeast Los Angeles County and northwest Orange County. Coyote Creek, the principal drainage in the watershed, is a concrete-lined trapezoidal channel. Coyote Creek has three main tributaries, including North Fork Coyote Creek, Fullerton, and Brea Creeks.

The upper part of the San Gabriel River drains to S14, the mass emission station for the San Gabriel River (Figure 4-4). Three bioassessment sites are located upstream from the San Gabriel mass emission station. Mass emission station S13 and bioassessment site 2 are located on Coyote Creek near its confluence with the San Gabriel River.

Figure 4-5 presents daily rainfall totals from October 1, 2004 through April 30, 2005 along with the wet and dry sampling events during this period. Monitored events had rainfall totals between 0.3” and 1.5”, although some storms continued over several days and accumulated rainfall totals of 3” or more. The largest monitored storm of the season occurred on January 7, 2005. This storm was preceded by several wet days followed by a couple days of dry weather. The December 5, 2005 storm was the weakest monitored storm, triggered by only 0.3 inches of rainfall.

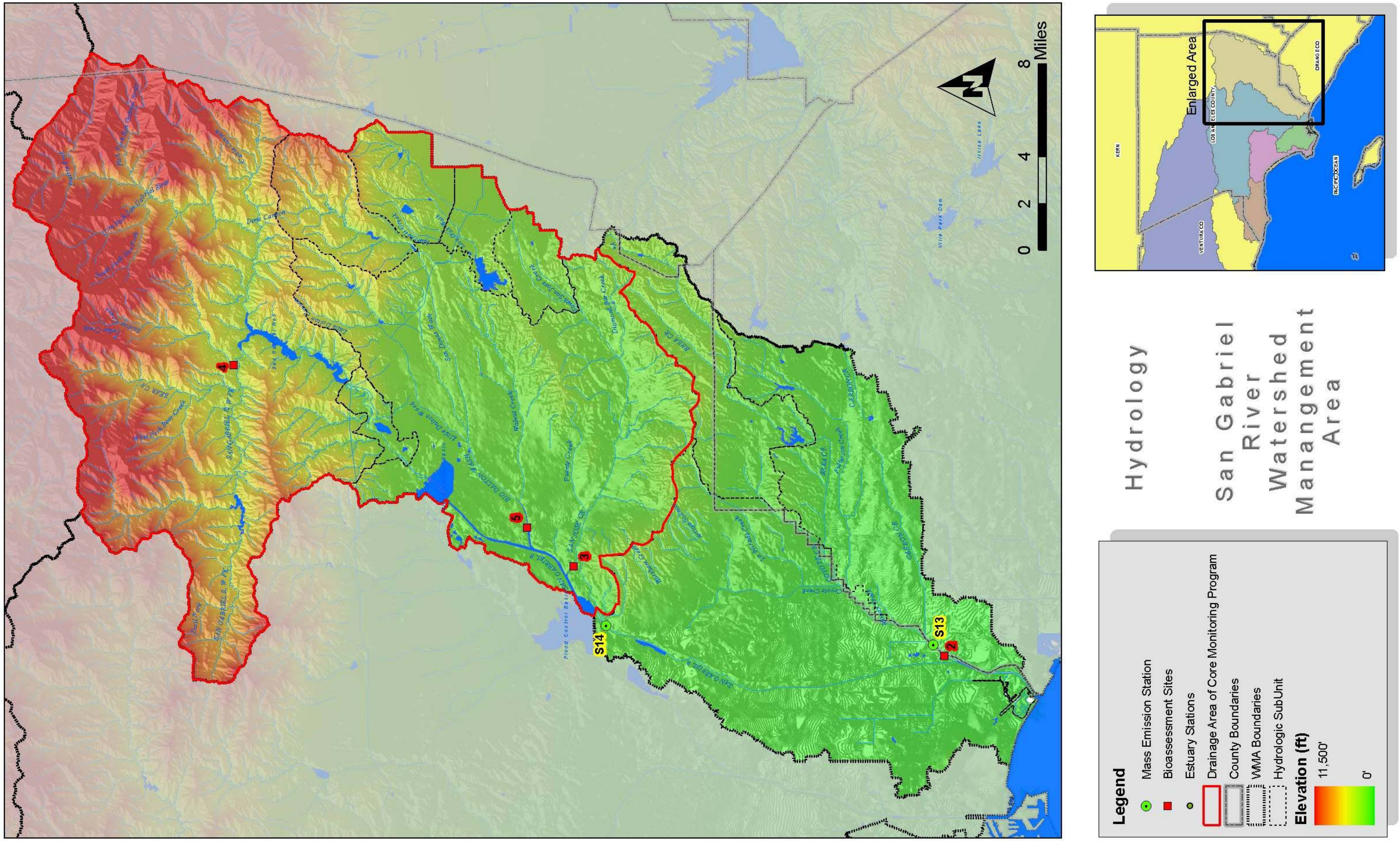

Figure 4-4. Watershed Hydrology and Monitoring Stations in the San Gabriel River WMA.

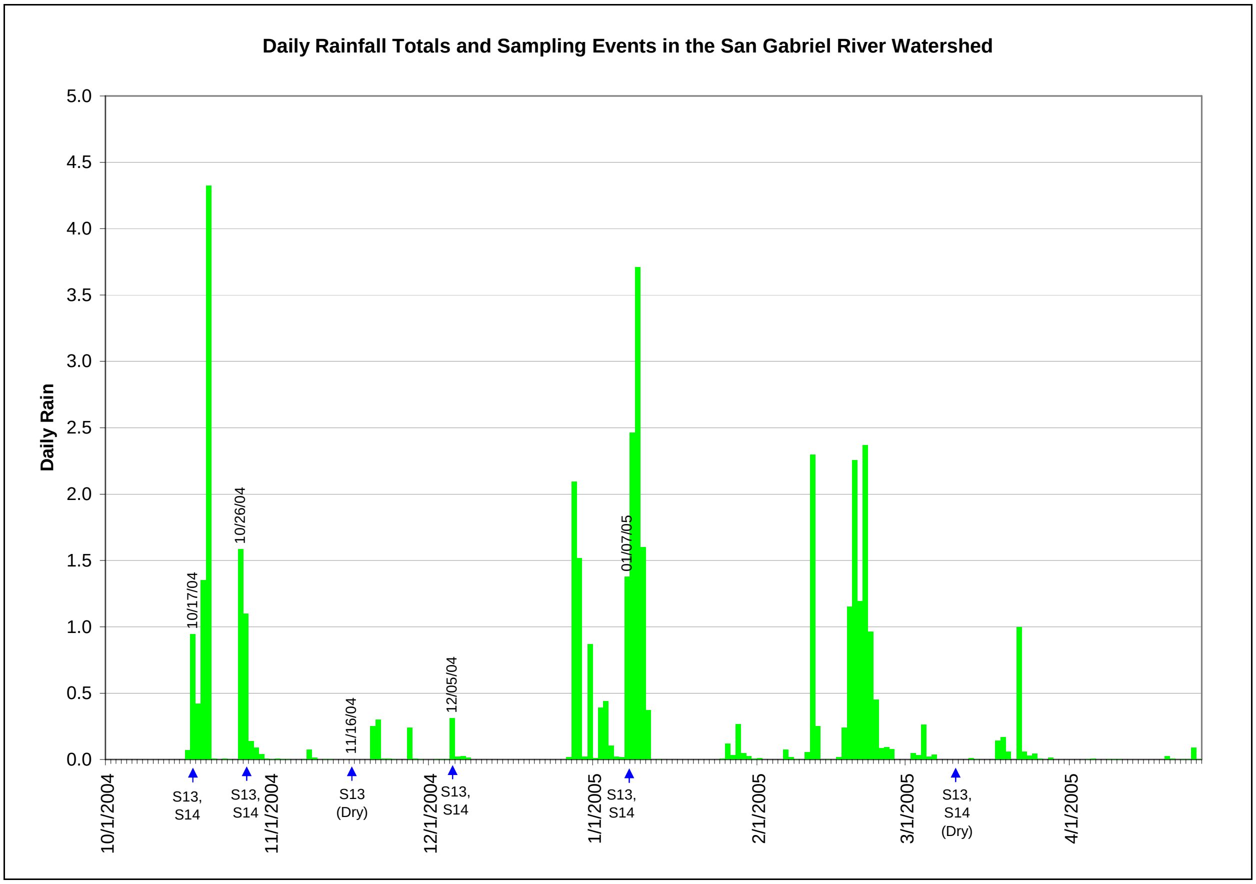

Figure 4-5. Daily Rainfall and Sampling Events During 2004-2005 at San Gabriel River.

Rainfall during the monitored storms was typically concentrated in the southern portion of the watershed above the S13 (Coyote Creek) mass emission station. Rainfall was also often heavy in the higher elevations to the north (Figure 4-6).

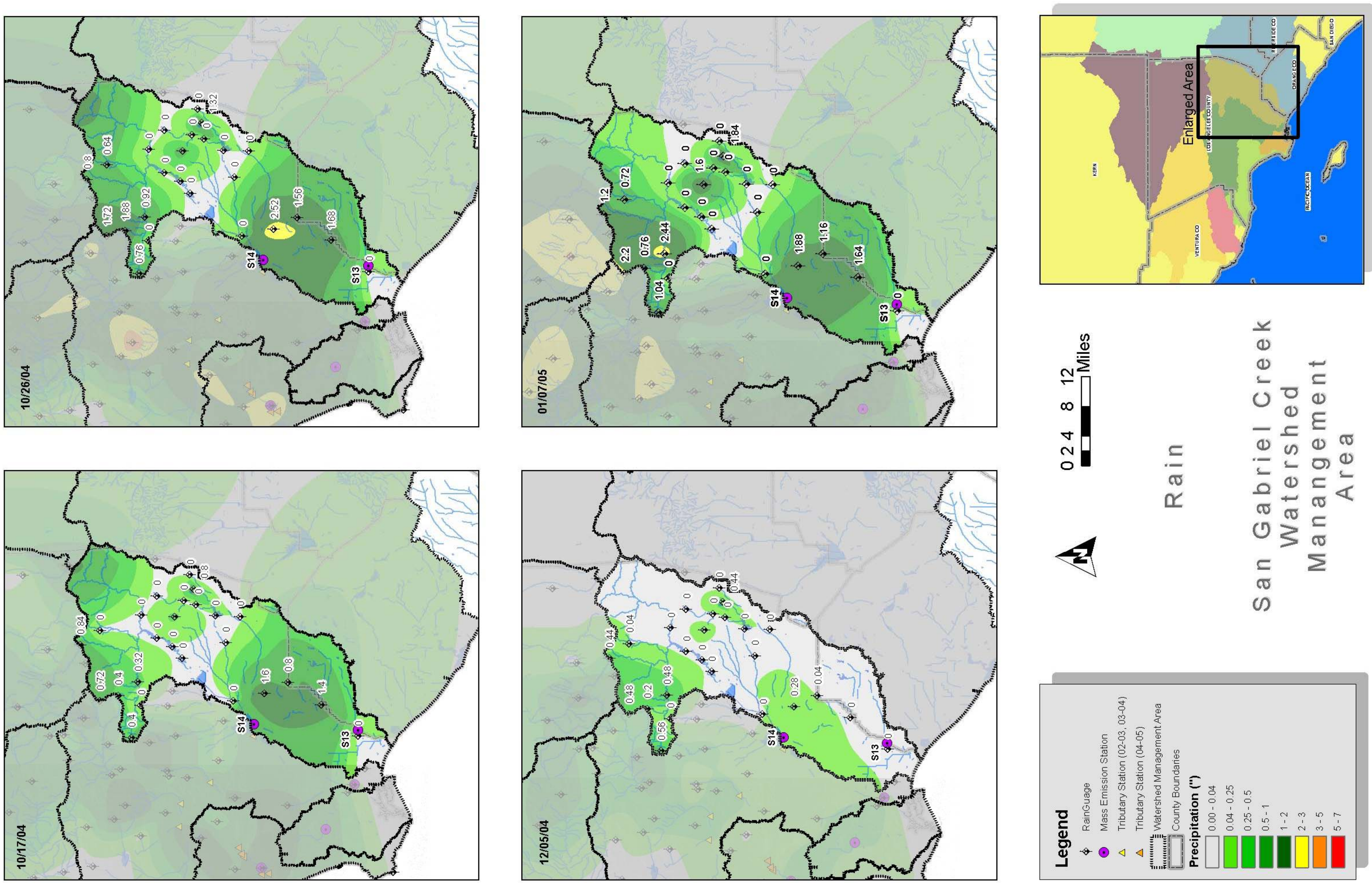

Figure 4-6. Distribution of Rainfall in San Gabriel Watershed for Monitored Storm Events.

4.2 Flow Monitoring

Figures 4-7 and 4-8 show a historical flow volume record of monitored storms at the Coyote Creek and San Gabriel River monitoring stations. Monitored flow (green bars) represents the amount of storm flow that is represented in the mass emission station composite sampling. Total flow (blue bars) represents the total amount of storm flow over the entire storm event. Note that the highly variable flow volume appears on a log scale. Flow data for the 2004/05 storm season is not yet available.

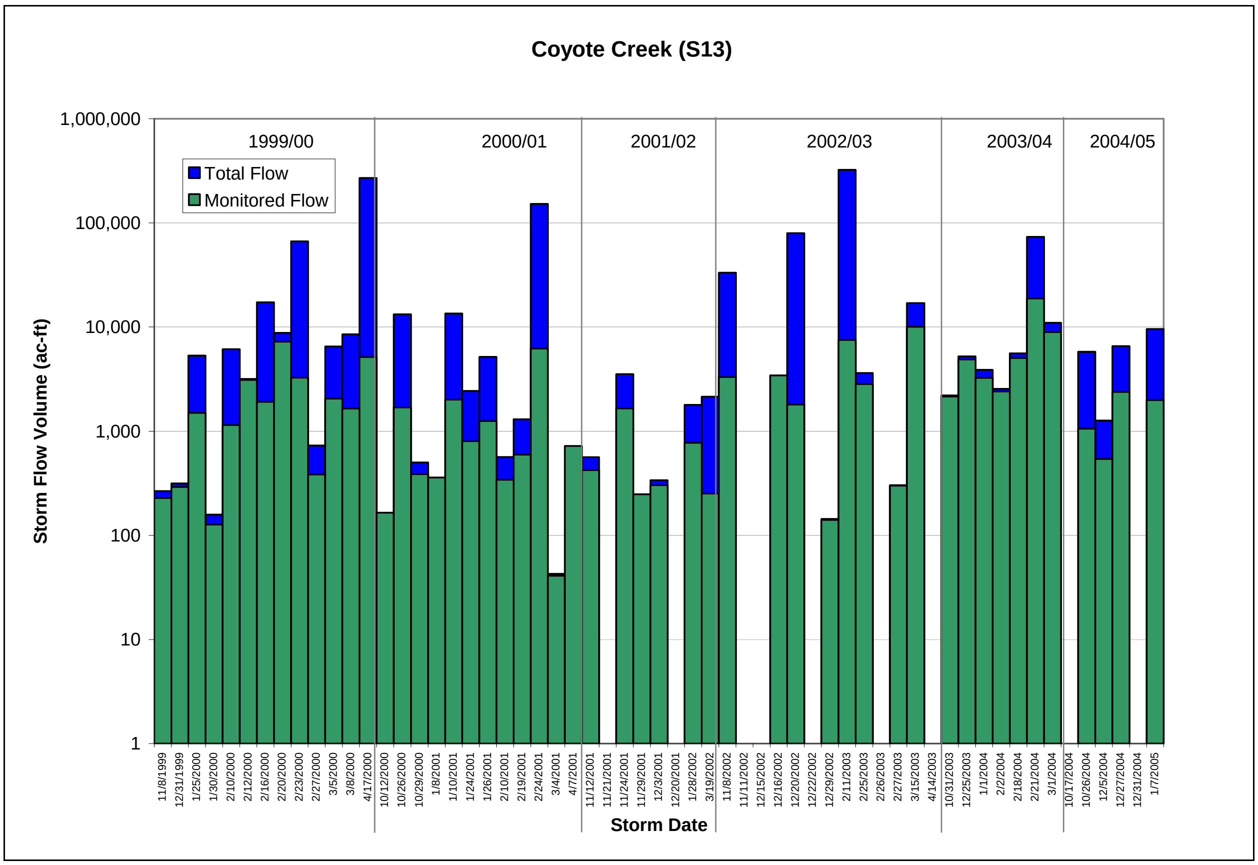

Figure 4-7. Storm Flow Volumes monitored on Coyote Creek.

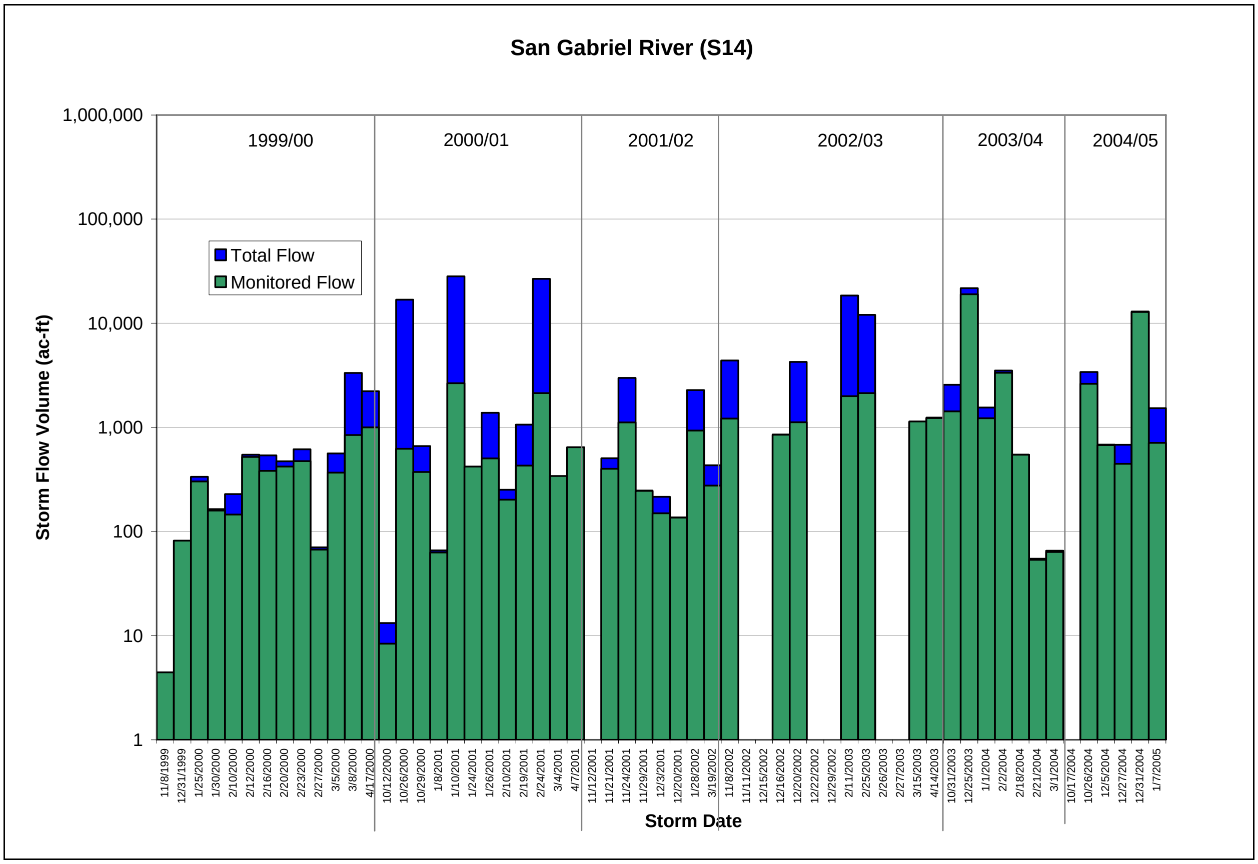

Figure 4-8. Monitored Storm Flow Volumes on San Gabriel River.

4.3 Core Stormwater Monitoring Summary

4.3.1 Mass Emissions

Two mass emission stations are located in the San Gabriel Watershed, one in the San Gabriel River and the other in Coyote Creek. Four wet weather events were monitored at each of these stations. Sampling at both stations occurred during storms on October 17 and 26, December 5, 2004 and January 7, 2005. San Gabriel River and Coyote Creek were monitored during two dry weather events. San Gabriel River was monitored on March 17 and June 21, 2005 and Coyote Creek was monitored on November 16, 2004 and March 9, 2005. The results from these sampling events are discussed in Section 4.3.1.1 and presented in Appendix C, Table 1 (San Gabriel River) and Table 2 (Coyote Creek). Highlighted cells in Tables 1 and 2 represent concentrations exceeding respective water quality objectives (WQO). This discussion presents the results based on groups of constituents (general chemistry, nutrients, bacterial indicators, metals, semi-volatiles and PCBs, and pesticides and herbicides). Wet weather data for each group of constituents are reviewed and presented first, followed by a brief comparison of the dry weather results. Section 4.3.1.2 presents a summary of the historical data collected at these stations and an assessment of the trend analyses performed on all water quality data collected to this point. Section 4.3.1.3 lists the constituents of concern (COC) for each of these drainages.

4.3.1.1 2004-2005 Results

San Gabriel River

Nearly all the general water chemistry results for the four storms complied with acceptable water quality criteria. Cyanide exceeded the Ocean Plan water quality objective (WQO) during the first storm event on October 17, 2004 and during the two dry weather events (Appendix C, Table 1). Oil and grease, and TPH were not detected in any samples collected during the 2004-2005 season. Major ions that constitute TDS, except carbonate, were detected in all samples; carbonate was never detected. Chloride was observed above the WQO only during the June 21, 2005 dry weather event. Total organic carbon and biological oxygen demand were highest during the first storm on October 17, 2004. Turbidity and TSS values were highest during the last storm on January 7, 2005.

Nutrients were detected during all four storm events except ammonia and nitrite which were only detected during the first and third storm events. Nitrite-N was the only nutrient that exceeded water quality objectives during the first storm event, October 17, 2004, with a value of 1.04 mg/L. Nutrient levels during the first storm were typically the highest measured for all storm events.

Indicator bacteria densities consistently exceeded WQOs at the San Gabriel mass emission site. Total coliform, fecal coliform and enterococcus densities exceeded objectives during all storm events monitored during the 2004-2005 season. Fecal streptococcus densities were similar in magnitude to enterococcus densities, as expected due to the similar bacterial species that comprise both groups. Samples from the first storm event (October 17, 2004) contained the highest densities of indicator bacteria. This is likely related to the high total organic carbon, biological oxygen demand and nutrient levels measured during this storm event, providing optimal growth conditions for the bacteria. Total coliform was the only indicator that exceeded water quality objectives during one dry weather event with a value of 17,000 MPN/100mL.

Aluminum, copper, lead and mercury were the only metals to exceed California Toxics Rule (CTR) criteria. Total aluminum and total lead concentrations exceeded WQOs in two out of four storms; total copper concentrations were above WQO during all storm events; and total mercury and dissolved lead exceeded WQO during one storm event. Total and dissolved beryllium, hexavalent chromium, silver and thallium and dissolved mercury were not detected during any of the storm events. The last storm event, January 7, 2005, generally had the highest concentrations of metals during any of the four storm events. The higher concentrations are likely related to the peak TSS levels that were measured during this storm. All metals were either non-detect or below water quality objectives during the dry weather events.

None of the semi-volatile organics, PCBs or herbicides were detected in any of the samples collected during the 2004-2005 monitoring season. Diazinon was the only pesticide that was measured above detection limits. Concentrations of diazinon were above WQOs during the first two storm events. Diazinon was detected below the WQO during the third storm and was not detected during the last storm event or the dry weather events.

Coyote Creek

Cyanide exceeded the Ocean Plan WQO during three of the four storm events and during the two dry weather events (Appendix C, Table 2). The majority of the other general constituents were detected in all storm samples, however concentrations were below WQOs. Maximum turbidity, TSS and VSS values occurred during the first storm on October 17, 2004. Total petroleum hydrocarbons and oil and grease were not detected in any of the samples. Chloride exceeded water quality objectives during both dry weather events.

Nutrients were detected in all samples, except for ammonia and nitrite which were not detected on October 26, 2004. Concentrations of nutrients were all below WQOs during all storm events. All nutrients were detected during at least one dry weather event, however concentrations were below WQOs.

Indicator bacteria exceeded WQOs for all wet weather and both dry weather samples collected at Coyote Creek. Similar to results at the San Gabriel River, fecal streptococcus results were comparable to enterococcus densities in all samples.

Metals that exceeded WQOs included aluminum, copper, lead and zinc. Total aluminum exceeded WQOs during the last three stormwater samples with concentrations ranging from 1,061 mg/L to 1,560 mg/L. Dissolved copper exceeded the WQO in two wet weather samples, while total copper concentrations exceeded objectives in all stormwater samples. Total lead exceeded the criterion in three out of four stormwater samples and total zinc only exceeded objectives during one wet weather event. Total and dissolved beryllium, chromium +6, mercury, silver and thallium were not detected in any of the wet or dry weather samples. Dissolved aluminum, cadmium and manganese were also not detected in any of the wet or dry samples. All metals were either non-detect or had concentrations below applicable water quality criteria during the dry weather events.

Bis (2-Ethylhexl) phthalate was the only semi-volatile organic that was detected during any of the sampling events. Concentrations were detected during the second dry weather event with a value of 14.20 µg/L. PCBs and herbicides were not detected in any of the samples collected during the 2004-2005 monitoring season. Diazinon was the only pesticide that was detected during three storm events. Concentrations were below WQOs.

4.3.1.2 Historical Review

San Gabriel River

Table 4-1 presents annual means for the constituents that were monitored from 1995 to 2005 with the appropriate water quality objectives. Each observation was compared to the lowest applicable WQO from the Basin Plan, Ocean Plan, or the CTR and those above the WQO were highlighted. Water quality objectives for metals are hardness dependent. Metal concentrations were determined using a mean hardness value; however, individual events show specific hardness for that particular event. Therefore, results for individual events may show different results that may be less than WQOs. Individual events for each year are presented in the annual reports.

The yellow-highlighted cells in Table 4-1 indicate that a constituent's detection limit is greater than the WQO. For statistical analyses, one-half the detection limit is used in place of a non-detect result. Therefore, annual means generated from values highlighted in yellow may be misrepresentative of actual concentrations. Table 4-1 suggests that total mercury and total thallium have consistently exceeded WQOs; however, since the detection limits are greater than the WQO, actual concentrations could not be determined. In addition, the Ocean Plan was developed for the protection of marine resources and applies specifically to discharges to the ocean and not to discharges to enclosed bays, estuaries or inland waters. The Ocean Plan criteria were intended for ocean water samples representative of the discharge area after initial dilution has been completed (SWRCB 2001). Therefore, applying the Ocean Plan criteria to stormwater samples collected upstream of the San Gabriel River mouth and interpreting these results should be done with caution. Concentrations for these constituents were not considered as exceedances.

Table 4-1 also presents frequency and mean magnitude of exceedance ratios for each constituent. The frequency ratio was determined by dividing the total number of years a constituent was analyzed into the number of times the mean value of a constituent exceeded the WQO. The mean magnitude of exceedance was determined by dividing the WQO for a constituent into the constituents mean value for each year, then calculating the average magnitude of exceedance. A frequency ratio greater than 0.5 (50%) and a mean exceedance ratio greater than 1.0 were used as the criteria for determining whether a given parameter should be considered as a COC.

Blue highlighted cells in Table 4-1 represent exceedances of water quality objectives; yellow cells represent constituents in which the detection limits were above water quality objectives and were not considered exceedances; orange cells represent a frequency ratio greater than 0.5 (50% exceedance) and a mean exceedance ratio greater than 1.0.

The 2004-2005 monitoring results at the San Gabriel River mass emission site were similar to findings from previous years. Cyanide and indicator bacteria have consistently exceeded water quality objectives since 1995. Total copper and total lead have sporadically been measured at elevated concentrations compared to the WQOs. Total aluminum and zinc and dissolved copper and lead have exceeded objectives during one year prior to 2004-2005. Turbidity was measured above water quality objectives during 1997-1998 and 2002-2003 and nitrite exceeded objectives during 2002-2003. Diazinon was measured above the WQO in 2002-2003.

Regression analyses were performed on the water quality data collected since 1995-1996 to determine if any of the constituents had a significantly increasing or decreasing trend. In the San Gabriel River, only a few constituents have significant increasing or decreasing trends. Biological oxygen demand (BOD) has a significantly decreasing trend (Figure 4-9). Annual average concentrations of BOD were between 30 and 50 mg/L during the first four years of monitoring, and have since decreased. During the last six years, BOD has had a relatively consistent annual average concentration between 10 and 20 mg/L, except during 2002-2003 when the average concentration was 30.3 mg/L. Conversely, oil and grease has increased significantly since the 1995-1996 monitoring season. Oil and grease has increased from an average concentration of below 1 mg/L from 1995-1999 to between 2.4 and 4.2 mg/L from 2000 -2005 (Figure 4-9b). Lastly, total boron concentrations have increased significantly since 1996-1997 (Figure 4-9c).

Table 4-1. Annual Mean Concentration for Constituents Measured at the San Gabriel River Mass Emission Site, 1995 to 2005.

Constituent	Units	Lowest WQO[1]	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	Frequency Ratio	Mean Exceedance Ratio[2]
General														
Alkalinity	mg/l		95.5	56.7	68.7	122.2	71.5	104.1	90.5	71.1	136.2	90.1	0.0	
Bicarbonate	mg/l		95.5	56.7	68.7	122.2	87.3	126.9	110.2			115.0	0.0	
BOD	mg/l		42.6	32.6	33.4	45.9	12.4	8.3	17.7	30.3	8.9	18.6	0.0	
Calcium	mg/l		47.7	33.0	35.0	55.9	36.5	59.6	45.1			38.5	0.0	
Carbonate	mg/l							1	1			1	0.0	
Chloride	mg/l	150	42.1	40.1	38.7	73.2	43.4	83.7	62.4	67.2	133.2	42.7	0.0	0.4
COD	mg/l		23.2	62.9	79.2	64.7	40.0	84.7	166.6	64.4	53.1	52.2	0.0	
Cyanide	mg/l	0.004	0.019	0.010	0.025	0.036		0.015	0.005	0.018	0.015	0.006	1.0	4.1
Dissolved Oxygen	mg/l	<5								8.34	9.63	9.24	0.0	0.6
Fluoride	mg/l	2.2	0.188	0.132	0.164	0.271	0.206	0.226	0.185	0.217	0.200	0.213	0.0	0.1
Hardness	mg/l		173	130	114	215	147	232	175	170	258	148	0.0	
Magnesium	mg/l		13.0	10.4	9.2	17.4	10.0	20.1	15.3			12.6	0.0	
MBAS	mg/l					0.10	0.04	0.07	0.09	0.08	0.06	0.11	0.0	
Oil and Grease	mg/l		0.68	0.98	0.64	0.81	1.66	2.40	2.83	4.23	2.66	2.50	0.0	
pH		6.5/8.5	7.73	7.48	7.46	7.70	7.26	7.54	7.64	7.80	7.78	7.32	0.0	
Potassium	mg/l		6.45	5.02	4.79	6.23	4.93	7.19	6.66			5.82	0.0	
Sodium	mg/l		40.4	29.0	30.2	56.0	38.0	65.0	55.5			31.4	0.0	
Specific Conductance	umhos/cm		469	435	394	724	455	767	588	630	1026	444	0.0	
Sulfate	mg/l	350	72.8	61.9	61.3	105.6	64.2	115.3	81.8	77.6	160.8	64.6	0.0	0.2
Total Dissolved Solids	mg/l	1500	300.5	289.0	249.4	449.8	267.0	467.6	369.2	409.0	629.6	255.0	0.0	0.2
Total Organic Carbon	mg/l		11.33	14.24	10.50	6.60	7.00	7.48	12.38	7.65	6.43	15.76	0.0	
Total Phenols	mg/l							0.05	0.05	0.05	0.05	2.31	0.0	
Total Suspended Solids	mg/l		266.6	170.0	321.8	81.2	134.0	105.7	194.8	543.0	29.6	508.8	0.0	
Turbidity	ntu	225	43.0	56.0	248.1	41.8	88.1	43.7	146.6	269.9	6.5	54.0	0.2	0.4
Volatile Suspended Solids	mg/l		31.4	30.5	48.0	17.8	25.3	24.7	38.2	94.4	8.2	56.5	0.0	
Nutrients														
Ammonia	mg/l		1.14	0.74	1.83	1.53		0.47	0.90			1.31	0.0	
Dissolved Phosphorus	mg/l		0.38	0.37	0.48	0.45	0.22	12.24	0.28	0.29	0.24	0.16	0.0	
Kjeldahl-N	mg/l		3.00	3.27	3.47	3.87	1.46	2.27	2.87	2.87	0.85	4.89	0.0	
NH3-N	mg/l		0.97	0.62	1.53	1.27		0.36	0.75	0.19	0.05	1.09	0.0	
Nitrate	mg/l		17.05	8.61	6.72	9.27	7.20	20.89	7.03	13.78	27.02	6.67	0.0	
Nitrate-N	mg/l	10	3.85	1.95	1.52	2.09	1.63	4.72	1.59	3.52	6.10	1.51	0.0	0.3
Nitrite-N	mg/l	1	0.21	0.29	0.30	0.57	0.28	0.40	0.41	1.01	0.80	0.30	0.1	0.5
Total Phosphorus	mg/l		0.59	0.80	0.58	0.51	0.26	18.81	0.38	0.41	0.28	0.46	0.0	
Indicator Bacteria														
Fecal Coliform	mpn/100ml	400	1,368,000	76,950	2,405,889	40,793	73,944	80,850	96,750	106,250	26,276	62,450	1.0	1085
Enterococcus	mpn/100ml	104	322,400			15,670	16,418	34,083	194,500	155,730	3,994	106,675	1.0	1021
Fecal Streptococcus	mpn/100ml		814,000	221,950	1,960,889	42,194	78,500	80,900	244,500	159,322	5,120	106,950	0.0	
Total Coliform	mpn/100ml	10,000	3,500,000	401,250	3,052,222	313,168	252,222	1,725,833	1,267,500	234,500	49,200	474,250	1.0	113
Metals														
Dissolved Aluminum	ug/l			73.75	1381.82		197.00	60.44	69.50	50.00	50.00	341.25	0.0	
Dissolved Antimony	ug/l							2.50	1.41	0.90	1.73	1.02	0.0	

Table 4-1. Annual Mean Concentration for Constituents Measured at the San Gabriel River Mass Emission Site, 1995 to 2005.

Constituent	Units	Lowest WQO[1]	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	Frequency Ratio	Mean Exceedance Ratio[2]
Dissolved Arsenic	ug/l			2.33				2.50	2.30	1.99	1.63	2.18	0.0	
Dissolved Barium	ug/l			13.50	59.42	50.06	50.76	40.42	46.78			48.50	0.0	
Dissolved Berylium	ug/l							0.50	0.50	0.50	0.50	0.50	0.0	
Dissolved Boron	ug/l		106.0	77.5	192.0	285.5	98.6	202.4	220.9			231.3	0.0	
Dissolved Cadmium	ug/l	2.5-4.5						0.50	0.50	0.50	0.50	0.46	0.0	0.1
Dissolved Chromium	ug/l	73-142.1		2.13				2.50	2.35	3.01	2.85	1.20	0.0	0.0
Dissolved Chromium +6	ug/l							5.00	5.00	5.00	5.00	5.00	0.0	
Dissolved Copper	ug/l	10.1-20.1		2.68	12.58			2.95	6.04	5.89	4.46	6.32	0.1	0.5
Dissolved Iron	ug/l		74.0	225.0	1748.6		279.0	133.3	136.7	351.0	73.4	288.0	0.0	
Dissolved Lead	ug/l	2.9-6.9			10.10			2.50	2.33	1.69	1.98	4.73	0.3	1.0
Dissolved Manganese	ug/l		53.00		90.91			50.00	50.00			57.35	0.0	
Dissolved Mercury	ug/l							0.50	0.50	0.50	0.50	0.50	0.0	
Dissolved Nickel	ug/l	58.4-116.1		2.55	5.04			5.02	4.31	5.56	4.47	4.46	0.0	0.1
Dissolved Selenium	ug/l							2.50	2.05	2.41	2.02	1.96	0.0	
Dissolved Silver	ug/l							0.50	0.50	0.50	0.50	0.50	0.0	
Dissolved Thallium	ug/l							2.50	2.50	2.50	2.50	2.50	0.0	
Dissolved Zinc	ug/l	131.4-261.6			99.09	31.62		28.64	25.90	22.44	32.94	19.03	0.0	0.2
Total Aluminum	ug/l	1000		815.0	4481.4	235.7	401.2	316.6	105.3	642.0	146.8	4594.0	0.2	1.3
Total Antimony	ug/l	6						2.50	1.45	1.37	1.43	1.20	0.0	0.3
Total Arsenic	ug/l	32		2.33				2.50	2.08	3.04	1.41	3.34	0.0	0.1
Total Barium	ug/l			27.00	105.88	56.80	56.63	43.12	50.22			100.48	0.0	
Total Beryllium	ug/l	4						0.50	0.50	0.50	0.50	0.50	0.0	0.1
Total Boron	ug/l		152.0	115.2	274.9	375.2	132.5	235.2	284.7			482.0	0.0	
Total Cadmium	ug/l	2.7-5.2			0.87			0.50	0.50	0.83	0.50	0.58	0.0	0.2
Total Chromium	ug/l	50	4.20	5.28	12.47			2.50	3.29	11.35	5.15	7.17	0.0	0.1
Total Chromium +6	ug/l									5.00	5.00	5.00	0.0	
Total Copper	ug/l	10.5-21	11.00	18.13	24.48	7.31	7.38	8.56	12.80	27.00	12.72	26.33	0.4	1.1
Total Iron	ug/l		1130	1597	8965	211	581	366	379	1318	221	4809	0.0	
Total Lead	ug/l	3.8-10.6		9.80	15.01			2.80	1.90	13.49	1.79	13.69	0.6	1.7
Total Manganese	ug/l		70.2	72.5	167.5			50.0	126.3			223.4	0.0	
Total Mercury	ug/l	0.16						0.50	0.50	0.50	0.45	0.44	1.0	3.0
Total Nickel	ug/l	58.5-116.3	12.20	5.85	8.86		4.67	6.26	5.09	14.90	5.91	10.31	0.0	0.1
Total Selenium	ug/l	60	3.50					2.50	1.82	2.66	2.17	2.02	0.0	0.0
Total Silver	ug/l	2.8		0.55				0.50	0.86	0.49	0.50	0.50	0.0	0.2
Total Thallium	ug/l	2						2.50	2.50	2.50	2.50	2.50	1.0	1.3
Total Zinc	ug/l	134-267	43.8	96.0	165.8	50.1		39.2	29.9	127.9	52.5	58.6	0.1	0.4
Pesticides														
Diazinon	ug/l	0.08					0.02	0.01	0.08	0.14	0.01	0.06	0.2	0.6
Prometryn	ug/l									1	1	1	0.0	

[1] WQO for metals are hardness dependent and were based on minimum hardness by year.

[2] Mean Exceedance Ratio calculated using annual mean concentrations reported up to four significant figures. Ratio shown may not exactly equal ratio of mean values shown in table due to rounding of presented means.

Blue = WQO Exceedances ; Yellow = DL above WQO; Orange = Frequency ratio > 0.5, Mean exceedance > 1.0.

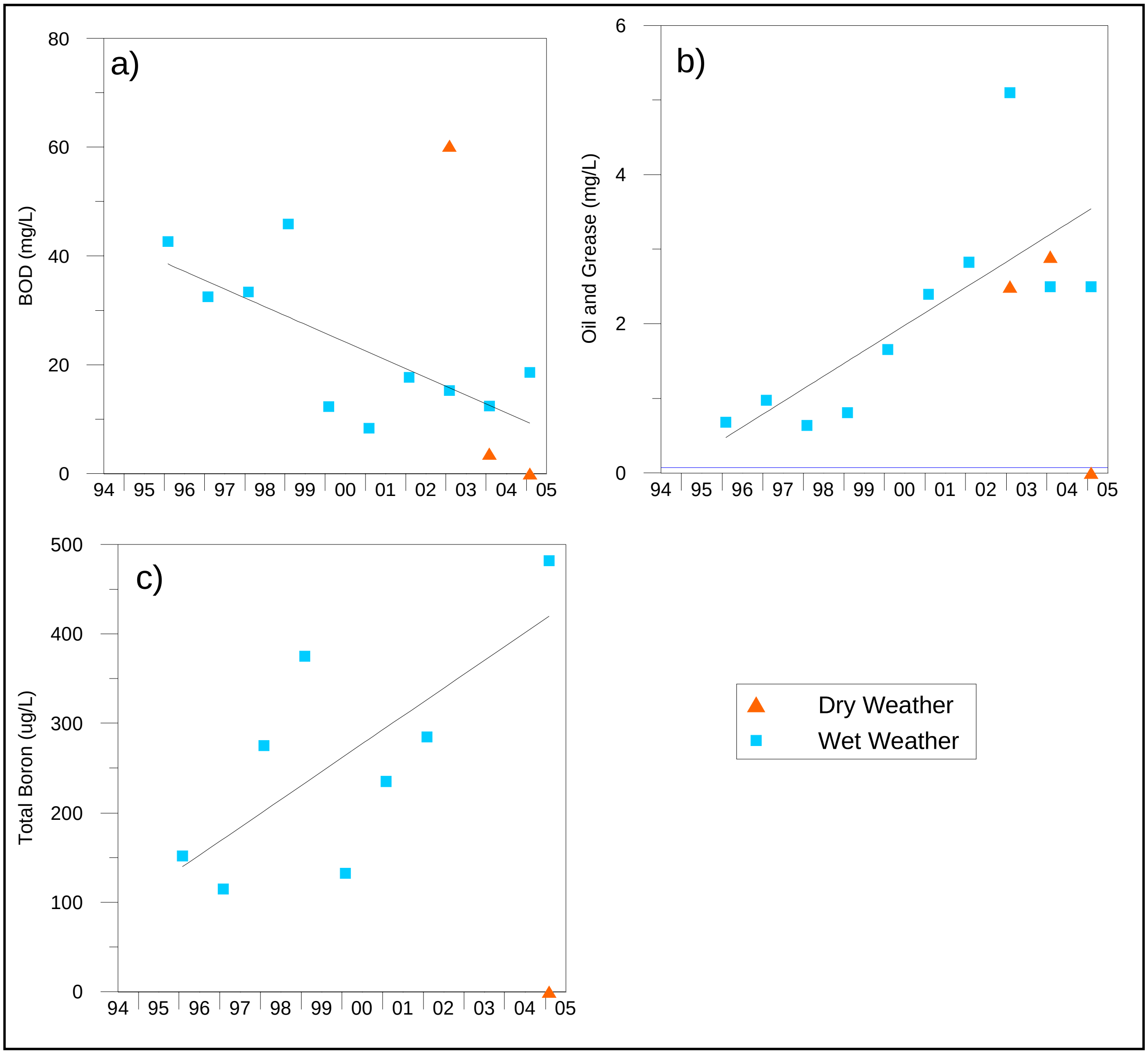

Figure 4-9. Scatterplot and Trends in annual mean levels for BOD (a), Oil & Grease (b) and Total Boron (c) at the San Gabriel River Mass Emission Site, 1995 to 2005.

Concentrations of the constituents that typically exceeded WQOs in 2004-2005 have shown no significant trend throughout the monitoring period. Indicator bacteria have consistently been measured at high levels. Prior to 2004-2005, total aluminum has consistently had an annual average below the WQO, with the exception of 1997-1998. Concentrations of total aluminum measured in one storm event in 2004-2005 were significantly higher than any previous samples. Total copper and total lead values do not show a discernable pattern. Figure 4-10a-d contains representative scatterplots of some of these constituents.

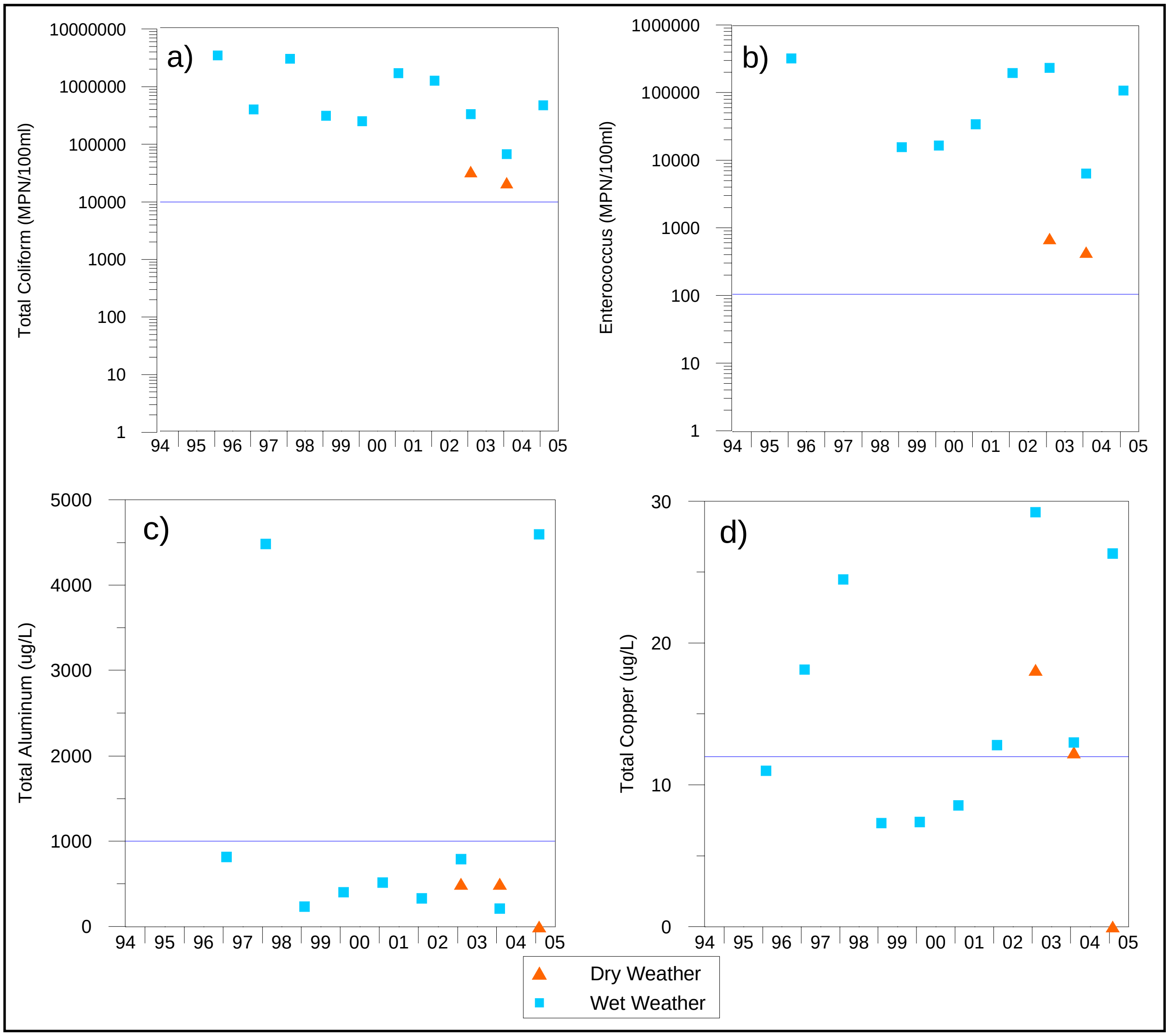

Figure 4-10. Scatterplots showing annual mean levels for Total Coliform (a), Enterococcus (b), Total Aluminum (c) and Total Copper (d) at the San Gabriel River Mass Emission Site, 1995 to 2005.

Coyote Creek

Table 4-2 presents annual means for the constituents that were monitored from 1995 to 2005 with the appropriate water quality objectives. Each observation was compared to the lowest applicable WQO from the Basin Plan, Ocean Plan, or the CTR and those above the WQO were highlighted. Water quality objectives for metals are hardness dependent. Metal concentrations were determined using a mean hardness value; however, individual events show specific hardness for that particular event. Therefore, results for individual events may show different results that may be less than WQOs. Individual events for each year are presented in the annual reports.

The yellow-highlighted cells in Table 4-2 indicate that a constituent's detection limit is greater than the WQO. For statistical analyses, one-half the detection limit is used in place of a non-detect result. Therefore, annual means generated from values highlighted in yellow may be misrepresentative of actual concentrations. Table 4-2 suggests that total mercury and total thallium have consistently exceeded WQOs; however, since the detection limits are greater than the WQO, actual concentrations could not be determined. In addition, the Ocean Plan was developed for the protection of marine resources and applies specifically to discharges to the ocean and not to discharges to enclosed bays, estuaries or inland waters. The Ocean Plan criteria were intended for ocean water samples representative of the discharge area after initial dilution has been completed (SWRCB 2001). Therefore, applying the Ocean Plan criteria to stormwater samples collected upstream of the Coyote Creek mouth and interpreting these results should be done with caution. Concentrations for these constituents were not considered as exceedances.

Table 4-2 also presents frequency and mean magnitude of exceedance ratios for each constituent. The frequency ratio was determined by dividing the total number of years a constituent was analyzed into the number of times the mean value of a constituent exceeded the WQO. The mean magnitude of exceedance was determined by dividing the WQO for a constituent into the constituents mean value for each year, then calculating the average magnitude of exceedance. A frequency ratio greater than 0.5 (50%) and a mean exceedance ratio greater than 1.0 were used as the criteria for determining whether a given parameter should be considered as a COC.

Blue highlighted cells in Table 4-2 represent exceedances of water quality objectives; yellow cells represent constituents in which the detection limits were above water quality objectives and were not considered exceedances; orange cells represent a frequency ratio greater than 0.5 (50% exceedance) and a mean exceedance ratio greater than 1.0.

The 2004-2005 water quality results at the Coyote Creek mass emission station were similar to findings from previous years. Indicator bacteria, total copper and total lead have most frequently exceeded water quality criteria. The annual average densities for all indicator bacteria have exceeded WQOs every year they have been analyzed. Total copper has also exceeded WQO every year since 1995-1996 except during 2000-2001. The annual mean concentration of total lead has also been consistently above the WQO. Total aluminum has exceeded WQOs during three of the monitoring years. Dissolved lead has exceeded the WQO during two years, while dissolved copper and zinc have exceeded objectives during one year. The annual mean concentration of cyanide has exceeded objectives each year since 2001-2002.

Table 4-2. Annual Mean Concentration for Constituents Measured at the Coyote Creek Mass Emission Site, 1995 to 2005.

Constituent	Units	Lowest WQO[1]	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	Frequency Ratio	Mean Exceedance Ratio[2]
General														
Alkalinity	mg/l		93.0	49.8	63.1	89.6	81.1	72.5	73.9	108.7	153.3	114.0	0.0	
Bicarbonate	mg/l		93.0	49.8	63.1	89.6	98.9	88.4	90.2			161.5	0.0	
BOD	mg/l		22.3	24.5	25.9	23.1	23.6	9.6	15.7	21.4	35.1	25.0	0.0	
Calcium	mg/l		34.9	23.2	33.1	38.9	30.2	30.9	29.9			41.4	0.0	
Carbonate	mg/l							1	1			1	0.0	
Chloride	mg/l	150	39.1	14.2	30.9	54.0	38.3	34.6	26.6	51.1	86.8	58.8	0.0	0.3
COD	mg/l		20.4	196.2	123.4	66.4	61.2	81.4	232.5	68.0	108.7	51.0	0.0	
Cyanide	mg/l	0.004							0.01	0.03	0.01	0.27	1.0	19.6
Dissolved Oxygen	mg/l	<5								8.41	9.22	10.13	0.0	0.5
Fluoride	mg/l	2.2	0.23	0.07	0.17	0.28	0.27	0.20	0.21	0.43	0.35	0.28	0.0	0.1
Hardness	mg/l		135.2	74.6	120.6	155.5	112.2	112.9	114.6	158.4	230.0	166.8	0.0	
Magnesium	mg/l		11.6	4.0	9.2	13.7	9.0	8.7	9.7			15.5	0.0	
MBAS	mg/l					0.12	0.12	0.10	0.17	0.10	0.17	0.11	0.0	
Oil and Grease	mg/l		2.61						3	2.27	2.5	2.5	0.0	
pH		6.5/8.5	7.81	7.48	7.28	7.66	7.17	7.11	7.45	7.89	7.37	7.14	0.0	
Potassium	mg/l		4.00	3.38	4.48	3.93	4.16	4.31	5.19			4.67	0.0	
Sodium	mg/l		45.9	15.0	34.5	59.8	47.3	38.1	31.9			55.3	0.0	
Specific Conductance	umhos/cm		523.6	257.0	372.2	619.5	432.7	387.8	356.0	749.5	960.4	569.7	0.0	
Sulfate	mg/l	350	84.9	26.7	63.5	111.1	62.5	53.9	40.2	74.2	126.2	94.9	0.0	0.2
Total Dissolved Solids	mg/l	1500	348.8	171.5	232.6	386.2	268.1	237.7	246.8	481.0	590.0	347.6	0.0	0.2
Total Organic Carbon	mg/l		14.8	8.2	12.7	10.9	14.4	15.6	21.6	12.5	21.4	14.3	0.0	
Total Phenols	mg/l								0.05	0.05	0.05	1.97	0.0	
Total Suspended Solids	mg/l		310	248	566	147	284	307	332	243	591	355	0.0	
Turbidity	ntu	225	76.8	42.1	195.1	77.5	63.3	87.3	101.2	36.3	15.8	16.8	0.0	0.3
Volatile Suspended Solids	mg/l		60.4	49.0	103.8	30.5	60.5	61.3	79.4	38.7	118.2	70.4	0.0	
Nutrients														
Ammonia	mg/l		0.60	0.52	1.02	0.75	1.01	0.72	0.60			0.89	0.0	
Dissolved Phosphorus	mg/l		0.14	0.23	0.46	0.18	0.26	0.24	0.36	0.21	0.30	0.13	0.0	
Kjeldahl-N	mg/l		2.72	2.93	4.40	3.58	2.72	2.45	4.14	2.43	2.90	3.86	0.0	
NH3-N	mg/l		0.47	0.39	0.86	0.62	0.84	0.59	0.49	0.86	1.01	0.74	0.0	
Nitrate	mg/l		13.76	4.59	3.78	7.91	6.05	3.47	3.50	5.22	7.49	5.66	0.0	
Nitrate-N	mg/l	10	3.11	1.04	0.90	1.78	1.37	0.83	0.84	1.18	1.74	1.10	0.0	0.1
Nitrite-N	mg/l	1	0.08	0.08	0.18	0.18	0.32	0.13	0.15	0.52	0.44	0.27	0.0	0.2
Total Phosphorus	mg/l		0.21	0.85	0.59	0.21	0.40	0.31	0.44	0.24	0.33	0.26	0.0	
Indicator Bacteria														
Fecal Coliform	mpn/100ml	400	4,044,000					157,725	1,576,667	151,795	24,020	93,000	1.0	2519.7
Enterococcus	mpn/100ml	104	470,002					22,950	556,667	191,933	23,672	278,740	1.0	2474.3
Fecal Streptococcus	mpn/100ml		628,002					38,950	803,333	201,933	30,600	404,340	0.0	
Total Coliform	mpn/100ml	10,000	6,320,002					432,000	3,500,000	351,917	65,280	706,000	1.0	189.6
Metals														
Dissolved Aluminum	ug/l			71.3	1542.0	116.2	107.6	59.7	63.6	50.0	50.0	50.0	0.0	
Dissolved Antimony	ug/l							2.50	1.54	1.48	1.63	1.61	0.0	

Table 4-2. Annual Mean Concentration for Constituents Measured at the Coyote Creek Mass Emission Site, 1995 to 2005.

Constituent	Units	Lowest WQO[1]	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	Frequency Ratio	Mean Exceedance Ratio[2]
Dissolved Arsenic	ug/l							2.50	2.46	3.04	2.78	1.72	0.0	
Dissolved Barium	ug/l			11.3	62.9	41.6	43.0	28.2	38.9			29.4	0.0	
Dissolved Berylium	ug/l							0.5	0.5	0.5	0.5	0.5	0.0	
Dissolved Boron	ug/l			88.5	204.8	214.4	117.0	114.1	169.0			185.4	0.0	
Dissolved Cadmium	ug/l	1.8-4.1			1.16			0.5	0.5	0.5	0.5	0.5	0.0	0.2
Dissolved Chromium	ug/l	51.5-129.4		2.38	4.69			2.50	1.88	2.48	4.61	1.01	0.0	0.0
Dissolved Chromium +6	ug/l							5.0	5.0	5.0	5.0	5.0	0.0	
Dissolved Copper	ug/l	7-18.2	4.60	2.35	31.47	5.19	5.83	4.52	9.52	6.06	7.77	6.20	0.1	0.7
Dissolved Iron	ug/l		196.0	370.0	2830.6	172.4	160.8	95.0	233.4	105.8	103.2	88.4	0.0	
Dissolved Lead	ug/l	1.8-6.2		2.38	19.62			2.50	1.35	1.87	1.99	2.33	0.3	1.5
Dissolved Manganese	ug/l		46.6		184.4			71.0	153.2			50.0	0.0	
Dissolved Mercury	ug/l							0.5	0.5	0.5	0.5	0.5	0.0	
Dissolved Nickel	ug/l	40.6-105.3			7.74			3.92	7.79	5.41	7.10	4.47	0.0	0.1
Dissolved Selenium	ug/l							2.5	2.5	2.4	3.3	2.4	0.0	
Dissolved Silver	ug/l							0.5	0.5	0.5	0.5	0.5	0.0	
Dissolved Thallium	ug/l							2.5	2.5	2.5	2.5	2.5	0.0	
Dissolved Zinc	ug/l	91.4-237.3	39.0		234.0	33.9		29.4	39.4	39.5	28.4	28.0	0.1	0.4
Total Aluminum	ug/l	1000		1662.5	3146.5	629.6	278.1	174.5	97.0	242.0	1239.6	840.2	0.3	0.9
Total Antimony	ug/l	6						2.50	1.55	1.59	2.09	1.98	0.0	0.3
Total Arsenic	ug/l	32		2.23				2.50	2.28	2.95	3.71	1.92	0.0	0.1
Total Barium	ug/l			60.0	115.6	54.7	54.8	32.5	42.2			48.0	0.0	
Total Beryllium	ug/l	4						0.5	0.5	0.5	0.5	0.5	0.0	0.1
Total Boron	ug/l			103.8	298.2	264.7	136.9	160.0	220.3			638.0	0.0	
Total Cadmium	ug/l	2-4.7			1.29			0.50	0.50	0.58	0.89	0.43	0.0	0.2
Total Chromium	ug/l	50	7.10	22.80	14.54	4.00		2.50	3.08	8.18	11.38	3.11	0.0	0.2
Total Chromium +6	ug/l									5.0	5.0	5.0	0.0	
Total Copper	ug/l	7.3-19	24.5	24.3	43.2	14.2	10.3	9.2	16.9	17.6	32.4	23.7	0.9	1.8
Total Iron	ug/l		2324.0	2487.5	13370.0	783.6	400.0	306.0	473.4	463.8	4183.8	1205.4	0.0	
Total Lead	ug/l	2.2-9.2	8.60	19.30	29.02			2.50	2.30	4.58	15.77	8.18	0.6	2.9
Total Manganese	ug/l		73.4	112.5	335.1	82.5		82.6	295.8			121.3	0.0	
Total Mercury	ug/l	0.16						0.5	0.5	0.5	0.4	0.5	1.0	3.1
Total Nickel	ug/l	40.7-105.5	13.60	7.30	13.49	5.70	4.56	4.30	8.61	11.88	12.89	6.77	0.0	0.1
Total Selenium	ug/l	60		2.40		4.81		2.50	2.50	2.38	3.62	2.44	0.0	0.0
Total Silver	ug/l	2.8	0.6					0.5	0.5	0.5	0.6	0.5	0.0	0.2
Total Thallium	ug/l	2						2.5	2.5	2.5	2.5	2.5	1.0	1.3
Total Zinc	ug/l	93-243	93.0	93.0	343.8	66.7	36.3	35.9	44.9	78.1	147.8	73.9	0.1	0.7
Pesticides														
Diazinon	ug/l	0.08					0.02	0.01	0.15	0.09	0.06	0.04	0.3	0.8
Prometryn	ug/l									1	1	1	0.0	

[1] WQO for metals are hardness dependent and were based on minimum hardness by year.
[2]Mean Exceedance Ratio calculated using annual mean concentrations reported up to four significant figures. Ratio shown may not exactly equal ratio of mean values shown in table due to rounding of presented means.
Blue = WQO Exceedances ; Yellow = DL above WQO; Orange = Frequency ratio > 0.5, Mean exceedance > 1.0.

Significant trends were only identified for total and fecal coliform (Figure 4-11 a-b). Coliform densities have decreased throughout the monitoring period; however they continue to be elevated above the WQO. This trend may be influenced by a single data point and a gap in the data. Indicator bacteria were not analyzed in samples collected during four consecutive years, beginning with the 1996-1997 monitoring season. This data gap and the influence of peak bacteria densities in the 1995-1996 samples likely influenced the trend analyses. Conducting the trend analyses with the 1995-1996 data point removed indicates that the decreasing trend in total and fecal coliform densities would not be significant. None of the other constituents had significantly increasing or decreasing trends. Figure 4-12 a – d shows the scatterplots for annual mean concentrations of total and dissolved copper and lead from 1994 to 2005.

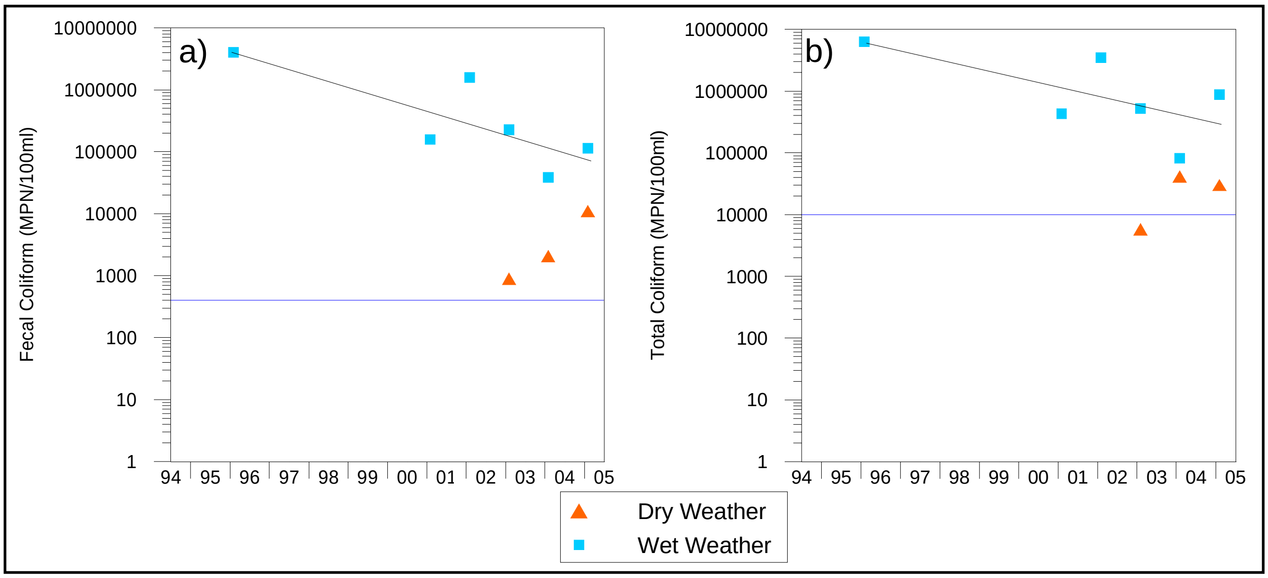

Figure 4-11. Scatterplot and Trends for Fecal Coliform (a) and Total Coliform (b) at the Coyote Creek Mass Emission Site, 1995 to 2005.

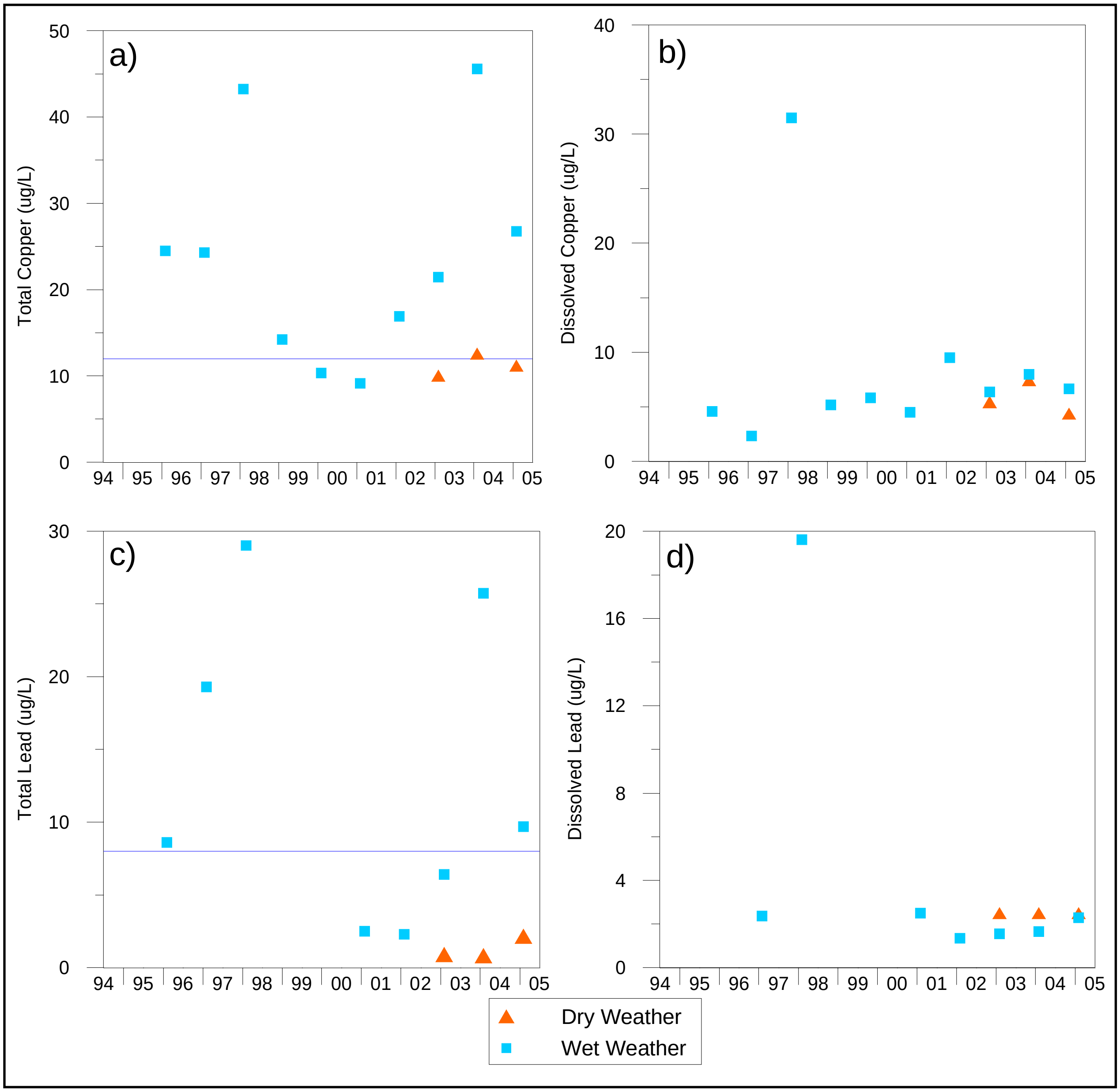

Figure 4-12. Scatterplots for annual mean levels of Total Copper (a), Dissolved Copper (b), Total Lead (c) and Dissolved Lead (d) at the Coyote Creek Mass Emission Site, 1995 to 2005.

4.3.1.3 Constituents of Concern

San Gabriel River

The constituents of concern for the San Gabriel River are shown in Figure 4-13 and Table 4-3. A constituent is considered a COC if its frequency ratio exceeds 0.5 and/or mean exceedance ratio exceeds 1.0 (see Section 4.3.1.2 for an explanation of how frequency ratios and mean exceedance ratios are derived). Therefore, COC's as they are designated in this report serve as flags for water quality managers and should not be used for other purposes such as regulatory compliance.

Constituents of concern in the San Gabriel River based on the mass emission data include cyanide, indicator bacteria, total aluminum, total copper and total lead (Figure 4-13). Total and fecal coliform and enterococcus densities consistently exceeded WQOs at the San Gabriel mass emission site. Average annual fecal coliform and enterococcus densities were greater than 1,000 times their respective WQOs. Total coliform densities exceeded its WQO by over 100 times. Total aluminum only exceeded the water quality objectives during two monitoring years, producing a frequency of exceedance of only 20%. Furthermore, total aluminum values were relatively low, resulting in a mean exceedance ratio of only 1.3. Two wet seasons had total aluminum values an order of magnitude greater than all other seasons, which influenced the mean exceedance ratio calculation. These two seasons, 1997-1998 and 2004-2005, corresponded to two of the wettest years over the monitoring period. Total copper had a frequency of exceedance of 40% and a mean exceedance ratio of 1.1. Total lead exceeded the WQO 60% of the time with a mean exceedance ratio of 1.7 and its annual mean exceeded the WQO by an average of 230%. Based on the 2004-2005 monitoring data, only the indicator bacteria concentrations indicated a "first flush" phenomena in that the highest concentrations were observed in the first storm event samples.

Cyanide had a mean exceedance ratio of 4.1 and was identified as a COC; however, it is not included in Figure 4-13 as the graph focuses on indicator bacteria and metals. The origin of cyanide detected in the stormwater samples can be from a number of potential anthropogenic and natural non-point sources. It is assumed that potential industrial point sources are regulated under their own individual NPDES permit. Stormwater runoff from metal plating and finishing operations can be source of cyanide. Non-point sources of cyanide may include pesticide use. The largest likely source of cyanide in the WMA is air-borne deposition from motor vehicle emissions. The amount of cyanide that could be released to the environment from natural sources is comparatively low. Potential natural sources of cyanide include incomplete combustion from forest fires, decomposition of plant material and fungi. Water concentrations of cyanide tend to breakdown within days, but may bind to organic matter in sediments carried by stormwater and remain more persistent (www.eco-usa.net, www.dsf.health.state.pa, www.cynaidecode.org, www.npi.gov).

Total mercury and total thallium have exceeded objectives since 2000-2001 (Table 4-1). However, it should be noted that the detection limits for these constituents are greater than the water quality objectives. Therefore, these constituents were not identified as COC's because actual values could not be determined.

Oil and grease and total boron are highlighted in this discussion of potential pollutant issues based on significantly increasing trends in their concentrations over the period of record (Figure 4-9 b, c). Boron is a naturally occurring substance found in clay-rich marine sedimentary rocks. Boron is used in glass and cleaning products, agrochemicals, insecticides, and can be found in sewage sludge and effluent. It can be used as an indicator of increasing urbanization in a watershed.

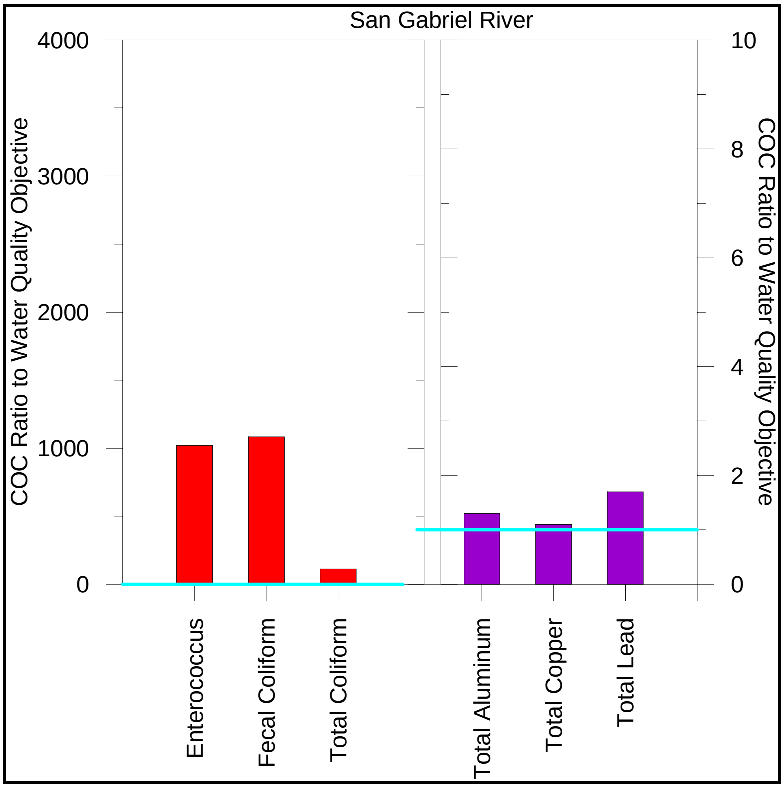

Figure 4-13. Mass Exceedance Ratio for Constituents Frequently Exceeding WQOs at the San Gabriel Mass Emission Site.

Table 4-3 summarizes constituents of concern identified by the mass emission data and compares them to the pollutants on the 303(d) list for the San Gabriel River. Constituents indicating increasing trends are also shown in Table 4-3. The first column of Table 4-3 lists constituents of concern as determined from the integrated data set of annual mean values; the second column lists constituents that show an increasing trend (Figure 4-9) even though concentrations may be below water quality objectives; and the third column is presented for comparison purposes and provides constituents that are 303(d) listed.

The 303(d) list identifies algae, high coliform densities, dissolved copper, total aluminum, total copper and total lead and dissolved zinc as constituents of concern for the lower segments of the San Gabriel River, which encompasses the estuary to Whittier Narrows Dam (Table 4-3). Water quality monitoring at the San Gabriel River mass emission station supports the listing of some of these constituents. Based on the monitoring results from the mass emission station cyanide, indicator bacteria, total aluminum, total copper and total lead have been identified as constituents of concern. Cyanide has been identified as a COC; however, it is not included on the 303(d) list. Alternatively, dissolved copper and zinc are included on the 303(d) list, however they have not consistently exceeded water quality objectives at the mass emission station. In addition, oil and grease and total boron have shown increasing trends throughout the monitoring period, however they are not included on the 303(d) list.

Table 4-3. Constituents of Concern, Increasing Trends and Comparison to 303(d) List at San Gabriel River.

Constituent	Constituents of Concern Based on Mass Emission Data Frequency/Magnitude	Constituents Indicating Increasing Trend	Comparison to 303(d) List
Cyanide	X		
Oil and Grease		X	
Enterococcus	X		
Fecal Coliform	X		X
Total Coliform	X		X
Algae			X
Total Boron		X	
Total Copper	X		X
Total Lead	X		X
Total Aluminum	X		X
Dissolved Copper			X
Dissolved Zinc			X

Coyote Creek

The constituents of concern for Coyote Creek are shown in Figure 4-14 and Table 4-4. A constituent is considered a COC if its frequency ratio exceeds 0.5 and/or mean exceedance ratio exceeds 1.0 (see Section 4.3.1.2 for an explanation of how frequency ratios and mean exceedance ratios are derived). Therefore, COC's as they are designated in this report serve as flags for water quality managers and should not be used for other purposes such as regulatory compliance.

The mass emission data collected at Coyote Creek suggest cyanide, indicator bacteria, total copper and total and dissolved lead are constituents of concern. Average fecal coliform and enterococcus densities were approximately 2500 times the WQO (Figure 4-14). Annual average total coliform densities were approximately 190 times the established criterion. The mean exceedance ratio for total copper was 1.8. Total and dissolved lead had mean exceedance ratios of 2.9 and 1.5, respectively. Based on the 2004-2005 data, only enterococcus indicated a "first flush" phenomena in that the highest concentration was observed in the first storm event sample.

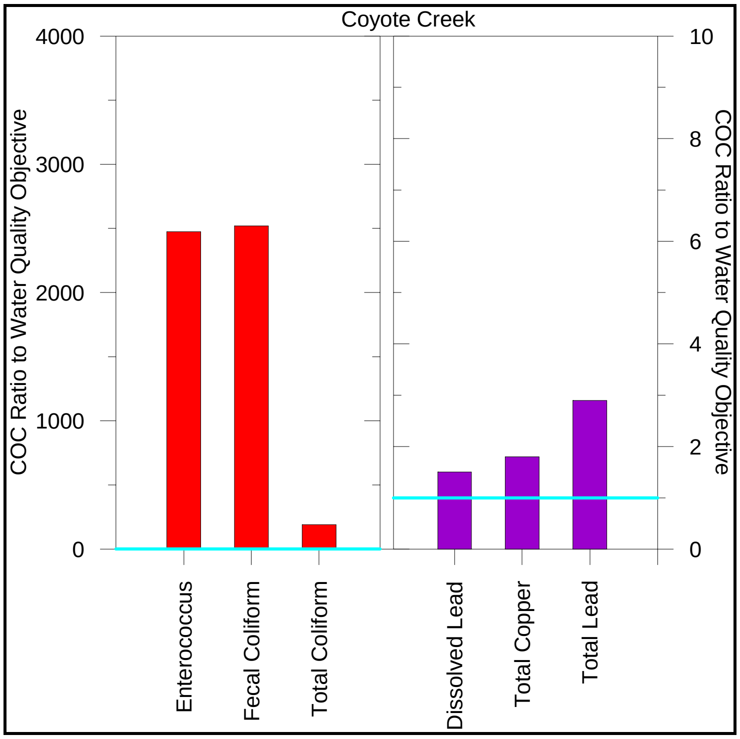

Figure 4-14. Mean Exceedance Ratio for Constituents Frequently Exceeding WQOs at the Coyote Creek Mass Emission Site.

Cyanide had a mean exceedance ratio of 19.6 and was identified as a COC; however, it is not included in Figure 4-14 as the graph focuses on indicator bacteria and metals. The origin of cyanide detected in the stormwater samples can be from a number of potential anthropogenic and natural non-point sources. It is assumed that potential industrial point sources are regulated under their own individual NPDES permit. Stormwater runoff from metal plating and finishing operations can be source of cyanide. Non-point sources of cyanide may include pesticide use. The largest likely source of cyanide in the WMA is air-borne deposition from motor vehicle emissions. The amount of cyanide that could be released to the environment from natural sources is comparatively low. Potential natural sources of cyanide include incomplete combustion from forest fires, decomposition of plant material and fungi. Water concentrations of cyanide tend to breakdown within days, but may bind to organic matter in sediments carried by stormwater and remain more persistent (www.eco-usa.net, www.dsf.health.state.pa, www.cynaidecode.org, www.npi.gov).

Similar to the San Gabriel River, total mercury and total thallium have exceeded objectives since 2000-2001 (Table 4-2). However, it should be noted that the detection limits for these constituents are greater than the water quality objectives. Therefore, these constituents were not identified as COC's because actual values could not be determined.

Table 4-4 summarizes constituents of concern identified by the mass emission data and compares them to the pollutants on the 303(d) list for Coyote Creek. The first column of Table 4-4 lists constituents of concern as determined from the integrated data set of annual mean values and the second column is presented for comparison purposes and provides constituents that are 303(d) listed. No constituents indicated significant increasing trends in Coyote Creek based on the results from the MES. Coyote Creek is 303(d) listed for abnormal fish histology, algae, dissolved copper, dissolved lead, dissolved zinc, total selenium, high coliform counts and toxicity. Table 4-5 presents the mass emission sampling results from 2000-2005 for metals included on the 303(d)-list for Coyote Creek. The results presented in Table 4-5 indicate exceedances of the WQO only for dissolved copper in individual samples collected from Coyote Creek. The frequency of exceedance is approximately 30 percent.

Table 4-4. Constituents of Concern and Comparison to 303(d) List at Coyote Creek.

Constituent	Constituents of Concern Based on Mass Emission Data Frequency/Magnitude	Comparison to 303 (d) List
Cyanide	X	
Enterococcus	X	
Fecal Coliform	X	X
Total Coliform	X	X
Algae		X
Total Copper	X	
Total Lead	X	
Total Selenium		X
Dissolved Copper		X
Dissolved Lead	X	X
Dissolved Zinc		X
Abnormal Fish Histology		X
Toxicity		X

Table 4-5. Frequency of Exceedance of the WQO for 303(d) Listed Metals in Samples Collected from Coyote Creek, 2000-2005.

	Total No. of Samples Collected (2000-2005)	No. of Samples with Non-Detect	No. of Samples with Measurable Concentration above Detection Limit	No. of Samples with Concentrations above WQO
Dissolved Copper	31	5	26	10
Dissolved Lead	31	22	9	0
Dissolved Zinc	31	9	22	0
Total Selenium	31	25	6	0

Historical monitoring data have also indicated low frequency of exceedances of these metals. The annual mean dissolved copper concentration exceeded the WQO only once throughout the entire monitoring period. Similarly, the annual mean level of dissolved zinc exceeded the WQO only once in seven years of monitoring. The annual mean concentration of total selenium never exceeded the WQO throughout the monitoring period. Alternatively, water quality monitoring at the Coyote Creek mass emission station supports the listing of dissolved lead. This constituent has been identified as a COC based on a mean exceedance ratio of 1.5. Alternatively, cyanide, total copper, and total lead have been identified as COC’s; however, they are not included on the 303(d) list.

4.3.2 Water Column Toxicity Monitoring

San Gabriel River

Samples collected from the San Gabriel mass emission station were analyzed for toxicity to *Ceriodaphnia dubia* survival and reproduction and/or sea urchin fertilization each year since 2002. Composited wet and dry event samples from each season were tested for toxicity, with the exception of 2004-2005, when only storm samples were analyzed.

Water column toxicity monitoring determined that stormwater collected from the San Gabriel River mass emission station on October 17 and 26, 2004 did not affect *C. dubia* survival or reproduction. Conversely, stormwater from both monitoring events inhibited sea urchin reproduction. Dry weather samples collected during 2004-2005 affected *C. dubia* reproduction and sea urchin fertilization.

Toxicity monitoring prior to the 2004-2005 season found that San Gabriel River stormwater and dry weather samples did not affect *C. dubia* survival or reproduction or sea urchin reproduction during any occasion.

Toxicity Identification Evaluations (TIEs) were unable to determine the stormwater pollutant causing the toxicity in 2001-2002 due to an insufficient volume of stormwater. TIEs were not performed on samples collected prior to 2001.

Coyote Creek

Samples collected from the Coyote Creek mass emission station were analyzed for toxicity to *C. dubia* survival and reproduction and/or sea urchin fertilization each year since 2002-2003. Composited wet and dry event samples from each season were tested for toxicity.

Water column toxicity monitoring determined that stormwater collected from the Coyote Creek mass emission station on October 17, 2004 did not affect *Ceriodaphnia* survival or reproduction, however stormwater samples collected on October 26, 2004 were toxic to *Ceriodaphnia* survival and reproduction. Sea urchin reproduction was inhibited by stormwater collected from Coyote Creek on both dates. Dry weather samples collected during 2004-2005 only affected sea urchin fertilization.

Historical bioassays performed prior to the 2004-2005 season determined that stormwater samples collected from Coyote Creek during 2002-2003 affected the survival and reproductive success of *C. dubia* and sea urchins. Wet and dry season samples from 2003-2004 only affected sea urchin fertilization.

In stormwater samples from 2002-2003, TIEs identified the toxic pollutant as one or more non-polar organic compounds, cationic metals, and metabolically-activated organophosphates. In 2003-2004 the toxic pollutant in stormwater was believed to be a volatile compound.

Further discussion of toxicity results and inter-relationships on a cross-watershed basis is presented in Section 10. Due to the limited data-set on a watershed basis, the inter-relationship discussion is presented on regional basis in Section 10. Correlations between toxicity results with COC's are discussed in section 10 using the results from all the watersheds.

4.3.3 Trash Monitoring

Photos were taken at the San Gabriel River and Coyote Creek mass emission stations after four storms, including the first storm event of the season for each year. Photos from the 2004-2005 storm season are provided in Appendix D. Figures 1-4 are from the San Gabriel River and Figures 4-8 are from Coyote Creek.

4.4 Regional Monitoring Summary

4.4.1 Bioassessment Results/Discussion

Information on the stream bioassessment surveys of October 2003 and October 2004 originally appeared in annual monitoring reports submitted to LACDPW (BonTerra 2004, Weston 2005). In the discussion below, ratings of the benthic macroinvertebrate communities are based on a CFG Southern California Index of Biotic Integrity (IBI) (Ode et al. 2005 (In Press)), a quantitative scoring system based on the cumulative value of seven biological metrics. The scoring range is 0-70, and the scores are categorized into qualitative ratings of Very Poor (0-13), Poor (14-26), Fair (27-40), Good (41-55), and Very Good (56-70). Additional individual metrics and aspects of species composition are discussed when notable. Section 10 of this report provides more overview and detail of the results from the regional monitoring.

4.4.1.1 Introduction

Stream bioassessment monitoring was conducted at four sites in the San Gabriel River Watershed. The locations of the sites are presented in Figure 4-4, and descriptions of the sites and the justification for the monitoring location is presented in Table 4-6. Urban monitoring sites were located in three tributaries of the main channel of the San Gabriel River, including Coyote Creek, San Jose Creek, and Walnut Channel. Station 4 was an upstream reference site located above the San Gabriel Reservoir in the North Fork of the river. In June 2005, these four locations and their sampling times were changed, with the approval of the RWQCB, to become part of the San Gabriel River Regional Monitoring Plan.

Table 4-6. San Gabriel River Watershed stream bioassessment monitoring sites. October 2003 and 2004.

Station	Receiving Water Body	Location	Coordinates	Justification
2	Coyote Creek Lined channel	Coyote Creek downstream of Willow St.	N 33º 47.719’ W 118º 05.361’	Los Angeles County Sanitation District baseline site
3	San Jose Creek Unlined channel	San Jose Creek downstream of Workman Mill Rd.	N 34º 02.260’ W 118º 01.494’	Los Angeles County Sanitation District baseline site
4	San Gabriel River Unlined channel	San Gabriel River upstream of the San Gabriel Dam	N 34º 14.692’ W 117º 51.947’	Upstream reference site
5	Walnut Channel Unlined channel	Walnut Channel downstream of N. Baldwin Park Blvd.	N 34º 03.674’ W 117º 59.847’	Assess impacts of upstream land uses; nursery and residential area

4.4.1.2 Benthic Macroinvertebrate Community

The benthic macroinvertebrate communities at the three urban influenced monitoring sites in the watershed were rated Very Poor, with total CFG’s Southern California Index of Biotic Integrity scores ranging from two to eight (Table 4-7). Station 4-San Gabriel River was rated Fair, and was sampled to document reference conditions in the watershed.

Table 4-7. Index of Biotic Integrity and Water Quality Measures of the San Gabriel River Watershed.

San Gabriel River Watershed	Station 2 Coyote Creek (lined channel)		Station 3 San Jose Creek (unlined channel)		Station 4 San Gabriel River Reference Site (unlined channel)		Station 5 Walnut Channel (unlined channel)	
Survey	**Oct-03**	**Oct-04**	**Oct-03**	**Oct-04**	**Oct-03**	**Oct-04**	**Oct-03**	**Oct-04**
Index of Biotic Integrity/ Qualitative Rating	3 Very Poor	2 Very Poor	8 Very Poor	13 Very Poor	30 Fair	40 Fair	7 Very Poor	6 Very Poor
Water Quality								
Temperature ©	NS	25	26.2	22.7	16.3	14	27.5	26.7
pH	NS	8.3	6.8	8.5	7.4	7.7	8.7	8.9
Specific Conductance (ms/cm)	NS	1.147	1.110	1.158	0.480	0.402	0.410	0.491
Hardness (mg/L $CaCO_3$)	NS	240	NS	244	NS	196	NS	204

Station 2-Coyote Creek was the lowest rated site in the watershed with IBI scores of three in 2003 and two in 2004. It also had the poorest quality physical habitat. The monitoring reach was located in a fully concrete-lined channel in the lower portion of the watershed. In 2003, the site was dominated by Ostracods and Chironomid midges in similar numbers. In 2004, the site was heavily dominated by Ostracods, which accounted for 76% of the benthic community. The highly tolerant, non-native snails Physa and Tarebia were present in relatively high abundance in both survey years. Taxa richness was relatively low, and there were no taxa collected that were highly intolerant to impairment (tolerance value of 0, 1, or 2). Water quality measures indicated a moderately high specific conductance of 1.147 ms/cm in 2004, but this was not measured in 2003.

Station 3-San Jose Creek was located in an unlined (soft bottom) but channelized portion of San Jose Creek and had IBI scores of 8 (2003) and 13 (2004). The substrate of the monitoring reach was complex and consisted of large rip rap boulders and cobble, which produced complex current flow. The benthic community was dominated in both years by Oligochaetes (earthworms) and Chironomid midges. Flatworms, the Baetid mayfly *Fallceon quilleri*, and leeches were also common. There were no taxa collected that were highly intolerant to impairment. Water quality measures showed varying pH between 2003 and 2004, with values of 6.8 and 8.5, respectively.

Specific conductance was moderately high with values of 1.110 ms/cm (2003) and 1.158 ms/cm (2004).

Station 4-San Gabriel River was designated as a reference site and was located upstream of the San Gabriel Dam, where it receives little or no urban runoff. The IBI scores were 30 in 2003 and 40 in 2004. The physical habitat of the site was good, as the substrate consisted primarily of boulders interspersed with layered gravel and cobble. The site supported a good diversity of low tolerance insect taxa, particularly in the orders Ephemeroptera (mayflies), Trichoptera (caddisflies), and Coleoptera (beetles). Taxa highly intolerant to impairment accounted for 0.8% and 5.5% of the community in 2003 and 2004, respectively. Total abundance was very low in the 2004 survey (7 organisms/ft^2, versus 209 organisms/ft^2 in 2003), likely due to scouring from a significant rain event that occurred approximately one week before sampling. Water quality measures indicated good conditions, with specific conductance values of 0.480 ms/cm (2003) and 0.402 ms/cm (2004).

Station 5-Walnut Channel was located in an unlined but channelized reach and had IBI scores of 7 (2003) and 6 (2004). The stream habitat was not optimal, but it did have some layered cobble substrate and good current flow. The benthic community structure was variable from 2003 to 2004. In 2003, the site was dominated by Oligochaetes and in 2004 by Chironomid midges. Ostracods and flatworms were abundant in 2003, but were nearly absent in 2004. No taxa highly intolerant to impairment were collected. Water quality measures were moderate, and specific conductance was similar to the San Gabriel River reference site, with values of 0.410 in 2003 and 0.491 in 2004.

4.4.1.3 Relationship of Bioassessment to Constituents of Concern

Data from the mass emission stations, summarized in Section 4.3, were used to identify possible relationships between constituents of concern and impacts to the benthic macroinvertebrate communities. Additional impairments identified in the 303(d) listing were not considered here due to a lack of available recent data.

Bioassessment Station 2-Coyote Creek was located in close proximity to the Coyote Creek mass emission station S13 (Figure 4-4). The benthic community was rated Very Poor, and although the physical habitat in this stream reach was also poor, other concrete lined channels in the region supported somewhat higher quality benthic communities. Constituents of concern identified based on their exceedance of water quality objectives included total copper and total and dissolved lead. High concentrations of heavy metals have long been known to negatively impact macroinvertebrate communities (e.g., Winner et al. 1980). Bacteria levels were consistently very high, and while bacteria themselves likely did not directly impact the benthic community, they generally indicate other water quality issues such as elevated fine organic matter or nutrients that could degrade the system.

Bioassessment Station 3-San Jose Creek and Station 5-Walnut Channel were located in tributaries that were above the confluence with the San Gabriel River and mass emission station S14 (Figure 4-4). Both of these sites had benthic macroinvertebrate communities rated Very Poor, but since this mass emission station received considerable urban runoff not associated with the two tributaries, data from this station are not necessarily applicable. Station S14 did, however, have exceedances for aluminum, copper, lead, cyanide, and bacteria, and if the source of these constituents were from San Jose Creek or Walnut Channel, they could negatively impact the benthic communities of those streams.

Bioassessment Station 4-San Gabriel River was located well upstream of any of the mass emission stations, and was designated as a reference site, thus no relationship between COCs and the benthic community can be made.

4.4.2 Estuary Sampling Program Results/Discussion

Seven stations within the San Gabriel River Estuary, identified as 4002, 4034, 4066, 4194, 4258, 4322 and 4520 were monitored under the supervision of SCCWRP in the summer of 2003. The locations of the stations are presented in Figure 4-15. Samples were analyzed for sediment chemistry, sediment toxicity and benthic macroinvertebrate diversity. The results from these sampling events are discussed in the following section and presented in Table 4-8. The complete list of laboratory analytical data results are presented in Appendix E, Table 1.

Currently, there are no universally accepted criteria for assessing contaminated sediments. However, SCCWRP decided to utilize Effect Range-Low (ER-L) and Effect Range-Median (ER-M) values to evaluate the potential for sediment to cause adverse biological effects (Long et al. 1995). The guidelines were intended to provide informal (non-regulatory) effects-based benchmarks of sediment chemistry data (Long et al. 1998). Two effects categories have been identified:

ER-L – Effects Range-Low: concentrations below which adverse biological effects are rarely observed; and

ER-M – Effects Range-Median: concentrations above which adverse biological effects are more frequently, though not always observed.

Sediment chemistry data from samples collected from each of the estuaries were compared to the ER-L and/or the ER-M data (Table 4-8).

In addition, for each estuary, ER-M values were used to calculate a mean ER-M quotient (ERM-Q). The concentration of each constituent was divided by its ER-M to produce a quotient, or proportion of the ER-M equivalent to the magnitude by which the ER-M value is exceeded or not exceeded. The mean ERM-Q for each embayment was then calculated by summing the ERM-Qs for each constituent and then dividing by the total number of ERM-Qs assessed. ERM-Qs were not calculated for constituents below the detection limit and thus were not used in the generation of the mean ERM-Q. The mean ERM-Q thus represents an assessment for each embayment of the cumulative sediment chemistry relative to the threshold values. In this way, the cumulative risks of effect to the benthic community can provide a mechanism to compare embayments. This method has been used and evaluated by several researchers (Hyland et al. 1999, Carr et al. 1996, Chapman 1996, and Long et al. 1995) throughout the country.

The aggregate approach using an ERM-Q is a more reliable predictor of potential toxicity but should not be used to infer causality of specific contaminants. ER-L and ER-M values were originally derived to be broadly applicable and they cannot account for site-specific features that may affect their applicability on a more local or regional level. Local differences in geomorphology can result in chemicals being more or less available and therefore more or less toxic than an ER-L or ER-M value might indicate. Additionally, some regions of the country are naturally enriched in certain metals and local organisms have become adapted.

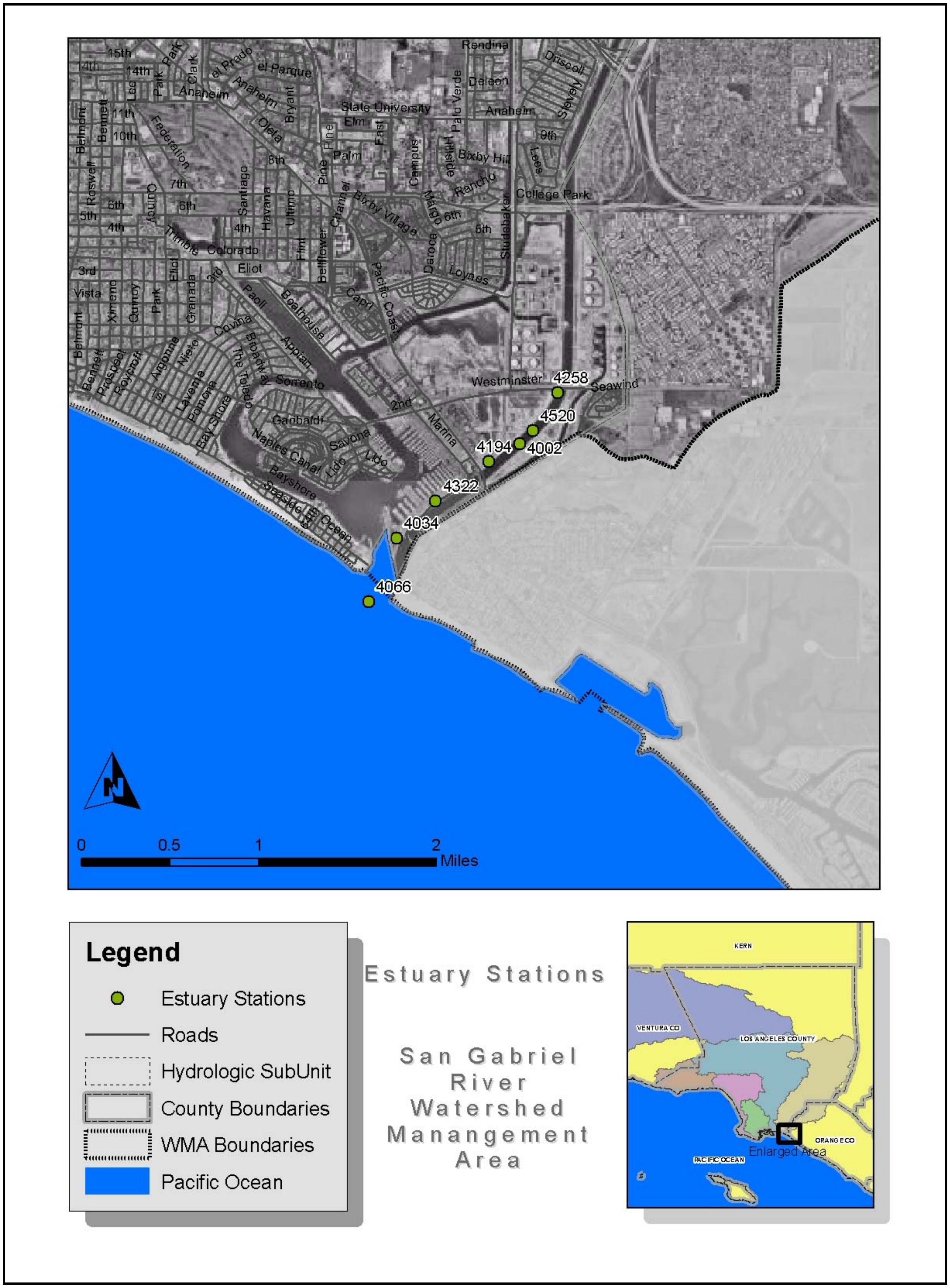

Figure 4-15. San Gabriel Estuary Sampling Stations.

Table 4-8. Analytical Results for Constituents Analyzed in the San Gabriel River Estuary.

Constituent	Units	ER-L*	ER-M*	San Gabriel River Estuary						
				4002	4034	4066	4194	4258	4322	4520
Toxicity										
Mean *Eohaustorius* Survival	%			96	93	96	97	92	88	89
Infauna Community Indices										
Number of species	#/0.1 m^2			14	30	6	14	23	28	18
Total abundance	#/0.1 m^2			223	286	15	37	1735	899	1160
Shannon-Wiener diversity				1.39	2.49	1.41	2.30	1.58	2.04	1.29
Evenness				0.53	0.73	0.79	0.87	0.50	0.61	0.45
Dominance				2	7	3	6	3	4	2
Sediment Size and TOC										
Gravel	%			0.21	0.25	0.28	0.28	0.19	0.00	0.33
Sand	%			88.99	83.14	99.72	94.28	68.08	82.08	91.29
Silt	%			10.11	15.52	0.00	5.35	29.19	16.66	6.85
Clay	%			0.70	1.11	0.00	0.09	2.54	1.27	1.46
Median size	microns			461.04	434.06	553.96	534.34	243.10	407.08	624.46
Mean size	microns			423.18	216.09	585.61	526.13	113.68	173.51	579.05
TOC	%			J0.195	J0.211	<0.017	J0.114	J0.226	0.399	0.273
Metals										
Arsenic	mg/kg	8.2	70	1.44	2.04	1.04	2.23	2.56	1.83	2.35
Cadmium	mg/kg	1.2	9.6	0.12	J0.08	J0.05	0.14	J0.08	J0.06	0.14
Chromium	mg/kg	81	370	15.3	17.4	7.4	10.4	11.7	13.7	5.7
Copper	mg/kg	34	270	9.1	17.0	7.5	13.5	14.5	11.3	8.0
Lead	mg/kg	46.7	220	11.5	18.3	4.7	15.8	10.8	21.4	9.8
Mercury	mg/kg	0.15	0.71	J0.02	0.04	0.10	0.04	0.04	0.03	0.02
Nickel	mg/kg	20.9	51.6	7.4	**23.8**	4.1	7.5	6.9	7.5	4.7
Silver	mg/kg	1	3.7	<0.025	0.27	0.65	0.11	0.13	J0.07	0.10
Zinc	mg/kg	150	410	37.2	47.0	22.0	43.5	39.6	36.1	48.3
Pesticides										
Total detectable DDT	µg/kg	1.58	46.l	1.5	**2.8**	1.0	**2.2**	**3.7**	**2.0**	0.0
Total detectable chlordane	µg/kg	0.6	6	0	0	0	0	0	0	0
PAHs										
Total detectable PAHs	µg/kg	4022	44,800	66	223	48	256	2614	114	485
PCBs										
Total detectable PCBs	µg/kg	22.7	180	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mean ER-M quotient				0.04	0.08	0.04	0.05	0.05	0.04	0.03

* Effects Range-Low and Effects Range-Median (Long et al. 1995)
Chemistry results in **bold** = exceeds ER-L
Chemistry results in **bold** = exceeds ER-M
Toxicity in **bold** = identified as moderately toxic (Bight 03 draft report, SCCWRP 2004)
Toxicity in **bold** = identified as highly toxic (Bight 03 draft report, SCCWRP 2004)
Mean ERM-Q in **bold** = above 0.10 threshold (Long et al. 1998)
NR = not reported
J = Estimated value above MDL and below RL

Sediment Chemistry. Sediments were analyzed for four groups of constituents: metals, pesticides, PAHs and PCBs. Nickel was the only metal that exceeded the ER-L at one station with a value of 23.8 mg/kg. There were detections of other metals at all stations; however, they were all below the ER-L and ER-M values.

The only pesticide with concentrations above ER-L values was total detectable DDT, which exceeded the ER-L at four out of six stations, with values ranging from 2.0 to 3.7 µg/kg. Total detectable chlordane was not detected at any of the stations.

Total detectable PAHs were all below the ER-L values and total detectable PCBs were not detected at any of the stations monitored in the San Gabriel River Watershed.

The mean ER-M quotient (ERM-Q) is a measure of the cumulative effects of the COC's for which ER-Ms are available. Sediments with mean ERM-Q values below 0.10 have a low probability of producing adverse biological effects (Long et al. 1998). The probability of producing adverse biological effects increases with ERM-Q values from 0.11 to 1.0 and is even greater for quotients greater than 1.0. ERM-Q values were all below the threshold of 0.10 for all seven stations monitored in the San Gabriel River Estuary. ERM-Q values ranged from 0.03 to 0.08.

Sediment Toxicity. The mean percent survival of the test organism, *E. estuarius,* exposed to San Gabriel Estuary sediments ranged from 88 to 97%. These values suggest that the San Gabriel Estuary sediments were not toxic to the test organisms (Bight 03 draft report, SCCWRP 2004).

Benthic Community Structure. Total abundance was greatest at station 4258 with 1735 organisms/0.1m^2 and the least at station 4066 with 15 organisms/0.1m^2. The total number of species was greatest at station 4034 with 30 organisms/0.1m^2 and the least at station 4066 with 6 organisms/0.1m^2. Evenness, a measure of the distribution of taxa, ranged from 1.29 to 2.49. Dominance, which describes the number of species comprising 70% of the total number of species, was highest at station 4034 with a value of 7, and lowest at stations 4002 and 4520 with a value of 2.

Sediment Size. Sand was the dominant sediment constituent at all stations sampled in the San Gabriel River Estuary. The median grain size ranged from 243.10 microns at station 4258 to 624.46 microns at station 4520. Station 4322 had the highest TOC content with a value of 0.399%.

4.5 Conclusions

In the San Gabriel River, COCs based on exceedance of WQO from mass emission data included cyanide, indicator bacteria, total aluminum, total copper and total lead. Indicator bacteria, total copper, total lead and cyanide consistently exceeded WQOs. Oil & grease and total boron did not exceed WQOs, however, they were included in the COC discussion under potential pollutant issues because historical data have shown a trend of increasing concentrations for these two constituents.

Although dissolved copper and zinc are on the 303(d) list for the San Gabriel River, water quality data collected from the mass emission site does not confirm that these constituents are persistent and elevated relative to WQOs. The annual mean concentration for dissolved copper exceeded WQOs once in seven years and the annual mean concentration of dissolved zinc never exceeded objectives in seven years of monitoring. Monitoring results from the most recent five years (since the 2000-2001 monitoring season) indicate that the frequency that individual sample results for each constituent exceed WQOs is even lower. Dissolved copper was measured above the WQO only once out of 29 samples and dissolved zinc never exceeded the WQO.

Additionally, neither of these 303(d)-listed metals show a significantly increasing trend over time.

Water quality data from Coyote Creek suggest cyanide, indicator bacteria, total copper and total and dissolved lead are the COCs due to frequent and persistent exceedances of the WQOs. Similar to the findings for the San Gabriel River, three metals that appear on the 303(d) list (dissolved copper and zinc, and total selenium) were not frequently found at concentrations above applicable WQOs at the mass emission site. For example, prior to the 2000-2001 monitoring season, the annual mean dissolved copper and zinc concentrations exceeded the WQO only once in five years while total selenium never exceeded the WQO.

Stream bioassessment monitoring was conducted in October 2003 and October 2004. Bioassessment monitoring sites were established at four locations in the San Gabriel River Watershed to assess biological integrity and to detect biological trends and responses to pollution in receiving waters throughout the region. Three of the sites received urban runoff and one of the sites was an upstream reference site. The three urban sites were located in tributaries to the main channel of the San Gabriel River, including Coyote Creek, San Jose Creek, and Walnut Channel. Macroinvertebrate communities of the urban sites had Index of Biotic Integrity scores between 2 and 13, and quality ratings of Very Poor. The upstream reference site had IBI scores of 30 and 40, and was rated Fair.

The San Gabriel River Estuary was monitored to estimate the extent and magnitude of ecological change in the Southern California Bight and to determine the mass balance of pollutants that currently reside within the SCB. Sediments were analyzed for chemistry, toxicity, and benthic macroinvertebrate diversity. The results of the chemistry assessment indicated that one metal was detected above the ER-L at one station within the Estuary. Total detectable DDT exceeded the ER-L value at four stations and total detectable chlordane, total detectable PAHs and total detectable PCBs were either not detected or below ER-L values at all stations within the estuary. All ERM-Q values were below the 0.10 threshold and the mean percent survival of the test organism was high suggesting that the sediments within San Gabriel River Estuary were not toxic.