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2.1 Regional Setting

A summary of the general geographical setting of San Diego County including the regional topography, climate, hydrology, land use, and population is presented in this section. Much of the land use data presented in this report is based on the 2003 San Diego Association of Governments (SANDAG) geographic information system (GIS) data. The 2006 SANDAG GIS data became available during the finalization of this report, but not within time for analysis and inclusion in the report at this time. Future land use analysis will be based on the 2006 SANDAG GIS data.

2.1.1 Geomorphology

San Diego County can be divided between three distinct geomorphic regions: the Coastal Plain Region as exposed west of the Peninsular Ranges, the Peninsular Range Region, and the Salton Trough Region as exposed east of the Peninsular Ranges (Figure 2-1). This geomorphic division reflects a basic geologic difference between the three regions; with Mesozoic metavolcanic, metasedimentary, and plutonic rocks predominating in the Peninsular Ranges, and Cenozoic sedimentary rocks predominating to the west and east of the central mountain range. The irregular contact between these geologic regions reflects the ancient topography of this area before it was buried by the thick sequence of Cretaceous and Tertiary sedimentary rocks deposited over the last 75 million years by ancient rivers and in ancient seas.

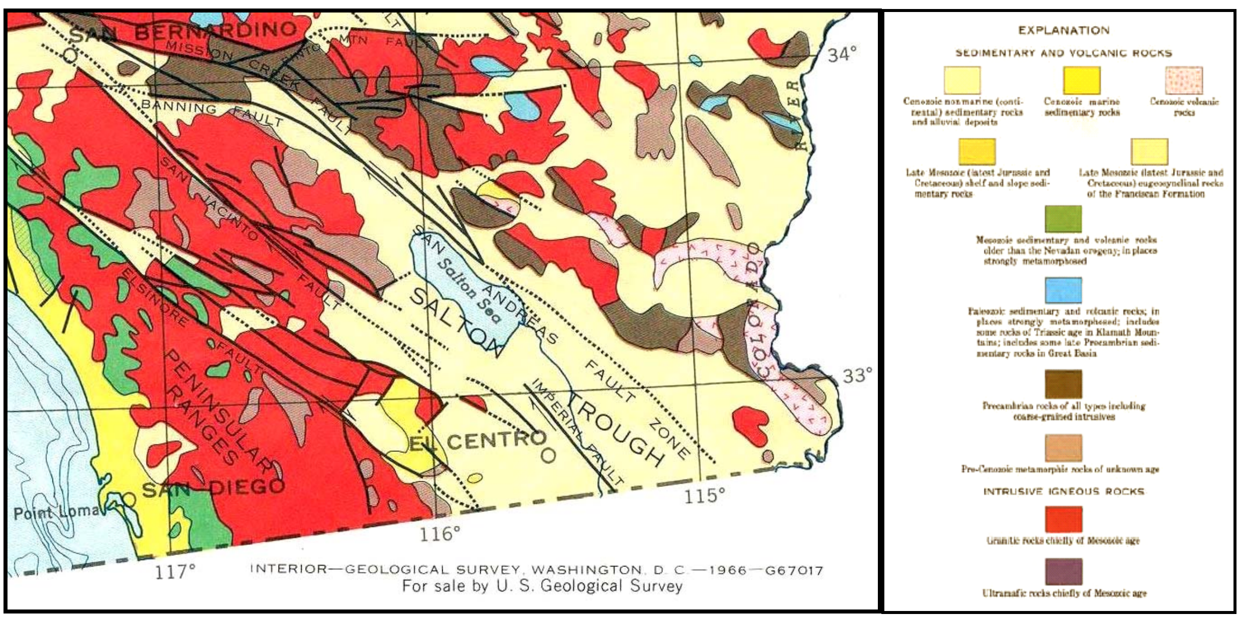


Figure 2-1. San Diego County Geology.

In the Coastal Plain region, resistant peaks composed of Mesozoic crystalline rocks extrude through the younger Cretaceous and Tertiary sedimentary cover and demonstrate the amount of topographic relief on the buried landscape of western San Diego County. The Coastal Plain Region is underlain by a sequence of marine and non-marine sedimentary rock units. Faulting has broken up this sedimentary sequence into a number of distinct fault blocks in the southwestern part of the county. North of La Jolla the effects of faulting are not as great and the rock units here are relatively undeformed.

The Peninsular Ranges Region is underlain primarily by plutonic rocks that formed from the cooling of molten magmas deep within the earth's crust. These magmas were generated during subduction of an oceanic crustal plate that was converging on the North American Plate between 140 and 90 million years ago. Over this long period of time, extensive masses of granitic rocks accumulated at depth to form the Southern California Batholith. Intense heat associated with these plutonic magmas metamorphosed the ancient sedimentary rocks into which the plutons intruded. These metasediments are now preserved in the Peninsular Range Region as marbles, slates, schist, quartzites and gneiss.

Approximately the eastern one-third of San Diego County falls within the Salton Trough Region. The Salton Trough is the northern landward extension of the Gulf of California and is undergoing active deformation related to faulting along the San Jacinto and Elsinore fault zones. These fault zones are in turn related to the major tectonic feature in the region, the San Andreas Fault.

Much of the land surrounding the Salton Sea in the Imperial and Coachella valleys is below present sea level. This is the result of crustal thinning and subsidence caused by the same extensional tectonics that continue to form the Gulf of California today. As a result of this rifting and subsidence, the Salton Trough has been filled with sediments to a depth of up to five miles since the early Miocene, approximately 24 million years ago. The source of these sediments has been the local mountain ranges, as well as the ancestral and modern Colorado River (Deméré, 2005).

San Diego County is located within the Peninsula Range Physiographic Province of California. One of the most prominent physical features in the region is the northwest-trending Peninsula Range which includes, from north to south, the Santa Ana, Agua Tibia, Palomar, Volcan, Cuyamaca, and Laguna Mountains. Generally, the region exhibits a gently sloping, dissected western surface and a steep eastern slope. The province is separated from the Salton Trough west of the Colorado River by abrupt fault scarps of marked relief (RWQCB, 1994).

The San Diego Region is divided into a coastal plain area, a central mountain-valley area, and an eastern mountain-valley area. The coastal plain area is a series of wave cut platforms overlain by thin terrace deposits. This terraced surface has been deeply incised by streams draining generally westward to the sea, and has been smoothed and rounded by local erosion. Local elevations range from sea level to approximately 1,500 feet. The coastal plain extends from the coast inland, along a band approximately 10 miles in width.

The central mountain-valley area is characterized by ridges and intermountain basins that extend from the coastal plain, northeastward to the Elsinore fault zone. The basins or valleys range in elevation from approximately 500 to 5,000 feet, are generally of fault block origin, and have been altered by erosion. The floors of the intermountain valleys are generally underlain by moderate thicknesses of alluvium. Notable examples of this occur near El Cajon, Escondido, and Ramona where elevations range from approximately 500 to 1,500 feet above sea level. At higher elevations ranging from 2,000 to 6,000 feet near the Laguna Mountains, Santa Ysabel, and Valley Center, plateau surfaces have been developed in the central mountain-valley area.

To the northeast of the Elsinore fault zone, the region has been designated as the eastern mountain-valley area. This area is comprised of broad, relatively flat valleys which are structurally of fault block origin. Locally, the down-dropped grabens contain thick sections of alluvial deposits. These valleys generally rise to the southeast from approximately 1,000 feet in elevation near Temecula to the rolling plateaus of Glenoak, Lewis, and Reed valleys which range from 3,000 to 3,500 feet in elevation.

Surrounding mountains include Red Mountain, Cahuilla Mountain, and Bachelor Mountain and elevations range from 4,000 to 7,500 feet above sea level (RWQCB, 1994).

The hydrologic soil groups are shown in Figure 2-2 (USDA). The coastal regions are largely comprised of very low infiltration, Group D Soil Type. Other areas are dominated by soil with low to moderate infiltration capacity. High infiltration, Group A soil is confined to only a few riparian regions.

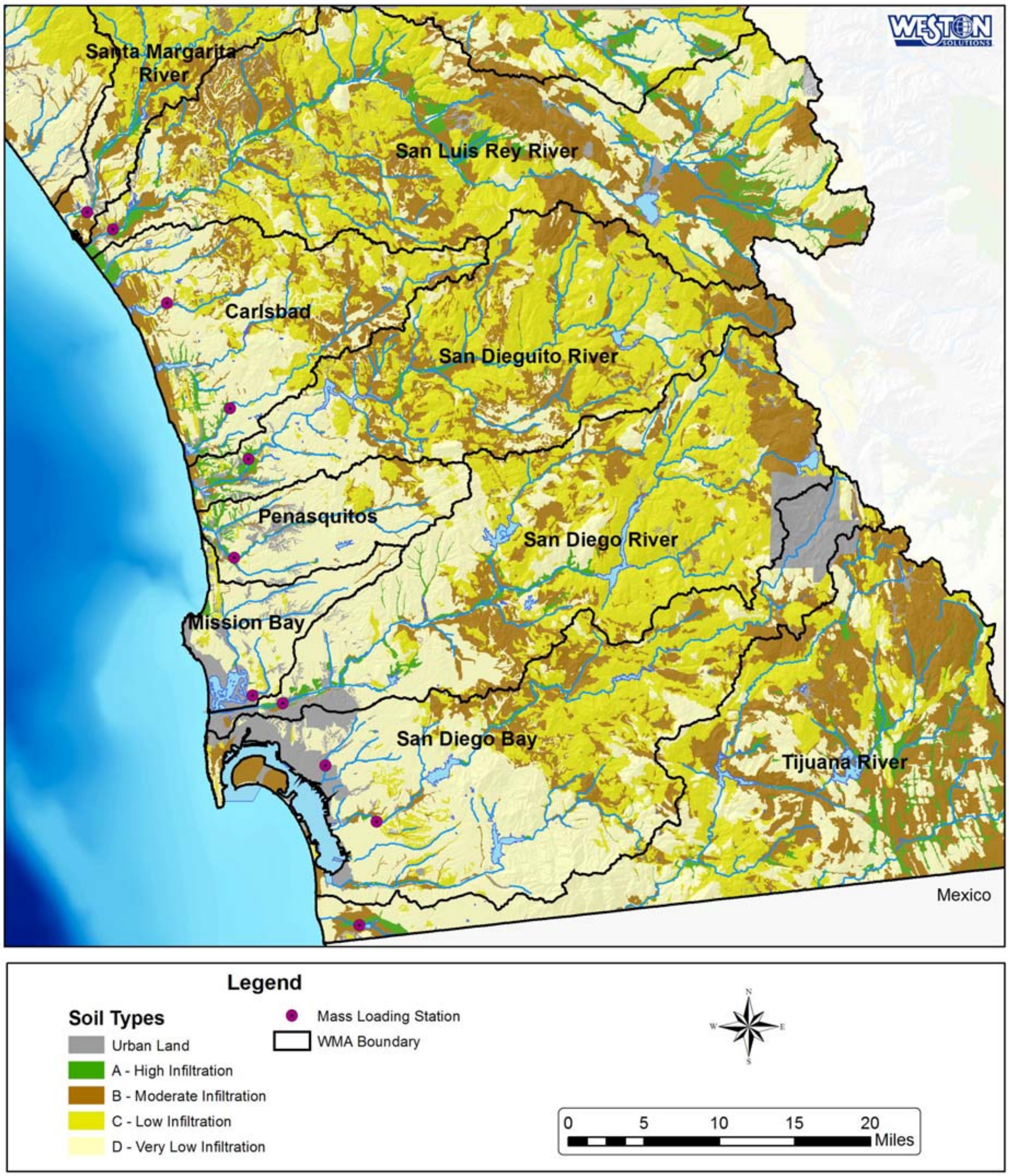


Figure 2-2. Hydrologic soil groups

2.1.2 Significant Regional Events

Southern California has experienced several notable events over the past two years that are likely to impact water quality throughout the watershed management areas (WMA). These events include the wildfires of 2003-2004, a prolonged dry period, and the record rainfall and flooding of 2004-2005.

2.1.2.1 Wildfires

Wildfires tore through large parts of San Diego County in October of 2003. A total of 600 square miles were burned. Homes and lives were lost, wildlife habitat was devastated, air quality deteriorated, and land cover was lost. Burned areas have the potential to adversely affect water quality by increasing the nutrient load for several years to come. Additionally, the burned areas greatly increase the potential for flooding, erosion, and higher peak flows in the short term (Meixner, 2004)

The Cedar Fire was the largest of the 2003 burns and affected the upper portions of the Los Peñasquitos, Mission Bay, San Diego River, and San Diego Bay WMAs. Over 280,000 acres burned over a ten-day period. The Paradise Fire covered 57,000 acres of the San Luis Rey, Carlsbad, and San Dieguito WMAs. The Otay Fire affected 45,000 acres of the San Diego Bay and Tijuana River WMAs. The most impacted WMA was the San Diego River WMA, where 74 % (over 200,000 acres) of the watershed was impacted by the fires.

The 2003 wildfires are discussed in greater detail in the *2003-2004 Urban Runoff Monitoring Report* for San Diego County (MEC-Weston, 2005).

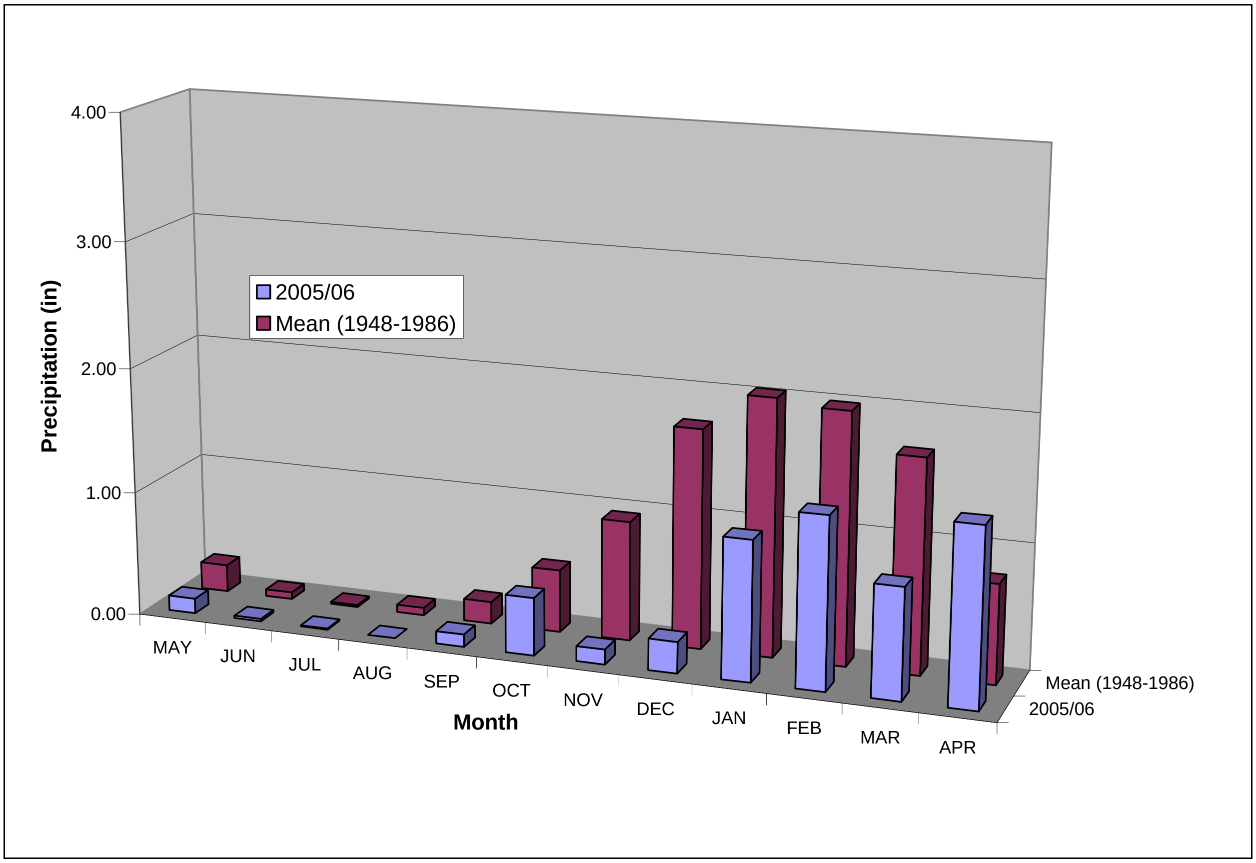
Wildfire activity, while not as severe as the October 2003 burns, continued in the region during the first half of 2004 when several fires broke out in the southwest portion of neighboring Riverside County. Three of these fires (Eagle, Melton, and Pleasure) totaling more than 17,000 acres in burned area, had the potential to affect WMAs of northwest San Diego County.

2.1.3 Rainfall and Climate

The San Diego Region coastal climate is generally mild with annual average temperatures near 65°F. As elevations increase inland, average temperatures decrease to approximately 57°F in the higher mountain areas. Warm, dry Santa Ana winds are frequent in the fall, resulting in the highest temperatures during the months of September and October. January is usually the coldest month of the year.

The coastal portions of San Diego County receive annual average rainfall amounts ranging from less than 9 inches in the extreme southwest to 11 inches in the north. The foothills to the east of the coastal plain receive precipitation amounts ranging from 17 inches in the north to 14 inches in the south. Mountain area precipitation ranges from 45 inches at Palomar Mountain in the north, to 39 inches at Lake Cuyamaca, and 21 inches at Laguna Mountain in the south.

On an annual basis, there are two distinct climatic periods: a dry (semi-arid) period from late April to mid-October, and a wet period from mid-October through late April. For the coastal and inland areas, the wet period typically provides 85 to 90 percent of the annual average rainfall, with the remaining rainfall attributed to residual storms and occasional "summer monsoons." Rainfall during 2005-2006 was generally below historical averages (Figure 2-3). The majority of the rain fell during the months of January, February, March, and April. April's rainfall amount was greater than historical averages.



Source: National Weather Service, 2006

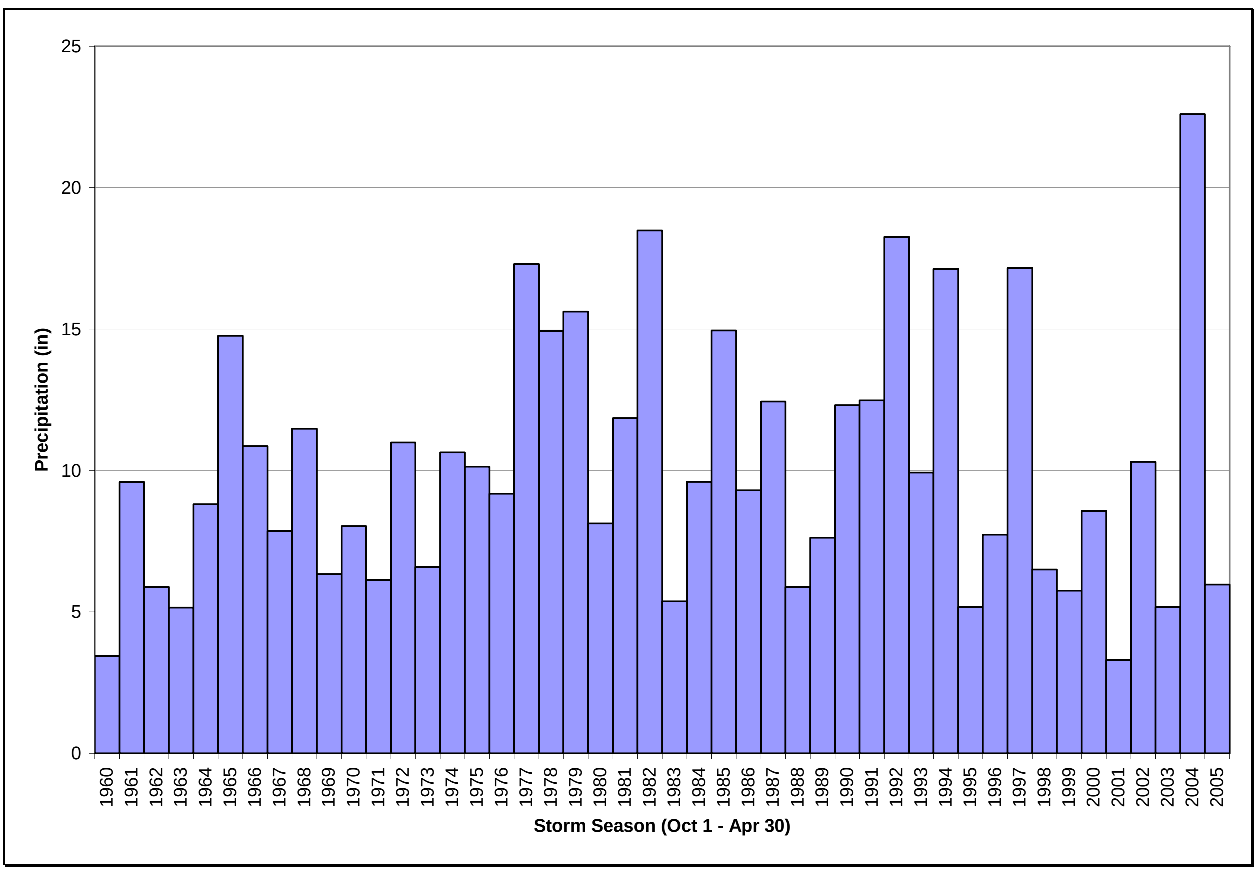
Figure 2-3. San Diego - Lindbergh Field Monthly Precipitation Summary 2005-2006 and Historical Mean (1948-1986).

Rainfall statistics for the San Diego region were developed at the request of the EPA by Steuber and Nold (1986), based upon the historical data records from the National Oceanic and Atmospheric Administration (NOAA) rain gauge at San Diego International Airport's Lindbergh Field (Table 2-1). A 39-year record from 1948 through 1986 was used to statistically analyze rainfall at this site. Results of this analysis indicated that an average of 18 storm events occur each year. The average yield of each event is 0.38 inches of rain over an approximate nine-hour period. Storm events were defined as a total accumulation of at least 0.1-inch of precipitation, together with intensities averaging at least 0.01 inches of precipitation per hour. Additionally, estimation of a representative storm event for the San Diego region was based on a statistical evaluation of this record. Based on the results of this statistical analysis, the typical storm event for the San Diego region yields 0.19 to 0.57 inches of rain and lasts 6 to 12 hours. Figure 2-4 presents a 46-year summary of annual rainfall at San Diego's Lindberg Field.

Table 2-1. Rainfall statistics for San Diego International Airport (1948 through 1986).

Month	Average Total (inches)	Average Event Duration (hours)	Average Event (inches)	Average Number of Events
January	2.05	11.78	0.51	3.51
February	1.96	11.10	0.43	2.94
March	1.81	10.80	0.45	3.37
April	0.75	6.31	0.23	1.77
May	0.20	2.41	0.09	0.51
June	0.07	1.07	0.08	0.19
July	0.02	0.28	0.00	0.03
August	0.07	1.07	0.08	0.19
September	0.19	2.77	0.10	0.31
October	0.42	4.31	0.18	0.78
November	1.07	8.19	0.38	2.28
December	1.74	9.29	0.37	2.53
Annual Average	**10.44**	**9.24**	**0.38**	**18.33**

Source: Steuber and Nold, 1986



Source: National Weather Service, 2005

Figure 2-4. San Diego - Lindberg Field Storm Season Rainfall 1960 to 2005.

2.1.4 Hydrology

San Diego County has two major drainage basins; the Pacific and the Salton Sea Basin (Figure 2-5). The majority of San Diego County and all major population centers in the region are contained within the Pacific Basin. The Pacific Basin drains from the highlands in the east portion of the county to the Pacific Ocean in the west. The region is divided into nine WMAs and 11 major hydrologic units (HU) (Figure 2-5). The nine WMAs are further broken down into 48 hydrologic areas (HA) (Table 2-2). The San Diego Region covers most of San Diego County and parts of southwestern Riverside and Orange Counties.

Most of the surface water streams of San Diego County are interrupted in character, having both perennial and ephemeral components. This is a result of the regional rainfall pattern and the development of surface water impoundments. Most of the major surface water streams are captured by impoundments. Many of these surface water impoundments store both natural runoff and imported water.

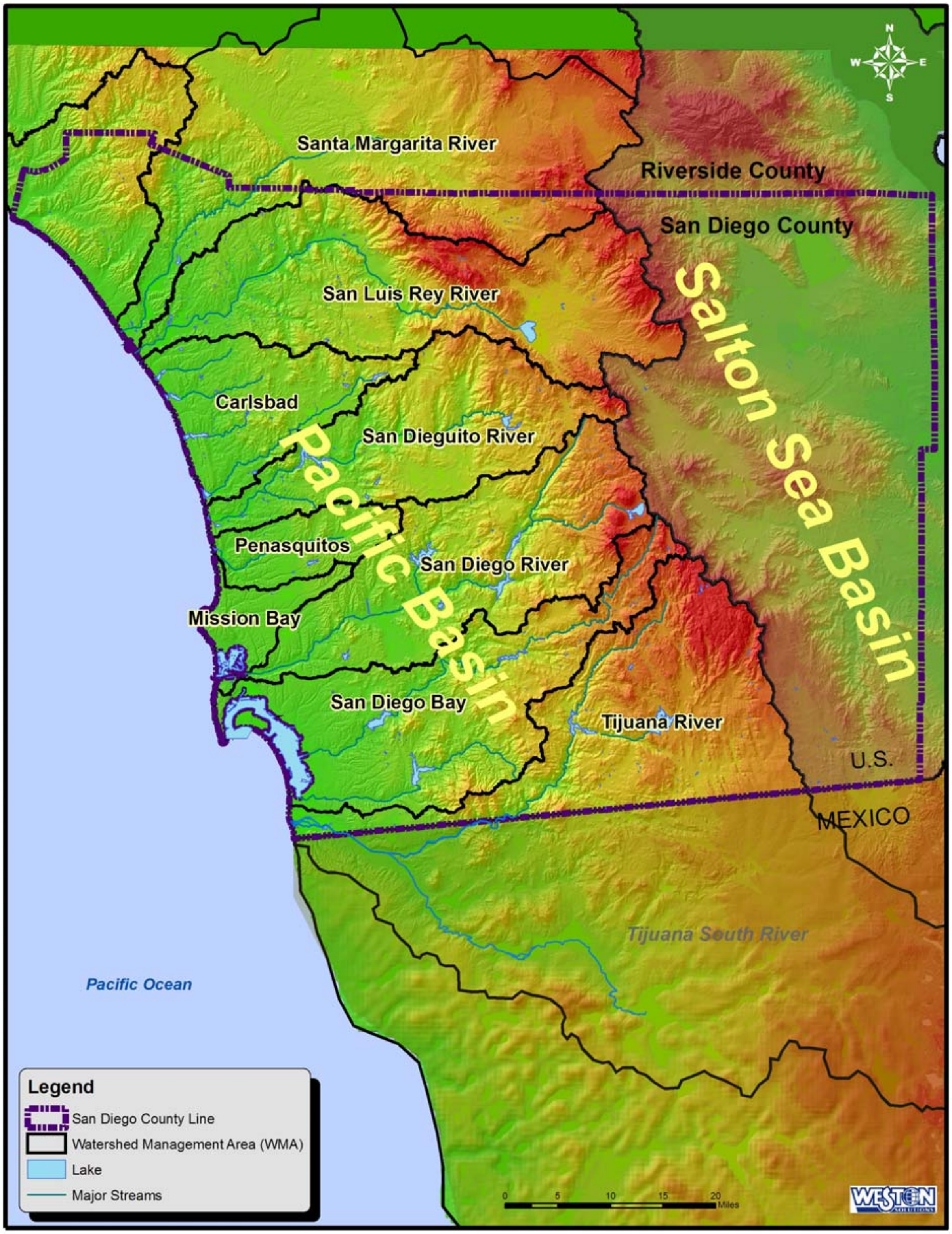


Figure 2-5. San Diego Watershed Management Areas.

Table 2-2. Hydrologic Areas in the San Diego Region.

Watershed Management Area	Hydrologic Unit	HU #	Hydrologic Area	HA #
Santa Margarita	Santa Margarita	902.00	Ysidora DeLuz Murrieta Auld Pechanga Wilson Cave Rocks Aguanga Oakgrove	902.10 902.20 902.30 902.40 902.50 902.60 902.70 902.80 902.90
San Luis Rey	San Luis Rey	903.00	Lower San Luis Monserate Warner Valley	903.10 903.20 903.30
Carlsbad	Carlsbad	904.00	Loma Alta Buena Vista Creek Agua Hedionda Encinas San Marcos Escondido Creek	904.10 904.20 904.30 904.40 904.50 904.60
San Dieguito	San Dieguito	905.00	Solana Beach Hodges San Pasqual Santa Maria Valley Santa Isabel	905.10 905.20 905.30 905.40 905.50
Peñasquitos	Peñasquitos	906.00	Miramar Reservoir Poway	906.10 906.20
Mission Bay	Peñasquitos	906.00	Scripps Miramar Tecolote	906.30 906.40 906.50
San Diego River	San Diego	907.00	Lower San Diego San Vincente El Capitan Boulder Creek	907.10 907.20 907.30 907.40
San Diego Bay	Pueblo San Diego Sweetwater Otay	908.00 909.00 910.00	Point Loma San Diego Mesa National City Lower Sweetwater Middle Sweetwater Upper Sweetwater Coronado Otay Valley Dulzura	908.10 908.20 908.30 909.10 909.20 909.30 910.10 910.20 910.30
Tijuana	Tijuana	911.00	Tijuana Valley Potrero Barrett Lake Monument Morena Cottonwood Cameron Campo	911.10 911.20 911.30 911.40 911.50 911.60 911.70 911.80

Source: RWQCB, 2001

Ground water throughout San Diego County occurs in basins that are relatively small in area and usually shallow. Nearly all of the ground water basins in the county have been intensively developed for municipal and agricultural supply purposes. Figure 2-6 illustrates the regional ground water basins and Figure 2-7 and Table 2-3 present the regional reservoirs.

Source: SDCWA, 2000

Figure 2-6. Major Ground Water Basins in San Diego County.

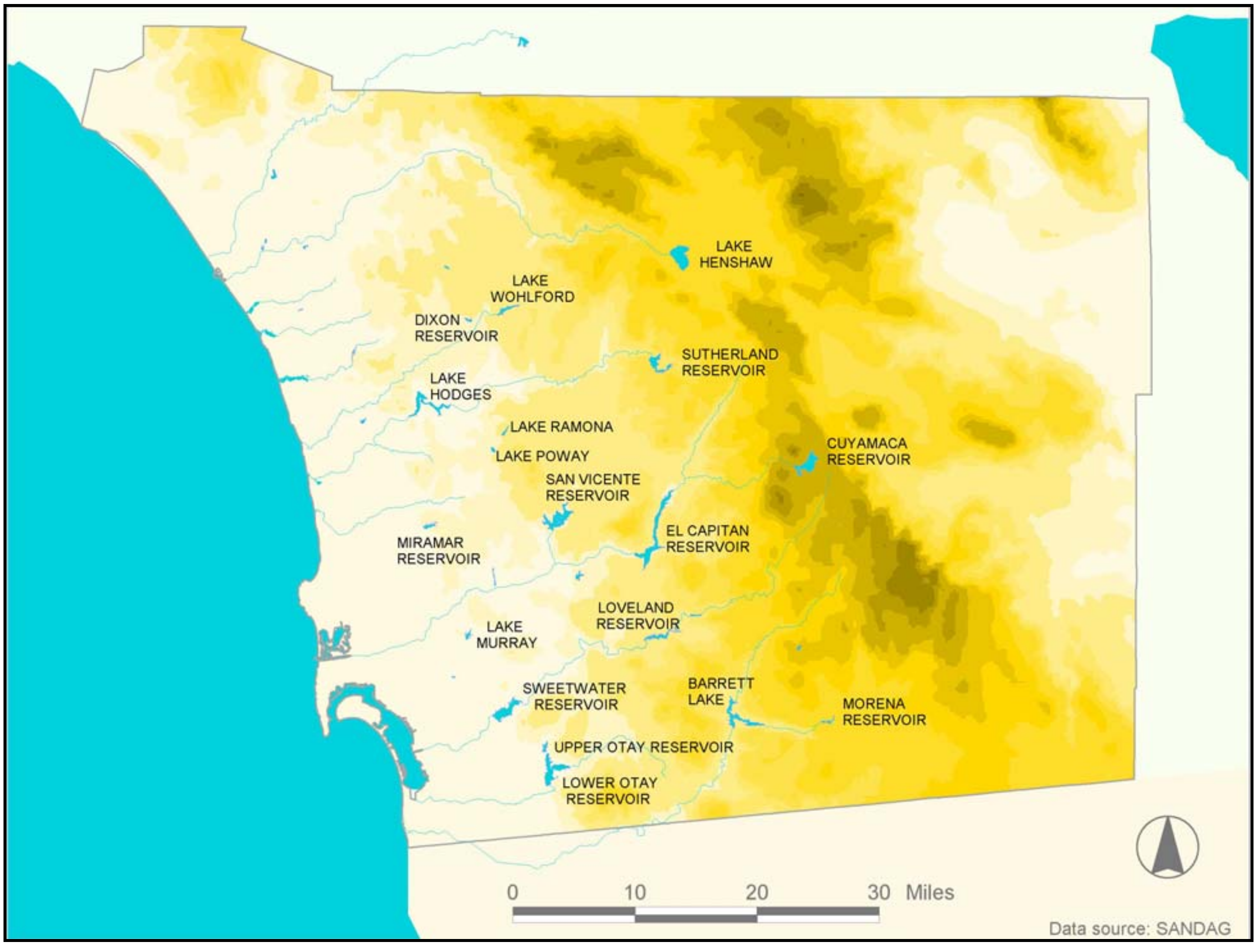


Figure 2-7. San Diego Reservoirs.

Table 2-3. Reservoirs in the San Diego Region.

Reservoir	Watershed	Owner	Year Built	Water Source	Capacity (AF)	Elevation (Ft)
Lake Henshaw	San Luis Rey	Vista Irrigation District	1923	Natural Runoff	51,774	2,656.92
Lake Wohlford	Carlsbad	City of Escondido	1924	Natural Runoff/ Upstream Releases	6,506	1,460.30
Dixon	Carlsbad	City of Escondido	1970	First Aqueduct	2,606	1,042.80
Sutherland	San Dieguito	City of San Diego	1953	Natural Runoff	29,685	72.90
Lake Hodges	San Dieguito	City of San Diego	1918	First Aqueduct/ Natural Runoff	33,550	84.58
Olivenhain	San Dieguito	San Diego County Water Authority	2003	Natural Runoff	24,364	989.5
San Dieguito	San Dieguito	San Dieguito Water District/ Santa Fe Irrigation district	1918	Second Aqueduct/ Upstream Releases	883	243.60
Lake Ramona	San Dieguito	Ramona Municipal Water District	1980	First Aqueduct	12,000	1,248.60
Lake Poway	San Dieguito	City of Poway	1971	First Aqueduct	3,330	930.80
Lake Miramar	Peñasquitos	City of San Diego	1960	Second Aqueduct	7,185	105.87
Lake Cuyamaca	San Diego	Helix Water District	1887	Natural Runoff	8,195	4,622.20
San Vincente	San Diego	City of San Diego	1943	First Aqueduct/ Natural Runoff/ Upstream Releases	90,230	175.38
El Capitan	San Diego	City of San Diego	1934	First Aqueduct/ Natural Runoff	112,807	116.58
Lake Jennings	San Diego	Helix Water District	1962	First Aqueduct	9,790	677.25
Lake Murray	San Diego	City of San Diego	1918	Second Aqueduct/ Upstream Releases	4,818	90.86
Loveland	Sweetwater	Sweetwater Authority	1945	Natural Runoff	25,400	1,298.36
Sweetwater	Sweetwater	Sweetwater Authority	1888	Natural Runoff	30,079	203.82
Lower Otay	Otay	City of San Diego	1919	Second Aqueduct/ Natural Runoff/ Upstream Releases	49,510	128.14
Barrett Lake	Tijuana	City of San Diego	1922	Natural Runoff/ Upstream Releases	37,947	104.34
Lake Morena	Tijuana	City of San Diego	1912	Natural Runoff	50,207	103.36

Source: SDCWA, 2000

2.1.5 Land Areas

The WMA boundaries are jurisdictional group boundaries set by the RWQCB rather than natural hydrologic drainage area boundaries. In most cases, the WMA and the watershed cover the same geographic area. There are two exceptions: the Peñasquitos and Mission Bay WMAs split the Peñasquitos watershed. Figure 2-5 indicates the WMA boundaries. The San Diego Bay WMA combines the Pueblo San Diego, Sweetwater, and Otay watersheds. Table 2-4 presents the land areas for each WMA and the percentage of land that falls within San Diego County.

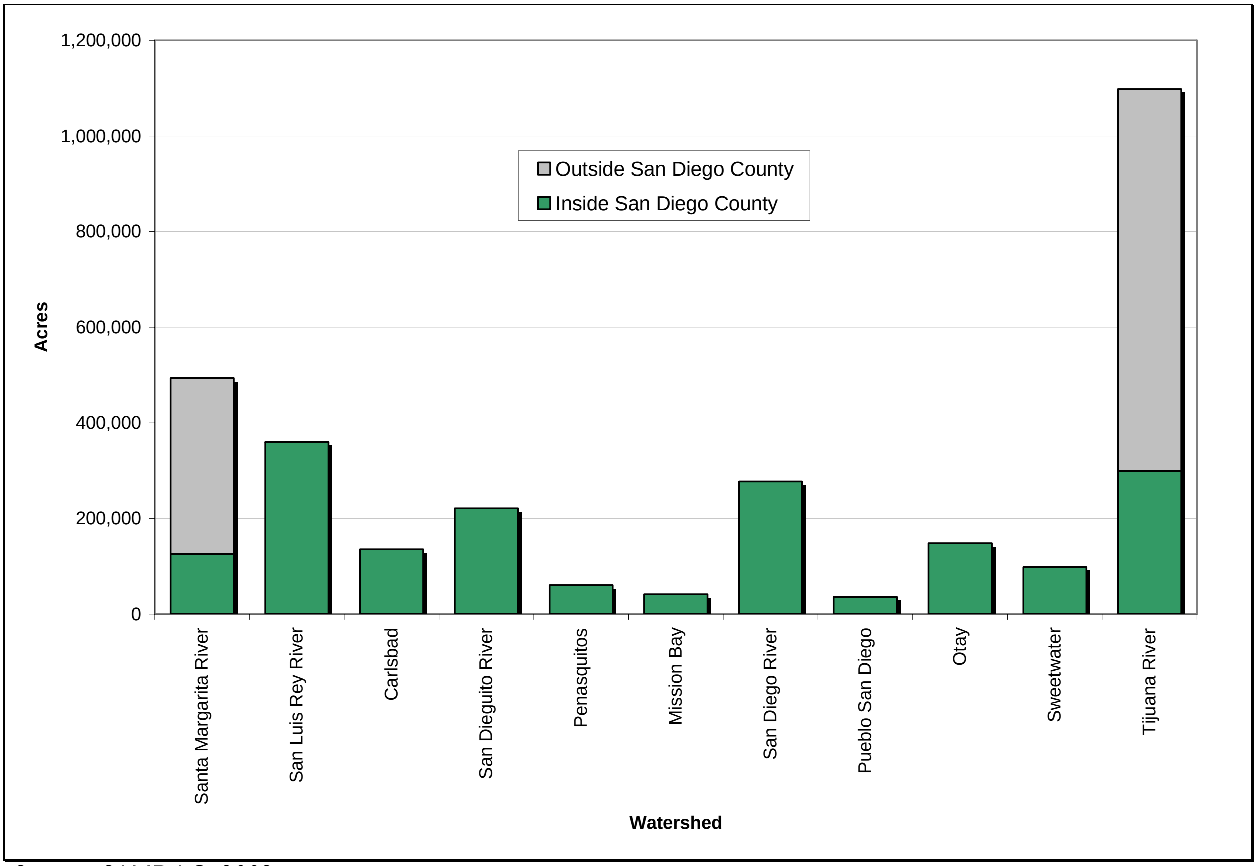
The Tijuana WMA is the largest of the San Diego WMAs, only 27% actually lies within the San Diego region (Table 2-4 and Figure 2-8). Similarly, only 27% of the Santa Margarita WMA lies within San Diego County. Of all the WMAs combined, only 58% of the land area lies within San Diego County.

Watershed areas are geographical boundaries that define a watercourse and its associated drainage basin. A single watershed can cross multiple jurisdictional boundaries. Table 2-5 presents the multi-jurisdictional composition of each watershed.

Land ownership for the San Diego watersheds is primarily private. Approximately 58% of the San Diego watersheds are privately owned (Figure 2-9).

Table 2-4. Watershed Management Areas in the San Diego Hydrologic Region.

Watershed Management Area	Total Acres	Acres Inside San Diego Region	Acres Outside San Diego Region	Percent Inside San Diego Region
Santa Margarita	473,971	125,777	348,194	27
San Luis Rey	359,893	359,244	649	100
Carlsbad	135,322	135,322	0	100
San Dieguito	221,307	221,307	0	100
Peñasquitos	60,418	60,418	0	100
Mission Bay	43,244	43,244	0	100
San Diego River	277,543	277,543	0	100
San Diego Bay	282,553	282,553	0	100
Tijuana	1,100,831	299,002	801,829	27
Total	3,272,614	1,901,203	1,371,411	58



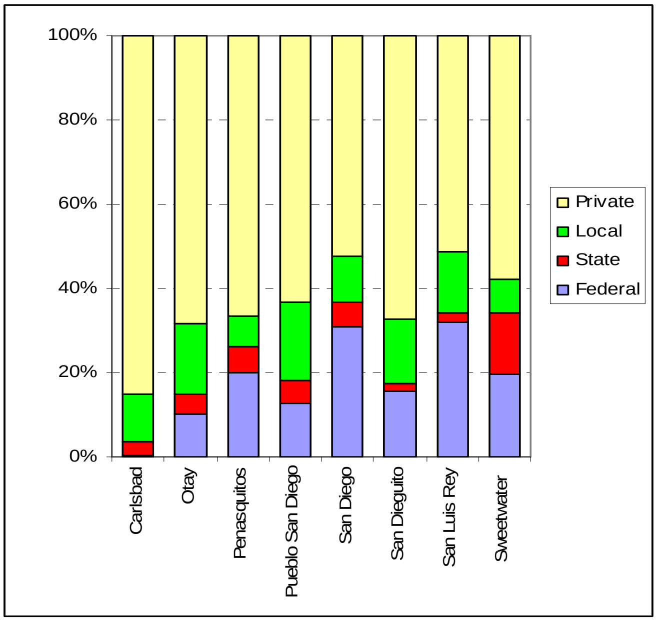
Source: SANDAG, 2003

Figure 2-8. Watershed Areas of the San Diego Hydrologic Region.

Table 2-5. Watershed Acreages by Jurisdiction.

San Diego County	Watershed													
City	Santa Margarita River	San Luis Rey River	Carlsbad	San Dieguito River	Penasquitos	Mission Bay	San Diego River	Pueblo San Diego	Sweetwater	Otay	Tijuana River	Other	*Total Acres*	*Percent*
Carlsbad			24,931										24,931	0.9%
Chula Vista									9,066	12,490			21,556	0.8%
Coronado									4,892				4,892	0.2%
Del Mar				994	152								1,146	0.0%
El Cajon							9,245			0			9,245	0.3%
Encinitas			11,502										11,502	0.4%
Escondido		41	17,428	5,857									23,326	0.9%
Imperial Beach									717		2,121		2,838	0.1%
La Mesa							3,052	1,634		1,134			5,820	0.2%
Lemon Grove								1,633		861			2,494	0.1%
National City								2,545		2,146			4,691	0.2%
Oceanside	99	15,952	11,002										27,054	1.0%
Poway				8,969	15,487		596						25,052	0.9%
San Diego				27,322	42,976	41,207	46,625	29,979	6,677	2,052	13,995		210,834	7.8%
San Marcos			15,446										15,446	0.6%
Santee							10,540						10,540	0.4%
Solana Beach			572	1,587									2,158	0.1%
Vista		731	11,132										11,863	0.4%
Unincorporated	125,582	342,500	43,310	176,582	1,806		207,259	122	76,877	129,401	283,071	909,624	2,296,133	84.7%
Total Acres	125,681	359,224	135,322	221,311	60,421	41,207	277,316	35,913	98,229	148,084	299,187	909,624	2,711,521	100.0%
Percent	4.6%	13.2%	5.0%	8.2%	2.2%	1.5%	10.2%	1.3%	3.6%	5.5%	11.0%	33.5%	100.0%	

(SANDAG, 2003)



Source: SANDAG, 2003

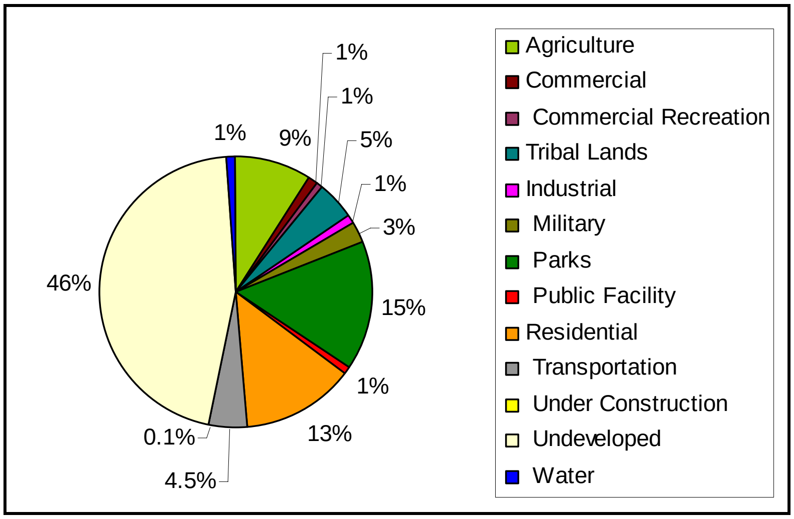
Figure 2-9. Land Ownership in San Diego Watersheds.

2.1.6 Land Use

Land use within San Diego County varies considerably from undeveloped vacant land to industrial (Table 2-6). Overall land use in the county is dominated by undeveloped vacant land (due mostly to geomorphological characteristics, i.e. steep terrain, limited water source, etc.) and park/recreational areas. These two land uses encompass approximately 62% of the total land area in the region. Residential and agricultural land uses comprise approximately 13% and 9%, respectively. Military and transportation land uses comprise approximately 7% combined. Tribal Lands comprise 4.5%. All other land use categories, including industrial and commercial, make up the remaining 2% (SANDAG, 2003).

Table 2-6. Land Use Distribution in San Diego Region.

Percent Land Use for the San Diego Region	
Agriculture	9.2%
Commercial	1.0%
Commercial Recreation	0.9%
Tribal Lands	4.5%
Industrial	1.0%
Military	2.5%
Parks	15.4%
Public Facility	0.8%
Residential	13.1%
Transportation	4.5%
Under Construction	0.1%
Undeveloped	45.9%
Water	1.1%



Source: SANDAG, 2003

Land use type can affect both the amount of runoff and the constituents of concern detected in runoff. Highly urban areas usually contain more impervious surfaces that generally produce more runoff per unit of rain than undeveloped areas. As development increases, impervious surface area within the watershed increases, thereby producing more runoff and a larger peak storm flow, which occurs sooner during a storm event than in undeveloped areas (TNS, 2002). Table 2-7 illustrates the land use distribution per WMA and the associated impervious surface area. Table 2-8 illustrates the estimated impervious surface area per WMA. Total estimated impervious surface area within San Diego Region equals approximately 22.4 % (The Center for Watershed Protection, 2006).

Table 2-7. Land Use Percentage per Watershed Management Area (WMA)

WMA	% Agriculture	% Commercial	% Commercial Recreation	% Tribal Lands	% Industrial	% Military	% Parks	% Public Facility	% Residential	% Transportation	% Under Construction	% Undeveloped	% Water	Total Acres
Carlsbad	8.9%	2.3%	2.1%	0.2%	3.1%	0.0%	12.5%	2.2%	31.8%	11.2%	0.5%	23.9%	0.01	135,345.05
Mission Bay	0.2%	3.0%	3.6%	0.0%	4.0%	2.8%	26.2%	4.7%	26.2%	18.1%	0.2%	6.4%	4.5%	43,268.17
Penasquitos	1.6%	2.5%	1.2%	0.0%	7.3%	0.0%	29.2%	3.0%	24.7%	11.9%	0.6%	17.8%	0.3%	60,423.61
San Diego Bay	2.1%	1.3%	1.3%	0.4%	1.6%	1.2%	24.4%	2.0%	19.2%	8.7%	0.1%	36.9%	1.0%	282,584.15
Otay*	1.8%	0.6%	1.4%	0.0%	2.6%	2.0%	30.4%	1.1%	9.9%	5.0%	0.1%	44.0%	1.1%	98,499.07
Pueblo San Diego*	0.0%	5.0%	1.7%	0.0%	2.4%	4.1%	7.2%	6.0%	40.1%	28.1%	0.2%	5.0%	0.2%	35,978.25
Sweetwater*	2.7%	0.9%	1.3%	0.7%	0.8%	0.0%	24.6%	1.5%	20.2%	6.4%	0.0%	39.8%	1.0%	148,106.83
San Diego River	2.3%	1.2%	0.9%	7.4%	1.3%	0.7%	18.1%	1.2%	15.4%	5.7%	0.0%	44.3%	1.6%	277,554.65
San Dieguito River	18.2%	0.3%	1.8%	3.4%	0.4%	0.0%	15.1%	0.4%	14.2%	3.1%	0.1%	42.2%	0.8%	221,320.40
San Luis Rey River	20.6%	0.2%	0.8%	13.4%	0.3%	2.8%	8.1%	0.3%	11.3%	2.2%	0.0%	39.6%	0.4%	359,886.75
Santa Margarita River	10.3%	1.5%	0.0%	0.2%	0.3%	7.5%	6.8%	0.0%	7.7%	0.9%	0.0%	63.4%	1.3%	493,428.45
Tijuana River	3.5%	0.1%	0.3%	6.5%	0.3%	0.1%	24.6%	0.2%	2.8%	2.4%	0.0%	58.4%	0.8%	299,263.38
Tijuana South River	6.0%	0.3%	0.0%	0.0%	0.6%	0.0%	0.1%	0.1%	10.2%	0.5%	0.0%	81.8%	0.2%	799,035.74
*San Diego Bay WMA watershed														**2,972,110.35**

Table 2-8. Estimate of % of Impervious Surface for each WMA

Santa Margarita River	San Luis Rey River	Carlsbad	San Dieguito River	Los Peñasquitos	Mission Bay	San Diego River	San Diego Bay	Tijuana River	Tijuana South River
11.1%	21.1%	38.3%	20.0%	43.4%	49.9%	27.3%	30.8%	16.8%	8.3%

2.1.7 Population

San Diego County currently has an estimated population of 2,813,833 (Table 2-9). The City of San Diego comprises a large proportion of this population with approximately 44% of the total county population living within the city limits. Unincorporated areas of the County represent another 16% of the overall population. Cumulatively, the remaining seventeen cities comprise 40% of the population although individually, each of these cities represents less than 7% of the total population in the County.

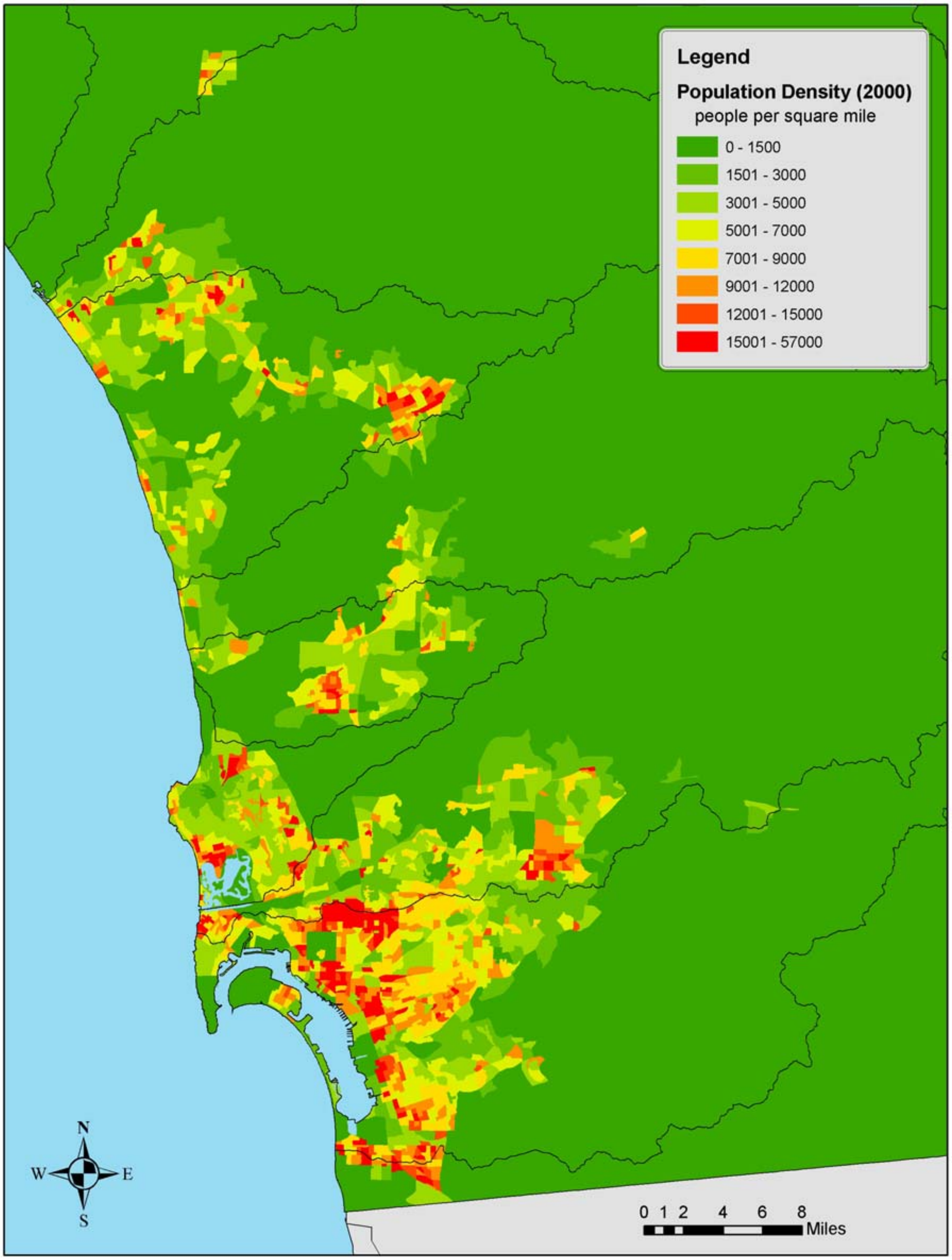
Table 2-9. Population Distribution in San Diego County (Census, 2000).

Location	Population	Percentage
Carlsbad	78,247	2.8%
Chula Vista	173,556	6.2%
Coronado	24,100	0.9%
Del Mar	4,389	0.2%
El Cajon	94,869	3.4%
Encinitas	58,014	2.1%
Escondido	133,559	4.7%
Imperial Beach	26,992	1.0%
La Mesa	54,749	1.9%
Lemon Grove	24,918	0.9%
National City	54,260	1.9%
Oceanside	161,029	5.7%
Poway	48,044	1.7%
San Diego	1,223,400	43.5%
San Marcos	54,977	2.0%
Santee	52,975	1.9%
Solana Beach	12,979	0.5%
Vista	89,857	3.2%
Unincorporated	442,919	15.7%
Total	2,813,833	100%

Sources: Census, 2000, U.S. Census Bureau; SANDAG

Residential areas tend to be concentrated along the coast, extending up to 30 miles inland in areas of favorable terrain. Inland urban expansion has resulted in the development of major transportation corridors to accommodate newer residential tracts. Strip commercial zones are common along the larger transportation corridors. Industrial centers are generally situated in areas adjoining military facilities, along transportation corridors, and on Port of San Diego property.

Population density within the watersheds mirrors urban development, with the San Luis Rey Watershed being the least densely populated and the Pueblo San Diego watershed being the most densely populated (Figure 2-10).



SANDAG, 2000

Figure 2-10. Population Per Acre for Watersheds Entirely within the San Diego Region (Tijuana population not included).

Increase in population leads to increase in development, which generally leads to more impervious areas, which leads to more runoff. Table 2-10 presents the population cycle for the San Diego County watersheds. More than 55% of the area's population lives in the three most populated watersheds (Table 2-10). Water quality concerns will most likely become more of an issue in the watersheds that are projected to have significant population growth. The three least densely populated watersheds: Otay, San Dieguito, and San Luis Rey are projected to grow at the fastest rate with projected population increases of 88%, 70%, and 80%, respectively (Table 2-10). The Carlsbad, San Diego Bay, and San Diego River Watershed Management Areas stand out as having the largest populations (Figure 2-11).

Table 2-10. 1990, 1997, and 2015 Population for Watersheds Entirely Within the San Diego Region.

Watershed	Total Population			Percent Change			Persons Per Acre	
	1990	1997	2015	1990-1997	1997-2015	1990-2015	1997	2015
San Luis Rey	116,413	134,482	242,069	16	80	108	0.37	0.67
Carlsbad	426,141	472,334	706,617	11	50	66	3.49	5.22
San Dieguito	114,097	126,237	214,214	11	70	88	0.57	0.97
Peñasquitos	387,603	442,731	560,555	14	27	45	4.27	5.40
San Diego	476,304	506,420	620,542	6	23	30	1.82	2.24
Pueblo San Diego	455,238	472,204	591,162	4	25	30	13.09	16.39
Sweetwater	265,053	295,270	359,420	11	22	36	1.99	2.43
Otay	133,220	143,916	270,549	8	88	103	1.46	2.75
Total	2,374,069	2,593,594	3,565,128	9	37	50	1.36	1.88

Source: 1990 Census and SANDAG's Population Estimates and Interim Series 8 Forecast (SANDAG, 1998)

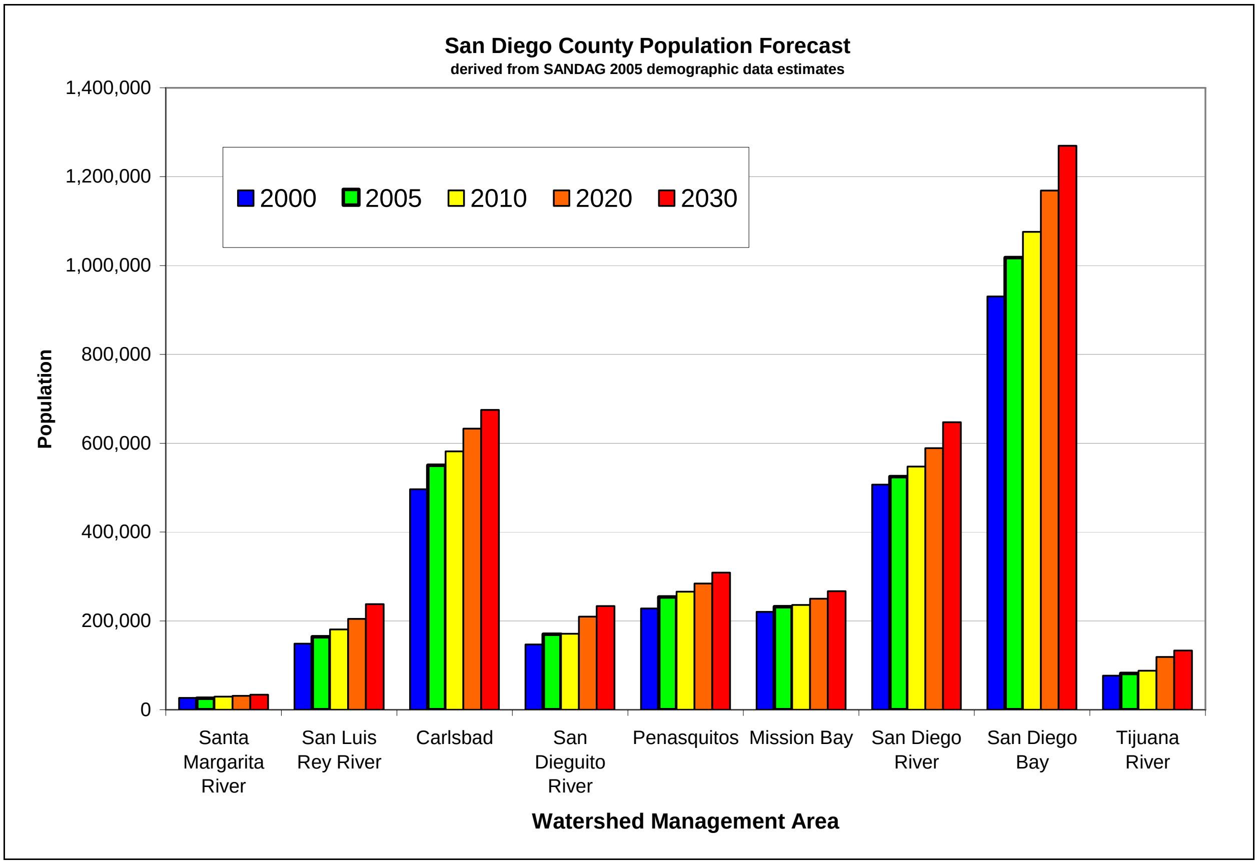


Figure 2-11. Population for Watershed Management Areas Entirely Within the San Diego Region.

2.2 Monitoring Site Descriptions

Monitoring site locations for the 2005-2006 MLS are shown in Figure 2-12, along with outlines of their respective runoff areas. Land use differs substantially within each catchment area and is discussed in the following sections and presented in Figure 2-13 and Figure 2-14 (US and Mexico data included). Open land identified in the runoff area is typically covered by chaparral. The following sections of this report summarize the major characteristics of each MLS. MLS are described in detail in each respective WMA section.

Figure 2-12. Mass Loading Station Locations (runoff/capture area shown in blue).

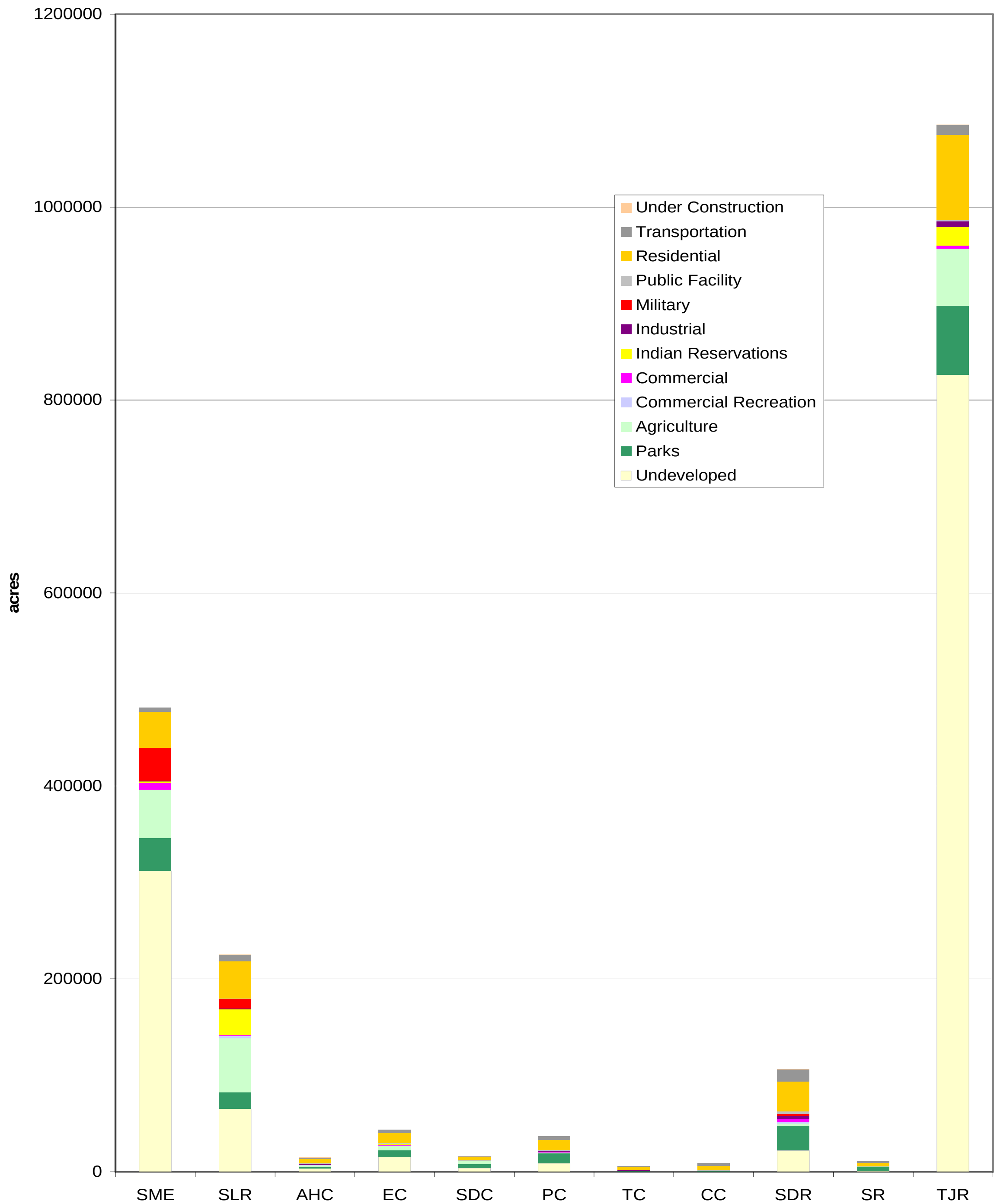


Figure 2-13. Contributing Runoff Land Use Acreages by Mass Loading Station.

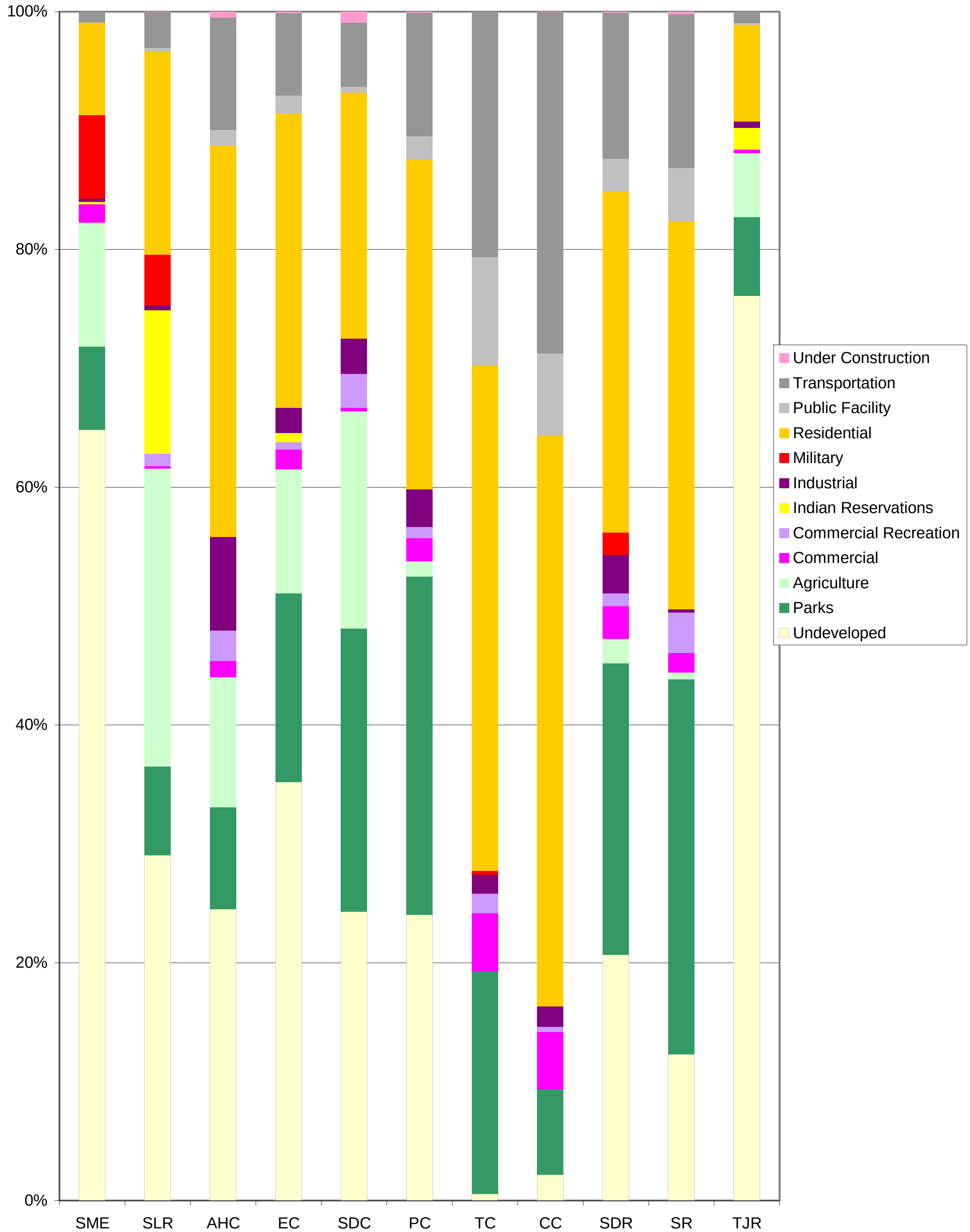


Figure 2-14. Contributing Runoff Land Use Percentages by Mass Loading Station.

2.3 Storm Event Summary

2.3.1 Representative Storm Event

Estimation of a representative storm event in the San Diego region was based on the statistical evaluation of the long-term data records from the National Weather Service rain gauge located at Lindbergh Field. Based on the results of this statistical analysis, the "typical" storm event at Lindbergh Field yields 0.19 to 0.57 inches of rain and lasts 6 to 12 hours. Since the depth and duration of a typical storm event varies in different parts of the county where monitoring stations are located, storm events that were preceded by 72 hours of dry weather and were forecast to be greater than 0.10 inches were considered viable events for mobilization.

A look at the 2005-2006 rain data together with the total rainfall for the year shows that representative storm events that were suitable to monitor occurred in October, January, February, March, and April. Figure 2-15 and Figure 2-16 summarize daily rainfall totals and distributions within San Diego County. The monitored storms were preceded by at least 72 hours of dry weather.

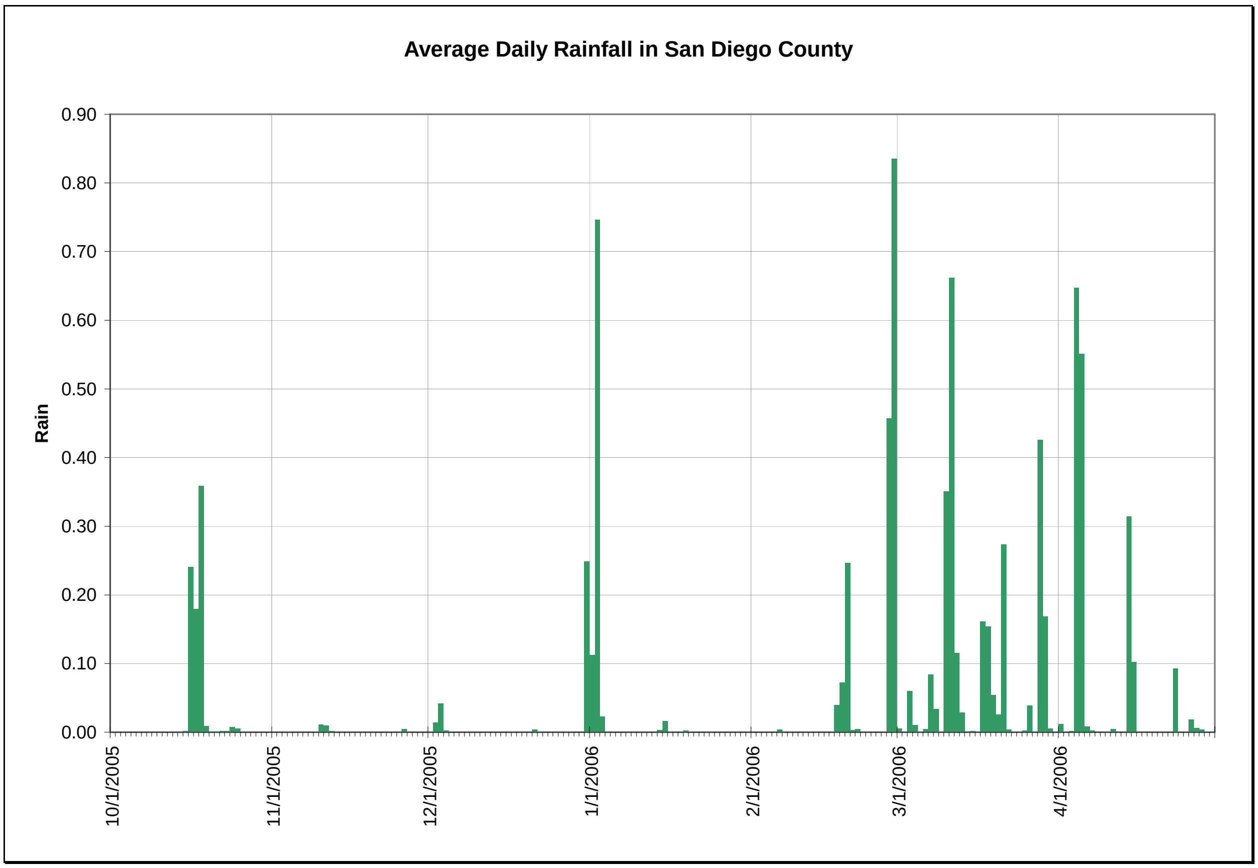


Figure 2-15. San Diego County Daily Rainfall Totals During the 2005-2006 Wet Season.

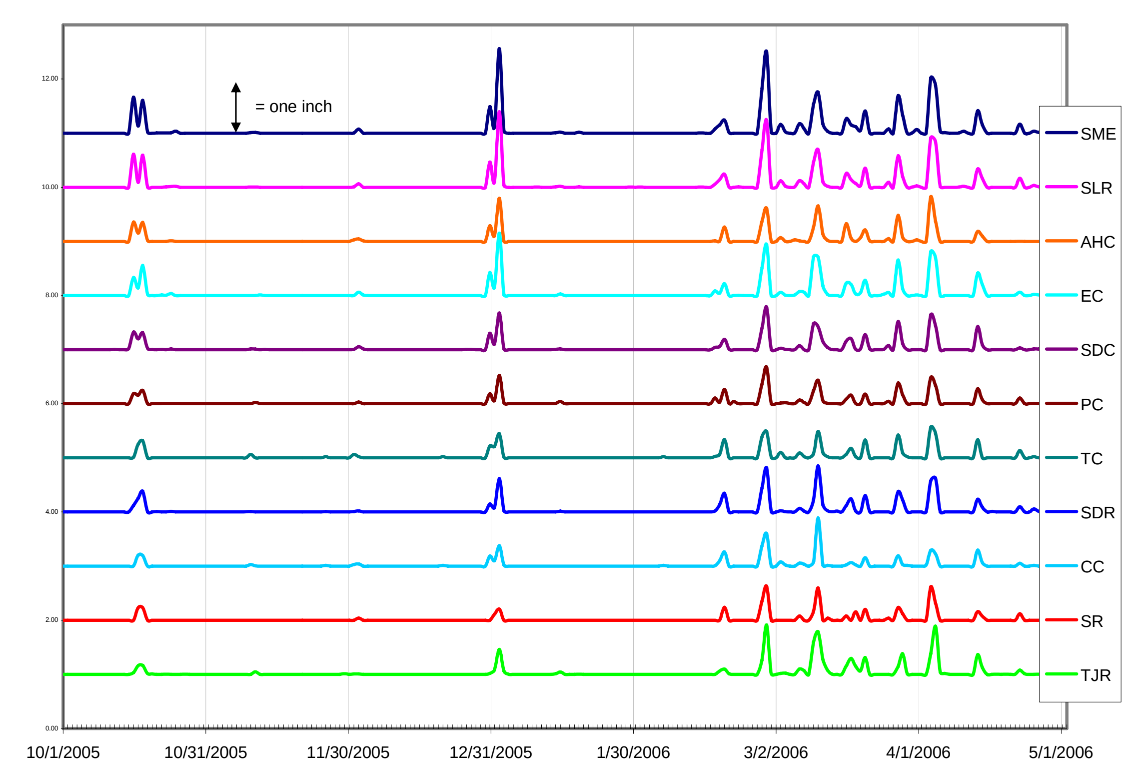


Figure 2-16. San Diego County Daily Rainfall Distribution During the 2005-2006 Wet Season.

2.3.2 Precipitation During Monitored Events

Rainfall during the 2005-2006 wet season was below the average of 10.44 inches (NWS, 2005). Rainfall totals for each MLS are presented in Table 2-11 for each of the monitored storm events. Rainfall distributions and totals were calculated by interpolating between rainfall amounts from available National Weather Service and San Diego County rain gages for the San Diego County area and data available from rain gauges installed at the MLS. Distribution and amount of the rainfall over each watershed was calculated and interpolated in ArcView GIS, as illustrated in Figure 2-17.

Table 2-11. Rainfall Summary by Mass Loading Station for Monitored Storm Events.

MLS	10/16/2005	12/31/2005	2/18/2006	2/27/2006	3/8/2006
Santa Margarita River				2.30	
San Luis Rey River	0.62	0.48	0.42		
Agua Hedionda Creek	0.40	0.29	0.26		
Escondido Creek	0.34		0.34		1.41
San Dieguito Creek	0.83	1.04	0.19		
Peñasquitos Creek	0.51		0.39	1.04	
Tecolote Creek	0.20		0.34	0.88	
San Diego River	0.68		0.48		1.01
Chollas Creek	0.30	0.48	0.26		
Sweetwater River	0.35	0.16	0.24		
Tijuana River	0.29		0.18	1.18	

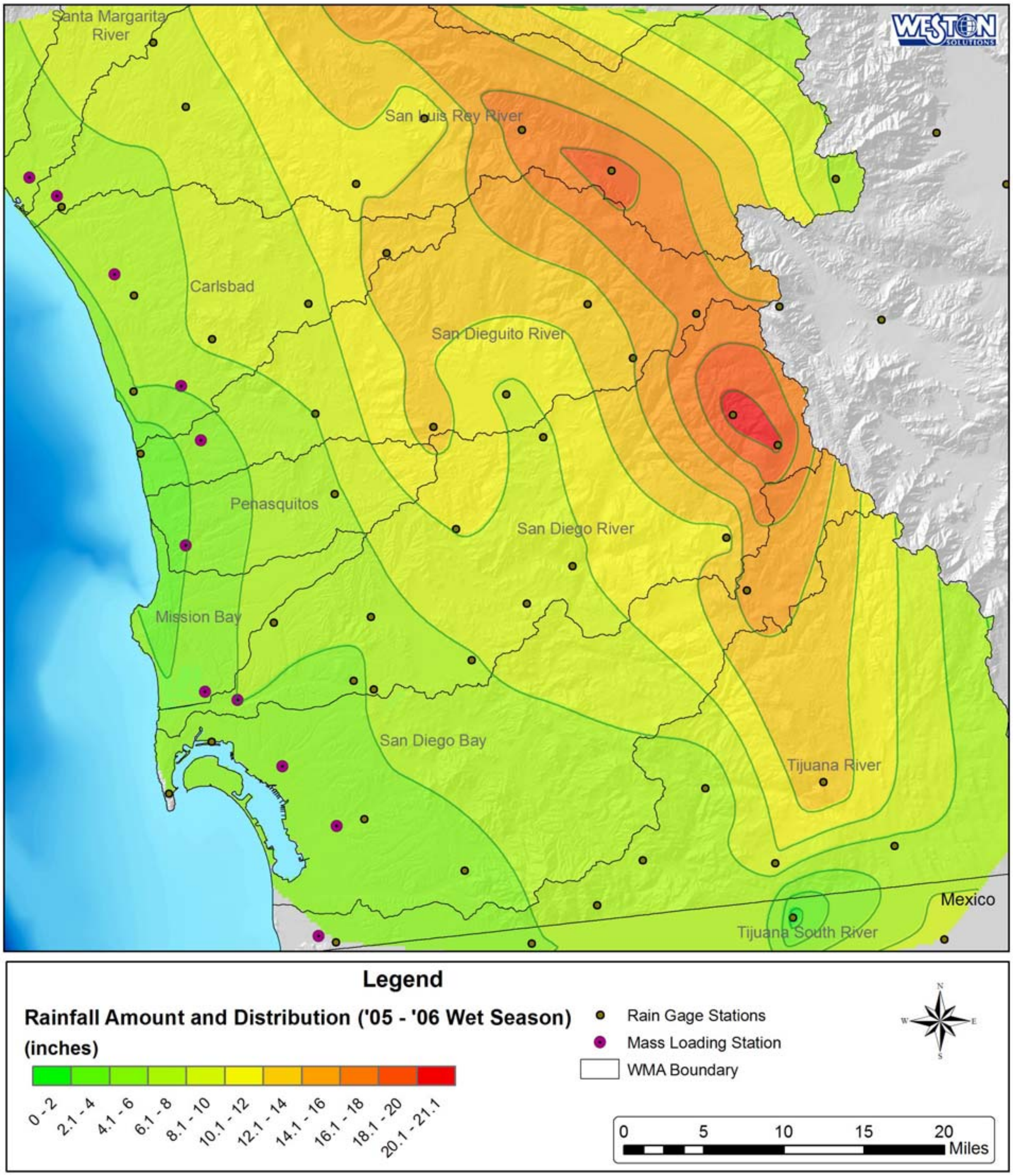


Figure 2-17. San Diego County 2005-2006 Rainfall Amount and Distribution.

2.3.3 Storm Water Runoff During Monitored Events

The design of the storm water monitoring program is based upon the isolation of individual storm events. Storm water runoff sampling protocol requires that a flow-weighted composite sample be obtained over the duration of runoff in order to sample total flow resulting from the precipitation event. Water quality sampling was terminated based upon the end of the precipitation and cessation of storm water flow. In larger watersheds with extended periods of runoff response, it was often necessary to manually terminate the automated samplers in order to avoid sampling ground water with runoff. Hydrographs for each monitored event at the eleven mass loading stations that recorded flow are presented in Appendix A.